

LEGISLATIVE HISTORY
OF THE
ATOMIC ENERGY ACT OF 1946
(Public Law 585, 79th Congress)

IN THREE VOLUMES

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Congressional Hearings

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ATOMIC ENERGY

HEARINGS BEFORE THE COMMITTEE ON MILITARY AFFAIRS HOUSE OF REPRESENTATIVES

SEVENTY-NINTH CONGRESS

FIRST SESSION

ON

H. R. 4280

AN ACT FOR THE DEVELOPMENT AND CONTROL
OF ATOMIC ENERGY

OCTOBER 9 AND 18, 1945

Printed for the use of the Committee on Military Affairs



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III

ATOMIC ENERGY

TUESDAY, OCTOBER 9, 1945

HOUSE OF REPRESENTATIVES,
COMMITTEE ON MILITARY AFFAIRS,
Washington, D. C.

The committee met at 10 a. m., Hon. Andrew J. May (chairman) presiding.

The CHAIRMAN. Gentlemen of the committee, we have met this morning for consideration of H. R. 4280, a bill for the development and control of atomic energy.

A few days ago, the President of the United States sent to the Congress a message recommending the enactment of this legislation. The development of atomic energy was done by the War Department. The President's recommendations are very definite and, at this point, will be incorporated in the record.

(The matter above referred is as follows:)

[H. Doc. No. 301, 79th Cong., 1st sess.]

MESSAGE FROM THE PRESIDENT OF THE UNITED STATES TRANSMITTING REQUEST FOR THE ENACTMENT OF LEGISLATION TO FIX A POLICY COVERING THE USE AND DEVELOPMENT OF THE ATOMIC BOMB

To the Congress of the United States:

Almost 2 months have passed since the atomic bomb was used against Japan. That bomb did not win the war, but it certainly shortened the war. We know that it saved the lives of untold thousands of American and Allied soldiers who would otherwise have been killed in battle.

The discovery of the means of releasing atomic energy began a new era in the history of civilization. The scientific and industrial knowledge on which this discovery rests does not relate merely to another weapon. It may some day prove to be more revolutionary in the development of human society than the invention of the wheel, the use of metals, or the steam or internal combustion engine.

Never in history has society been confronted with a power so full of potential danger and at the same time so full of promise for the future of man and for the peace of the world. I think I express the faith of the American people when I say that we can use the knowledge we have won, not for the devastation of war, but for the future welfare of humanity.

To accomplish that objective we must proceed along two fronts—the domestic and the international.

The first and most urgent step is the determination of our domestic policy for the control, use, and development of atomic energy within the United States.

We cannot postpone decisions in this field. The enormous investment which we made to produce the bomb has given us the two vast industrial plants in Washington and Tennessee, and the many associated works throughout the country. It has brought together a vast organization of scientists, executives, industrial engineers, and skilled workers—a national asset of inestimable value.

The powers which the Congress wisely gave to the Government to wage war were adequate to permit the creation and development of this enterprise as a war project. Now that our enemies have surrendered, we should take immediate action to provide for the future use of this huge investment in brains and plant. I am informed that many of the people on whom depend the continued successful operation of the plants and the further development of atomic knowledge are getting ready to return to their normal pursuits. In many cases these people are considering leaving the project largely because of uncertainty concerning future national policy in this field. Prompt action to establish national policy will go a long way toward keeping a strong organization intact.

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It is equally necessary to direct future research and to establish control of the basic raw materials essential to the development of this power whether it is to be used for purposes of peace or war. Atomic force in ignorant or evil hands could inflict untold disaster upon the Nation and the world. Society cannot hope even to protect itself—much less to realize the benefits of the discovery—unless prompt action is taken to guard against the hazards of misuse.

I therefore urge, as a first measure in a program of utilizing our knowledge for the benefit of society, that the Congress enact legislation to fix a policy with respect to our existing plants, and to control all sources of atomic energy and all activities connected with its development and use in the United States.

The legislation should give jurisdiction for these purposes to an Atomic Energy Commission with members appointed by the President, with the advice and consent of the Senate.

The Congress should lay down the basic principles for all the activities of the Commission, the objectives of which should be the promotion of the national welfare, securing the national defense, safeguarding world peace, and the acquisition of further knowledge concerning atomic energy.

The people of the United States know that the overwhelming power we have developed in this war is due in large measure to American science and American industry, consisting of management and labor. We believe that our science and industry owe their strength to the spirit of free inquiry and the spirit of free enterprise that characterize our country. The Commission, therefore, in carrying out its functions should interfere as little as possible with private research and private enterprise, and should use as much as possible existing institutions and agencies. The observance of this policy is our best guaranty of maintaining the preeminence in science and industry upon which our national well-being depends.

All land and mineral deposits owned by the United States which constitute sources of atomic energy, and all stock piles of materials from which such energy may be derived, and all plants or other property of the United States connected with its development and use should be transferred to the supervision and control of the Commission.

The Commission should be authorized to acquire at a fair price, by purchase or by condemnation, any minerals or other materials from which the sources of atomic energy can be derived, and also any land containing such minerals or materials, which are not already owned by the United States.

The power to purchase should include real and personal property outside the limits of the United States.

The Commission should also be authorized to conduct all necessary research, experimentation, and operations for the further development and use of atomic energy for military, industrial, scientific, or medical purposes. In these activities it should, of course, use existing private and public institutions and agencies to the fullest practicable extent.

Under appropriate safeguards the Commission should also be permitted to license any property available to the Commission for research, development, and exploitation in the field of atomic energy. Among other things such licensing should be conditioned, of course, upon a policy of widespread distribution of peacetime products on equitable terms which will prevent monopoly.

In order to establish effective control and security, it should be declared unlawful to produce or use the substances comprising the sources of atomic energy or to import or export them except under conditions prescribed by the Commission.

Finally, the Commission should be authorized to establish security regulations governing the handling of all information, material, and equipment under its jurisdiction. Suitable penalties should be prescribed for violating the security regulations of the Commission or any of the other terms of the act.

The measures which I have suggested may seem drastic and far-reaching but the discovery with which we are dealing involves forces of nature too dangerous to fit into any of our usual concepts.

The other phase of the problem is the question of the international control and development of this newly discovered energy.

In international relations, as in domestic affairs, the release of atomic energy constitutes a new force too revolutionary to consider in the framework of old ideas. We can no longer rely on the slow progress of time to develop a program of control among nations. Civilization demands that we shall reach at the earliest possible date a satisfactory arrangement for the control of this discovery in order that it may become a powerful and forceful influence toward the maintenance of world peace instead of an instrument of destruction.

Scientific opinion appears to be practically unanimous that the essential theoretical knowledge upon which the discovery is based is already widely known. There is also substantial agreement that foreign research can come abreast of our present theoretical knowledge in time.

The hope of civilization lies in international arrangements looking, if possible, to the renunciation of the use and development of the atomic bomb, and directing and encouraging the use of atomic energy and all future scientific information toward peaceful and humanitarian ends. The difficulties in working out such arrangements are great. The alternative to overcoming these difficulties, however may be a desperate armament race which might well end in disaster. Discussion of the international problem cannot be safely delayed until the United Nations Organization is functioning and in a position adequately to deal with it.

I, therefore, propose to initiate discussions first with our associates in this discovery, Great Britain and Canada, and then with other nations, in an effort to effect agreement on the conditions under which cooperation might replace rivalry in the field of atomic power.

I desire to emphasize that these discussions will not be concerned with disclosures relating to the manufacturing processes leading to the production of the atomic bomb itself. They will constitute an effort to work out arrangements covering the terms under which international collaboration and exchange of scientific information might safely proceed.

The outcome of the discussions will be reported to the Congress as soon as possible, and any resulting agreements requiring congressional action will be submitted to the Congress.

But regardless of the course of discussions in the international field, I believe it is essential that legislation along the lines I have indicated be adopted as promptly as possible to insure the necessary research in, and development and control of, the production and use of atomic energy.

HARRY S. TRUMAN.

THE WHITE HOUSE, October 3, 1945.

The CHAIRMAN. We have here as witnesses this morning a number of very busy men who, like the committee, have to be at work all the time. Mr. Secretary Patterson is present and we will ask you, Judge, to open the hearing with a statement or in any way you care to proceed.

STATEMENT OF THE HONORABLE ROBERT P. PATTERSON, SECRETARY OF WAR

Secretary PATTERSON. Mr. Chairman, I appear in support of H. R. 4280. This bill is in line with the President's message last week relative to the development of atomic energy. As you have just pointed out, this project at the present time is a war project developed by the War Department. The time has come, as we see it, when the project should be put on a broader basis and where not only its war-time aspects but its peacetime aspects for the longer range future should be dealt with and covered by legislation of a basic character, declaring the national policy and providing for the further intensive development of the production of nuclear fission and the release of atomic energy.

I have a short statement. If the committee sees fit, I will read it; then I will have some remarks of a more general character.

The CHAIRMAN. You may proceed in your own way, Judge.

Secretary PATTERSON. The atomic bombs that dropped on Hiroshima and Nagasaki did more than destroy the Japanese will to fight. They delivered into the custody of the people of this country the responsibility for developing and administering a force of such incalculable potentialities that we are even now only dimly aware of their ultimate extent.

It is the desire of every American that this mighty power be used to make secure and lasting the peace for which a quarter of a million

of our young men gave their lives, and also that the horizons of our knowledge be pushed outward so that atomic energy may become as effective an element in the enrichment of our daily lives as it proved itself in the ending of the war against Japan.

In the years when the existence of our Nation was threatneed and the speed of our victory depended on the speed with which we unlocked the energy that lies within the atom, the responsibility for directing research, constructing facilities, and producing weapons in this field was entrusted to the War Department.

General Groves, who is here with me today, was placed in charge of the project and given unlimited authority to carry this urgent war task to a successful conclusion. He reported directly to the Chief of Staff and the Secretary of War. Time was the only scarce commodity, so far as his assignment was concerned. Everything else was made available as fully and as fast as it was needed. Over all our work hung the ever-present possibility that Germany or Japan might discover the secret first and that the United States might have to bear the crushing impact of the first atomic bomb.

We succeeded in our mission and thereby cut months from the probable length of the war. We would have won without the bomb, but thousands of American soldiers who are alive today would have died before final victory was achieved.

The story of our success is a story of teamwork. The combined efforts of science, management, labor, and the armed forces produced the atomic bomb. Now it is up to us to turn this discovery into a bulwark of the peace it helped to win.

No single department of Government should be charged with a responsibility that affects the whole future of mankind so directly and so immediately. Even the winning of a war seems a minor matter by comparison with the importance of applying fully and controlling wisely the power of the atom.

If we misapply the knowledge we now have or fail to carry forward our research with the utmost vigor, we may be passing a sentence of death on the future of our own country and the entire world.

The bill that is before your committee today reflects the views of the men who were most responsible for the wartime development of atomic energy as to the most effective method of controlling and carrying forward development in this field within the United States. It embodies all the points on domestic policy recommended by the President in his message to the Congress last week.

The manner in which this legislation was prepared will be of interest to you. In May of this year, 2 months before the test in New Mexico showed conclusively that the atomic bomb would work, Secretary Stimson, with the approval of the President, appointed an interim committee to recommend legislation that would insure that this discovery would be controlled and developed in the best interests of the people of this country.

The Secretary served as chairman of the committee, with George L. Harrison, former chairman of the Federal Reserve Bank of New York and present president of the New York Life Insurance Co., as his alternate. Mr. Harrison is here today. The other members of the committee were Secretary James F. Byrnes, then a private citizen; Ralph A. Bard, Under Secretary of the Navy; William L. Clayton, Assistant Secretary of State; Dr. Vannevar Bush, director of the

Office of Scientific Research and Development and president of the Carnegie Institution of Washington; Dr. James B. Conant, chairman of the National Defense Research Committee and president of Harvard University; and Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, and Chief of the Office of Field Service in the Office of Scientific Research and Development.

General Groves was present in an advisory capacity at all meetings of the committee. The members were also aided by the advice and experience of eminent scientists who had rendered invaluable service in the atomic bomb project—Dr. J. R. Oppenheimer, Dr. E. O. Lawrence, Dr. Enrico Fermi, and Dr. Arthur H. Compton. Representative industrialists who had taken a prominent part in the project also assisted the committee in its work.

The drafting of the bill, in line with the principles and policies established by the committee, was done by Brig. Gen. Kenneth C. Royall and Mr. William L. Marbury, both of whom have frequently appeared before your committee and who are present this morning to answer any questions you may have as to the details of the bill.

When the interim committee had reached unanimous agreement on the scope and language of the proposed legislation, it was submitted to interested Government agencies, including the Department of State, the Department of the Interior, and the Department of Justice. With one or two minor exceptions, the revisions suggested by these departments were incorporated into the bill.

In the opinion of the interim committee, the legislation you now have is the soundest and most comprehensive that could be drawn to cover all those phases of domestic control of atomic energy that require action in the interest of national security, world peace, and the promotion of human welfare. The final draft was reviewed by the President before its transmittal to Congress.

There has been distributed to the members of your committee a summary of this bill. You will note that the essential provisions are these:

The first section declares that all activities connected with the release of atomic energy shall be conducted in the interest of the Nation and world peace, so as to promote the national defense, protect the safety of our inhabitants, safeguard world peace, and further the acquisition of knowledge in this field.

Under the bill, jurisdiction is in an Atomic Energy Commission of nine members appointed by the President, with the advice and consent of the Senate, to serve for 9 years. Members of the Commission are not expected to devote their full time to the work of the Commission, but the Commission will exercise general supervision over all atomic-energy activities. For the actual day-to-day administration of the act, there is provided a full-time Administrator and Deputy Administrator. To aid these officials, the President is empowered to establish and appoint the advisory boards that he deems proper. The bill grants to the Commission the full general powers necessary to the performance of its functions, such as the right to adopt regulations, to acquire property by purchase or eminent domain, to make contracts, and to create corporations. With certain exceptions, similar general powers are conferred upon the Administrator.

All items of Government-owned property relating to the production of atomic energy, including the plants and other property of the Manhattan Engineer District, are transferred to the Commission. The Manhattan Engineer District, of course, is the branch or organization of the War Department organized to carry on activities of the atomic energy project under the title of "Manhattan Engineer District." All rights in substances found in Government-owned lands which are directly connected with the release of atomic power are forever vested in the United States, and such lands or deposits are to be turned over to the Commission at its request. The Commission is also authorized to require private persons to declare any property now or hereafter determined to be directly connected with atomic energy, and to acquire such property, at a fair price, by purchase or eminent domain.

With the property thus coming into its custody, the Commission is empowered, through its own employees or through contractors, to conduct all necessary research and experimentation in this field, to develop processes for the release of atomic energy and for its use for military, industrial, scientific, or medical purposes. To this end, the Administrator may license or dispose of the Commission's property to other Government agencies or private persons, upon appropriate terms and conditions.

As a necessary corollary to the power of supervision which comes to the Commission, the bill also grants to the Commission full control over the use, processing, export, and import by private persons, of all substances determined to be sources of or directly connected with atomic energy.

In the licensing of its property and the control of private activities the bill expressly imposes upon the Commission the policy of minimum interference with and the encouragement of private research and of maximum employment of other Government agencies, educational institutions, and private enterprise. The Commission is also enjoined to encourage the widespread distribution, so far as feasible, of permission to engage in activities subject to its jurisdiction, and to discourage the growth of monopoly in trades and industries affected by these activities.

This proposed legislation also authorizes the Commission to adopt and administer the necessary security regulations, and provides suitably strict penalties for their violation. Penalties for violation of the other provisions of the act and the regulations of the Commission are also established.

The question of international control or interchange of information concerning atomic energy is not determined by this legislation. In his message the President drew a clear line between the domestic phase and the international phase of this problem. This bill concerns itself with the domestic phase. Under section 11 (a), the Atomic Energy Commission would be specifically prohibited from granting any information or rights to foreign nations without the express approval of the President. In all its activities the Commission would function under the basic principles laid down by Congress in this bill.

Logic demands, it seems to me, that we set our domestic house in order, so far as the development of atomic energy is concerned, before we enter into discussions or reach decisions as to what should

be done in the international field. What we need now is a body under legislative authority to take possession of the resources we have, to acquire other resources, and to administer them in such a way that the United States will leave nothing undone in furtherance of knowledge and application in this field.

By establishing a Commission of nine members to be selected by the President with the advice and consent of the Senate, you will take the first step toward the determination of a sound permanent policy for the research and manufacturing organization that was built up under the stress of war.

It is the thought of those who participated in the drafting of this legislation that the citizens designated by the President to serve on the Commission, as well as the Administrator and his Deputy, would be representative of all that is best in our national life—men of demonstrated wisdom and judgment who would accept appointment not because of any emoluments that might attend their membership but rather because of a profound recognition of the significance of atomic power to the future of civilization.

There are many important decisions that must be made in the immediate future, notably those involving the further operation of the Manhattan District Project. We now have three enormous manufacturing plants in operation, as well as many smaller ones, and we have built up a well-integrated and irreplaceable organization of scientists, executives, engineers, and skilled workers. To allow this organization to disintegrate because of uncertainty concerning future national policy would be nothing less than a national disaster. Some of our most valuable people have already left and more will go unless prompt action is taken to clarify the situation that affects their future.

No one, not even the scientists most familiar with what has already been achieved, can foresee the ultimate fields into which atomic research will lead. At present, however, there are three great fields that call for our utmost in the way of research and reduction to practice: (1) The development of atomic energy as a controlled source of power, to make available heat and power in supplement to existing sources and also as a means to brand-new developments; (2) the application of atomic energy to weapons, subject to international arrangements that may be later made; (3) the application of activities characteristic of this field of growth of the sciences and practical arts, particularly of medicine, chemistry, and physics.

None of these developments will come overnight or without the most intensive research. The prompt passage of this bill is bound to accelerate our progress along these lines and so to promote the national welfare and safety.

The War Department has taken the initiative in proposing that it be divested of the great authority that goes with the control of atomic energy, because it recognizes that the problems we now face go far beyond the purely military sphere.

The atomic bomb is the most devastating weapon we know, but the means of releasing atomic energy which it employs may prove to be the greatest boon to mankind in the world's history. The wisest minds in our Nation will be required to administer this discovery for the benefit of all of us.

My statement, Mr. Chairman, covers the development of the energy in simple fashion; makes mention of the vast importance of the project, the vast importance not only to the winning of the war, but, as we see it and as we are advised by those most expert in the field, also the vast importance to all phases of our national life.

You all know the history of this enterprise that was conducted by the War Department under the title of the Manhattan Engineer District. It cost the people of this country over \$2,000,000,000 expended upon that project, but the results of that expenditure made the cost thus far seem cheap, because the work that was done has unlocked possibilities of a vaster extent than we can conceive of today.

As we see it, we have this need for legislation along the lines of H. R. 4280: As I have pointed out, the uncertainty as to the future of this project has led to some of the valuable personnel leaving on account of the vagueness in which the matter now rests as a matter of the national will.

We also have, as one of the urgent needs, pressing forward along the lines of research and development—further research as to the possibilities along the line of nuclear fission and release of atomic energy—and we have the need of putting the knowledge we acquire into practical application at the earliest possible date. I think the need of legislation of a more permanent character at this time is evident to all. But what kind of legislation? This discovery, contributed to by scientists, industrialists, executives, engineers, and military personnel, represents national property, a national asset, developed solely at the cost of the United States. Therefore, the legislation that is before you carries out that idea—that it is national property.

Of course, another thing that makes it necessarily of national concern is that the tremendous power that is locked up in this enterprise, the tremendous power that is locked up that will be unlocked—power to be used for further development of our national safety and national welfare, but at the same time power that could be most dangerous, indeed, to us if not controlled—is a national asset.

This bill is far reaching and the powers of the Commission are most extensive; but it is submitted that nothing less than this will answer the need. Therefore, there are very few restrictions, indeed, upon the power of the commission of nine, the Atomic Energy Commission, that is proposed to be set up by this bill, that will control the problem.

I would close my statement by again pressing, as I have already, the need for prompt consideration and prompt passage of legislation. Once in awhile I will admit there are advantages to be gained by slow deliberation, but not generally. Generally it has been my experience that prompt consideration, prompt disposition of cases, has advantages vastly outweighing the slower processes.

The matter is presented now for your consideration and I press the urgency of the problem. That is nothing new, because the President's message presses the same point.

The CHAIRMAN. Mr. Secretary, the Chair is advised that General Groves is here as a witness and has some kind of an early engagement that makes it necessary for him to get away.

Secretary PATTERSON. I will be in attendance and I will respond later to questions.

The CHAIRMAN. That is what I was going to suggest.

Secretary PATTERSON. We have General Groves, Dr. Bush, and Dr. Conant here to testify at the committee's pleasure.

The CHAIRMAN. We will call General Groves now and will call the Secretary back later for questions.

General Groves, do you have a statement you wish to make?

General GROVES. Yes, sir.

STATEMENT OF MAJ. GEN. LESLIE R. GROVES

General GROVES. In coming before your committee today we are appealing for an opportunity to give you our existing powers. In the interest of the war effort, there was delivered into our care the responsibility for directing all activities relating to the release and use of atomic energy.

We have discharged that responsibility to the best of our ability. Thanks to the brilliant and selfless efforts of the thousands of scientists, engineers, industrialists, workers and Army and Navy officers associated with the project, and to the wise counsel of Secretary Stimson and his advisers and the members of the Military Policy Committee, our work achieved its purpose. It helped to shorten the war and to save the lives of American and Allied fighting men.

But the individual responsibility that was desirable in wartime should not be continued today. The hopes and fears of all mankind are so inextricably bound up with the future development of atomic energy, and the problems requiring immediate solution are so fundamental that control should be vested in the most representative and able body our democratic society is capable of organizing.

The bill you are considering today is intended to create such a body.

It would establish a commission of nine distinguished citizens, with a revolving membership to guard against political domination or the development within the commission of frozen attitudes that would act as a brake on experimentation and new ideas.

Within the limits of general policy, as defined by Congress, and of appropriations, as authorized by Congress, the commission would have broad power to conduct or supervise all research and manufacturing activities relating to the use of atomic energy for military or civilian purposes; to control the raw materials from which atomic energy may be derived and to provide for the security of information and property connected with the release of atomic energy. It is also the aim of this legislation that the commission capitalize on the initiative and ingenuity of American science and America industry by giving as much freedom and encouragement to private research and private enterprise in this field as it is possible to give consistent with the requirement of American security.

The success of the Manhattan District Project would have been impossible without the support it received from colleges and universities, from large and small industrial corporations, and from the skill of American labor.

Our progress in the future atomic development will depend equally on the utilization of the fullest support that can be drawn from all of these sources. At the root of this legislation lies a recognition of the importance of maintaining continued leadership by the United States

in scientific progress, utilizing existing private and public facilities to the broadest extent.

The bill specifically provides for the most widespread practical distribution of licenses for atomic research and development within the United States and enjoins the Commission to discourage the growth of monopoly in trades and industries affected by these activities.

In order that the membership of the Commission may include outstanding leaders in American life, its members are not expected to devote their full time to the work of the Commission but are left free to engage in other activities.

The day-by-day work under the law would be carried out under the direction of an administrator and a deputy administrator, who will, of course, devote their entire time to their duties. These, too, should be men of the highest caliber who are willing to make the financial sacrifice necessary to accept such posts in the face of industry's ability to make more tempting salary offers.

The scientific and other personnel to be employed by the Commission would be chosen without regard for civil-service regulations. My experience in operating the Manhattan District Project leads me to the conclusion that such a provision is essential if atomic development is to proceed with efficiency and effectiveness.

It is hoped that this work will attract young and highly talented scientists who will stay with the commission 5 or 6 years, after which they would leave to take better-paying jobs outside. I will say quite frankly that they should not be men who look forward to lifetime jobs on the project. The key staff of the project, both scientific and administrative, should be a rotating one so that the commission will not degenerate into a static organization with an inflexible approach to the problems involved in this vast and complicated field.

I should like before I close to emphasize what Secretary Patterson has already said about the desirability of speedy action on this measure. The decisions we now have to make will affect the welfare of the United States and of the world for many years to come. They should not be made by one man. I am convinced that the prompt adoption of this bill will be a powerful and necessary stimulus to continued advances in our development and control of atomic energy.

Here, more than ever before in our history, it is a case in which man is the keeper of his own destiny. In irresponsible hands, the power of the atom might destroy the world. Properly developed and properly administered, this same force can help light the way to a future of lasting peace and prosperity for all the people of the world. This bill is an important step in that direction.

The CHAIRMAN. Does that conclude your statement, General?

General GROVES. Yes, sir.

The CHAIRMAN. I think I want to ask you one question. You invited my interest when you referred to the fact that this ought not to be a static organization, that it ought to be able to utilize the talents of young scientists who would serve for 5 or 6 years, and then go to better jobs. Is there anything in your understanding of this legislation that would enable the compulsory use of a man for research in this organization if he decided that he wanted to quit and go out, when we needed him as an essential man?

General GROVES. No, sir; there is no way that he could be compelled to serve.

The CHAIRMAN. It is your idea that the business will be inviting enough and men will be patriotic enough so that they will render this service?

General GROVES. Yes; and also the fact that they are young men. What we should offer them is an opportunity to come into this field, work with us for 5 or 6 years and develop and become capable then of seeking better employment outside.

It would be a serious mistake to build up a permanent scientific organization where once they were there they would stay for a lifetime.

The CHAIRMAN. What you have actually done in the laboratories of this Manhattan Project is to develop a force that is loose and has to be harnessed by the Government and controlled in the interest of the public and of the country and of our national defense?

General GROVES. Yes, sir.

The CHAIRMAN. It is a vitally important thing.

General GROVES. There is no question of that, and I think the best answer is where the world would be if Hitler had developed this bomb and then started his attack on the other countries of the world. The war would have been over in a few days and the world capital would have been Berlin.

Mr. THOMASON. I think, General Groves, we are all agreed on the importance of this marvelous discovery, and also that there ought to be very speedy legislation on the subject. My quick reaction to the bill, from its explanation by both Secretary Patterson and yourself, is quite favorable.

What I am interested in, though, is that I want to know if we are going to give this secret to any other country or let it leak out to them, and if this will do the trick. If they can discover it themselves, it is all right with me. Perhaps that is not quite the feeling of the Army, but I do think in view of legislation coming up, and in view of the President's statement this morning, which was quoted in the press, that it behooves this committee, if we are going to pass legislation, to write it so that we know that this valuable secret is going to be retained by this country and not leak out to other countries.

Mr. SHORT. I wish the general would tell us, though, just how much of a secret it is.

Mr. THOMASON. Yes, I was just coming to that. I do not know what the General wants to say about it, or whether he wants somebody else to answer that, but I think this committee is going to be expected to determine, as the gentleman from Missouri says, how much of a secret it is, and since it is such a powerful thing, both in the interest of war and peace, and inasmuch as we, through our efforts and our money and our fine minds, have discovered it, if we are going to keep it. My own feeling is that if some other country has some scientists who are able to discover it themselves, that that comes under the head of their business, but I am not for giving this secret, or letting it leak out to anybody.

With that comment, General Groves, I would like to know how you feel about it.

General GROVES. In reply to your question, the bill provides certain security regulations in section 17 with sections 18 and 19; which are largely a part of 17, and gives us a better control of the

security than exists, I believe, on any other item which should be kept as national property.

Mr. THOMASON. Is there any permissive authority for this commission that you propose to set up to give it to another country under any conditions?

General GROVES. There is a provision in there which the Secretary referred to about that being done under whatever directions are received from the President.

Mr. THOMASON. Then, under the terms of the bill, in the last analysis, it would be left to the discretion of the President?

General GROVES. Yes, sir.

Mr. THOMASON. Would it not if he wanted to give it to somebody else?

General GROVES. That is correct.

Mr. THOMASON. Congress would have nothing to do with it. The commission would make its recommendations to the President, and then if the President, in the exercise of his discretion, wanted to give it to somebody else, why, he would have authority to do it, is that what the bill means?

General GROVES. I believe, unless Congress otherwise decides.

Mr. THOMASON. That is the very thing I am coming to. Does the bill say that?

General GROVES. I do not believe so, sir.

Mr. THOMASON. I, for one, think it ought to.

General GROVES. That, of course, is a matter of international relationships, and that is wholly out of my field.

Mr. THOMASON. Yes; I see. Everybody has agreed this is a marvelous discovery and it is of national and international importance. In it is almost the determination of the future of civilization, but I think Congress and the people ought to know who is going to control this great secret. If somebody else can find out, as they probably will, that is just a repetition of history.

General GROVES. I believe that to understand that problem satisfactorily it is necessary to consider what Mr. Short brought out, which is essentially how much of a secret it is.

The CHAIRMAN. That is what we want to know.

General GROVES. The big secret was really something that we could not keep quiet, and that was the fact that the thing went off. That told more to the world and to the physicists and the scientists of the world than any other thing that could be told to them. It was something that we did not know until we had spent almost \$2,000,000,000 and had worked about 3 years. We did not know whether it would go off or not, and that is the thing that really told them more than anything else that could be told.

The secrets, as they are loosely termed in the public discussion, are divided properly, I think, into about three classes. One class of these secrets consists of established scientific facts which were not secret at all. They were well known to the best scientists of the world before this work ever started. They had been published. They had been published in odd places, but were easily collectible. Anyone who wanted to could find those secrets. Coupled with those were certain others which had been theories before the explosion confirmed them, and the deductions were what would naturally be made by competent scientists. When we speak of competent scientists in this field we

mean scientists that are top-notch, not just first-class men. Those secrets could be deduced by those men knowing that the bomb had actually gone off. The extent of that information which, in fact, was public knowledge to the scientists of the world, is the limit of the Smyth report which you have heard so much about. In other words, nothing in that report discloses any secrets to the world.

The second classification of secrets is the scientific developments which went beyond this, and most of those developments were not basic. They were made up of hundreds and hundreds of problems that had to be solved before this work could be done.

They involved things such as the purification of metals and the purification of other products and the handling of certain products that are not easy to handle safely. They involved all the research work, principally that which was done in many laboratories by thousands of scientists. There are other ways to do this. We hit one way. Probably there are several ways in which you can do those various items, but they require a tremendous amount of work.

This could undoubtedly be achieved by other nations if they spend the money, the labor, and the time and have the scientific organization with which to do it. In time they can, of course, do it. It is merely a case of relative speed.

Another class of secrets falls in the industrial sphere. This contains many industrial applications which, in the course of time, will be made known in this country.

A man who has worked on this project and who is confronted with a similar problem in industrial life cannot forget the solution that was used on this project, and he is going to use that information no matter how honorable he is, and he cannot be prevented from doing it. It is just like a child who is given an arithmetic problem to solve and knows the answer in advance. He cannot help but take advantage of knowing that answer.

The other class of secret, which is the biggest field, is the ingenuity and the skill of the American worker and the American management, both the top management and the junior management, and that is a secret that I do not think any other nation has, and I do not think anyone is going to have it in a hurry.

The net effect is that we are ahead at the present time. It will take the other countries a number of years to catch up, and opinion as to that number of years will depend entirely on to whom you are talking, how optimistic he is, and how easily he forgets some of the problems that we had.

I have talked recently to engineers who told me how fast they can do certain things. Well, they never did it while the job was going despite all of the pressure that we put upon them. I am sure they cannot do it when they do not have that pressure upon them, and I do not think that foreign nations that do not work as hard as we do, both as to hours and as to industry and effort can catch up with us for some time.

That is really the secret. In other words, we are ahead. They can catch us, but it is going to take them time; it is going to take them effort, and it is going to cost them money. How fast other countries can do it I do not know. I have never been in most of them. I spent the war in Washington.

Mr. THOMASON. Are you willing to say, General, the progress that other nations are making in the discovery of this atomic energy, and what the present status of that progress is?

General GROVES. I think we can state this: That we do not know what other nations are doing, but we have pretty good ideas. Our intelligence of Germany and Japan was perfect, insofar as to how far they were along. We did not know whether we were right. That is, of course, always a danger in military intelligence, but we were not taking any chance that maybe we were wrong. It turned out, as we expected, that they were not in our class in the solution of this problem, and they learned more by knowing that this bomb went off than they had learned since the world was closed to communications with them.

Mr. THOMASON. But you do know that Germany and Japan were both working on this thing?

General GROVES. They were interested in it. Germany was working on it. How much Japan was working on it we do not know, but it was not anything of a serious effort. It was too big a job for Japan, and they knew it.

Mr. ANDREWS. We are all quite interested in this great subject which is now before the committee, General. Would you explain your association during the last 3 or 4 years with the Office of Scientific Research and Development?

General GROVES. Do you mean Dr. Bush's office?

Mr. ANDREWS. Yes.

General GROVES. We had the very closest relations with them, Dr. Bush and Dr. Conant were members of the Military Policy Committee, and Dr. Conant assisted me personally with advice, and also Dr. Tolman. Dr. Bush helped me all the time throughout our work. I will say, as far as I am concerned, that there was the closest of relations. They did everything that could be done to make the thing go in the way of giving me the very best advice, which was, in some cases, all-controlling.

Mr. ANDREWS. With that reply, General, my question may be reserved for Judge Patterson, Dr. Conant, and Dr. Bush.

We have been very much interested in this committee in the post-war period in the operation of the Office of Scientific Research and Development, and the establishment of a permanent National Agency of Sciences. My understanding is that this bill has not yet really been acted upon in the Senate. Assuming that that bill became law and the National Academy of Sciences were established and then a commission were set up, what would be the relationship between the two bodies, General?

General GROVES. I believe the proposed commission would be a body by itself working on one problem. That is essential because it is such a complex problem. Its relations with the other body would be, I hope, similar to our own past relations with other agencies, in which there was the freest cooperation by all concerned in this work. If we developed a product in our process that was of value to them, we would give it to them. An example of that was a special lubricant which was developed. That information was passed over to them. I hope that there would be liaison there which would enable each to take advantage of the knowledge and advice of the others, and that there would not be any interference between them. There

are certain benefits to each as far as they are concerned in this project, I believe enough to help in both directions.

Mr. ANDREWS. I understand you definitely favor the permanent establishment of a National Academy of Sciences?

General GROVES. I think that is stretching my answer a little. My answer really would be that with the establishment of this Commission it should work with the other body if that were decided upon.

Mr. ANDREWS. Do you favor that too?

General GROVES. I am not familiar enough with that to testify on that. It certainly would not be objectionable to this bill.

Mr. ANDREWS. The relationship to be finally established as a matter of fact is a matter of policy to be decided upon by this new board or set-up?

General GROVES. Yes, sir; and the head of the other agency, and if they worked along in that fashion it would be fine.

Mr. BROOKS. General, the term "nuclear fission" occurs throughout the bill. Would you explain just what that is?

General GROVES. That is quite a job, I think, to explain it in simple language, and I hesitate to do it when I have all of these distinguished scientists here behind me. It is really what is known as the splitting of the atom, which occurs when a neutron hits the atom and releases one or more neutrons, which then go on.

Mr. BROOKS. In other words, that is the heart of the whole bill, is it not?

General GROVES. Nuclear fission and the modifying words that follow really describe what is the heart of atomic energy, and it is believed to be inclusive of everything that might be applicable to atomic energy.

The CHAIRMAN. Do not go into the details of that.

Mr. BROOKS. No; I am not going to expose any figures here.

The CHAIRMAN. I know you are not.

Mr. BROOKS. I want to ask you this from the standpoint of national defense. You know the processes required to develop this atomic energy. Would you say in time of peace that another great nation could develop this process without our knowing about it?

General GROVES. Yes, sir; if they took time enough.

Mr. BROOKS. They could conceal it and handle it in such a way that it would be impossible for us to know about it?

General GROVES. Yes, sir.

Mr. BROOKS. Is there anything in this bill that would help us to gain information of that character in the event some other nation decided to go into that field?

General GROVES. No; there is nothing that would enable us to enter into any international negotiations or anything of that kind.

Mr. BROOKS. Is there anything you have in mind that we could put into the bill that would assist in that respect?

General GROVES. No. Of course, an effort has been made to make this a domestic bill without getting into international phases.

Mr. BROOKS. That is all.

Mr. SHORT. General Groves, is it not factual to say that many minds and a great many countries for a long time have contributed to the discovery of the atomic bomb?

General GROVES. Yes, sir.

Mr. SHORT. And that science, by its very nature, is international and universal?

General GROVES. That is correct.

Mr. SHORT. And no nation and no people have a monopoly on the discovery of truth, and that while, perhaps, the secret is widely known, the elements that control the atomic bomb, the mechanics for its development and production, are more or less a secret principle?

General GROVES. Yes, sir.

Mr. SHORT. So that we can at least keep the methods of its manufacture, or the assembling of it and the mechanics and machine tools and the knowledge from the different laboratories, we can keep all that data more or less a secret?

General GROVES. We cannot keep it secret for any great number of years because other nations will find out how it is done. There will be other applications, and engineering is progressing, particularly scientific engineering, so it is merely a question of time.

It could be well compared to a football team which develops the T-formation. When the originators no longer have a monopoly on it, and if the opposition has the best team, why, they can beat the originator.

Mr. SHORT. Of course, Germany was pretty far advanced in the development and had gotten a long way toward the development of this bomb in Norway. If it had not been for the Norwegian underground and the British Intelligence, Hitler might have beaten us to the draw?

General GROVES. No, sir; I think that is an exaggerated statement because he could not have beaten us. He just did not have the industrial capacity and the capacity to get teamwork that we had here. There was a great deal of friction within Germany. It was subrosa friction, not on the surface, but he did not have the capacity to do it because he had not organized it well and it could not have succeeded.

Mr. SHORT. Of course, the destruction of the plant in Norway by the Norwegian underground certainly disrupted it.

General GROVES. There was undoubtedly something to that, but it was not a controlling factor. Even if that had not been destroyed, he would not have gotten there first. It was undoubtedly annoying to them, but it was not a controlling factor.

Mr. SHORT. They are not as far advanced as some newspaper and magazine articles would lead us to believe.

General GROVES. That is a correct statement.

Mr. SHORT. I am glad to have you make that statement.

General GROVES. In other words, we were way ahead from the time we really got into this business, and then we kept going at a real speed, while they were going relatively at a snail's pace.

Mr. SPARKMAN. As I understand it, this proposed legislation is for the purpose of controlling within our own Nation for the present, the bomb, and the President's message related primarily to that, but also touched on international control. That is not referred to in this legislation, and it is not thought that in this legislation we should touch on the international aspect of it at all.

General GROVES. No, sir; we would like very much to avoid that in its entirety, for it has no bearing on it.

Mr. ARENDS. General, I am very happy that this matter is up for early consideration, because you may or may not remember I intro-

duced a bill on this general subject on September 24, 1945, and I am very much interested in it, as well as people all over the Nation.

The bill I introduced, H. R. 4152, provides for the establishment of a commission of national defense to study the revision of our national defense necessitated by atomic and other weapons, and because of the question raised by the gentleman from Texas, Mr. Thomason. I would like to read this particular bill for the benefit of some of the members of the committee who have not had an opportunity to look it over. It touches on this very point. The bill reads as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is hereby established a commission to be known as the Commission to Study the Technological Revision of Our National Defense Necessitated by Atomic and Other Weapons.

SEC. 2. The Commission shall be civilian in character, composed of fifteen members to be appointed by the President of the United States and shall include representatives of scientific and industrial research and other leading citizens who are conversant with the problems of the nations defense. The scope of the Commission shall be limited to the study of technological data pertaining to national defense.

SEC. 3. It is the intent of Congress that the President shall require technical advisers from the military services and other branches of the Government to serve in an advisory capacity. The military services and other branches of the Government shall give the Commission full access to the facts relating to technological revolution in warfare, so far as it shall not endanger national security.

SEC. 4. The Commission shall make interim quarterly reports to Congress for its information in the formulation of an adequate national defense program. The Commission shall be terminated not earlier than January 1, 1948.

SEC. 5. There is hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, the sum of \$500,000, or so much thereof as may be necessary, to carry out the provisions of this act.

Mr. ARENDS. In other words, in this bill we leave any decision or final determination in the hands of Congress, whereas the bill under consideration leaves everything in the hands of the Commission, or one man, to do as he sees fit.

Mr. CLASON. I wonder if the General can give us any idea of the value of the property which would be turned over to this Commission as a result of this legislation, if it is passed.

General GROVES. I could give you the value of about what it cost us.

Mr. CLASON. I believe you said that was over \$2,000,000,000.

General GROVES. The project to date has cost in the neighborhood of \$2,000,000,000 and more, and that is really the value of what we are turning over; and if we consider it as a going concern and the cost of the development as properly chargeable to what we have developed.

If you are thinking of the physical property we are not turning over that much property, because a great deal of this expense was in operational cost, research, and development; but if you refer to the physical property only, I cannot give you that figure as a firm figure, but it would be on the order of probably a billion and a half first cost. If you apply some of these new theories on prevalent investment, I do not know just how much that would be worth. But if you put it on a reproduction cost, it would be about a billion and a half. But that is purely a guess; I would like you to understand that.

Mr. CLASON. As I read the bill, it rather indicates that all of the items that will go into the bomb can be secured within the confines of the United States; is that a fact?

General GROVES. As far as the Commission is concerned, it has to do only with operations in the United States, but the Commission is subject to the President as to what goes on elsewhere.

Mr. CLASON. It seems to me it is broad enough so that if a scientist from Russia, let us say, or anyone else, is developing an atomic bomb, based on some other ore than uranium, the Commission would have the right to seize, within the United States, all of the lands that carry that ore, even though it proved to be coal or some other mineral or ore; is not that true?

General GROVES. Yes; that would be true with the wording of the bill, but I think that is getting into a field that we certainly do not foresee, and I do not believe anyone else does. It is possible that in the dim future that would occur.

Mr. CLASON. Would you expect that any scientific explorations that might be made in other countries at this time would be along the same line of employing the same ores that we would?

General GROVES. I am certain of that.

Mr. CLASON. As I read the statement of Dr. Langmuir yesterday before the Senate committee, it appears that in his mind that within from 5 to 10 years Russia will have the process and the information in regard to the atomic bomb, and that there will be probably 10 years in which we might, perhaps, keep ahead of Russia.

What would you think about that statement?

General GROVES. I read what he said in the Washington Post this morning, and to me he seemed to be talking about how fast Russia would go and how slow we would go.

Mr. CLASON. How long would it take Russia, if it goes after the development of this bomb, to develop it?

General GROVES. I think that depends. It can vary, and it varies according to how much of an all-out effort they make, and how much they are willing to sacrifice in the way of security. It varies most of all with how much is done in secret. You can take your choice, but it will take time and a lot of money before they can catch up with us, but they can do it. In that I speak only for myself and not for any of my officers or any people that we have consulted with. That is a personal opinion which is primarily on the industrial basis rather than the scientific. I believe that for another country to do this work, if it had the power of the greatest countries left in the world, but had no particular ideas, that it would take them from 5 to 20 years, and the difference in time would depend entirely on how "all-out" they made their efforts and how much they threw security to the winds.

If they do make the same equipment we have made, that could only be made in the United States, and possibly in Switzerland, and when they place foreign orders they are disclosing their hand. It would all depend on how far they disclosed their hand.

In other words, if people are going to starve in their countries to do this project, or if they want to do it in some forest where nobody goes, it varies from 5 to 20 years. Just where that is I do not know.

Mr. SHORT. Because of the tremendous, enormous cost, it is not likely that atomic energy will be used in the immediate future for commercial purposes, is it?

General GROVES. I think that is correct, if you define the immediate future as being within the next 10 years. But you must give due consideration to the fact that there will be development in atomic

energy, with possible side developments that might lead toward commercial use as a result of governmental research.

Mr. SHORT. Until such time and some other country develops this atomic bomb, so far as any one nation now is concerned, no other country could wage war successfully against the United States, is that true?

General GROVES. I think they would have to think of what would happen to them.

Mr. SHORT. And so long as the United States can retain sole knowledge and possession of the atomic bomb, it is in a position of being able to wage war successfully against any other nation.

General GROVES. Yes; with two qualifications. First that nobody finds out a means for stopping us from delivering on the target. That is the reason that makes it very important not to place our sole reliance upon this weapon and say that with it we cannot be defeated. It is a very strong weapon, but it is not a substitute for our Army and Navy, and it would be a terrible mistake to consider it so. It is very strong but it is not overwhelming because somebody may stop it.

Also, we must not forget that this is a secret that cannot be held; it is just a question of time. The worst thing that could be done would be to rely only on this weapon and say that with it we cannot be defeated. It is not a substitute for an army and navy. It is a very strong weapon, but someone may discover something to stop it.

Mr. CLASON. Up to the present time, we do not know of any Nation that has found any defense for it?

General GROVES. No; I do not know of any; but I do not know much about the rest of the world.

Mr. CLASON. If that be true, I would like to know whether or not, in the development of this bomb the Government has used any foreign personnel who are not American citizens?

General GROVES. Yes; they have been used.

Mr. CLASON. If they return to their home countries, are they not in position to aid in the swifter development of the atomic bomb in the foreign countries from which they come?

General GROVES. Yes, sir.

Mr. CLASON. Some of them are very capable scientists?

General GROVES. Yes, sir.

Mr. CLASON. But as I read this bill, this bill does not prevent the Commission from employing foreigners hereafter.

General GROVES. No, I do not believe it does.

Mr. CLASON. Is it the purpose of the Commission to retain in its employ the scientists from other nations who are now employed there?

General GROVES. No; of course, I do not know what the Commission will decide to do, but I would not imagine that they would frequently do that.

Mr. CLASON. Why is the bill drawn so they can do that, to permit nationals from all other countries to be employed by and with their salaries paid by the United States Government?

As to secrecy, in connection with this bill—

General GROVES. I believe the only reason I can give for that is the fact that we were so determined to avoid any of the international problems involved that we did not set it up in this bill. So far as our employment of foreigners, I cannot tell you the exact figures, but they are extremely limited. They were necessary if we were to accomplish the purpose. I cannot even recall now just who they are.

Mr. CLASON. In employing these persons, as I read the bill on page 18, they do not have to comply with any civil-service law or any other statute, and apparently they can put foreigners in positions where they may get a considerable amount of, if not full, knowledge of what is going on in the Commission.

Is not that a rather dangerous proposition, in view of the fact that so far as your criminal processes are concerned, you can even send a man to jail for violating simple regulations?

It seems to me, from the criminal standpoint, you are making it a serious proposition all the way through and opening that up pretty wide.

General GROVES. I do not believe the Commission would, in fact, employ any foreign citizens normally. If I were in a position of responsibility with the Commission I certainly would not employ any foreign citizens unless the rewards to be gained for the project were sufficient compensation for the risk to security.

I would like to say that the only thing that would preserve security would be to lock everybody up, and when they decided to leave to shoot them and be done with it. That is the only way you could have perfect security.

Mr. CLASON. How much do you expect this Commission would need in the way of funds?

General GROVES. That is extremely difficult to answer, because it depends a great deal upon what the Commission decides upon. We do not know about certain essential things. We do not know what the situation will be abroad; we do not know how many bombs we should have in storage, and we do not know what future developments may bring forth.

Mr. CLASON. The bill also provides for the setting up of a corporation, as the Commission sees fit, for various things. What is the need of a corporation? Why cannot the United States Government go ahead without the formation of a corporation?

General GROVES. It is sometimes quite essential for security reasons to have a corporation established, and there are certain other places where it is desirable. In this project to date, there has been no widespread use of any specially set-up corporation. There have been some things done entirely for security reasons to enable us to do the job in a better way. As soon as it is known the United States Government is doing something, everybody knows we are doing it.

Mr. CLASON. Why should not this Commission save money? In its transactions it will be involved probably in many millions of dollars, but without being subject to the General Accounting Office to the same extent that most agencies of the Government are.

General GROVES. In order to insure that our procedure on accounts was correct the Comptroller General has arranged with us to have field auditors practically associated with us throughout, in passing on the bills promptly, so in case of doubt the bills could be straightened out promptly. As you know, accounts that run for 2 or 3 years are very hard to adjust. We have had many unusual projects in connection with these properties, and while those provisions are difficult to write, we have done so to the satisfaction of the Comptroller General. However, there are possibilities where there would be disputes, and I think the committee will appreciate the fact that in carrying on this extremely complex program, it has to be free of that possibility.

Mr. CLASON. I have read the bill, and while I appreciate the purposes for which it was drawn, how can any large corporation proceed with the development of research on the use of atomic principles, based upon the same ores used in the bomb under this bill?

General GROVES. They will proceed under a license given by the Commission. That is provided for in section 13, I think, on page 21 of the bill.

Also, in section 13 it provides that—

it shall be unlawful for any person without the consent of the Administrator and upon such conditions as he, with the approval of the Commission, may prescribe to do certain things that may be done with such consent.

Mr. CLASON. It also provides, on page 22, subsection (d), line 20—

it shall be unlawful for any person to conduct research involving the release of atomic energy in amounts deemed and to be prescribed by the Commission as constituting a national hazard or being of military or industrial value—

And so forth.

General GROVES. Yes, sir.

Mr. CLASON. Do you not think that is going to be a pretty severe restriction combined with section II, so you cannot bring anything into the United States in quantities enough to accomplish anything under this bill? There is nothing you can bring in here in large quantities.

General GROVES. It has set up the most rigid limitations, and it is put in the hands of this authority for the reason that has been set forth, that this is a situation so complex and so complicated that it makes it impossible to write laws in advance as to how each particular operation shall be conducted. It also is something that cannot wait. If a mistake is made in this instance it may easily be a fatal mistake. If a mistake is made in this field it may be irreparable.

This whole thing is so complicated and of such magnitude that no mistake can be allowed; it is like a man on skis going down hill who cannot stop, and it would mean that it could get out of control.

Irreparable damage might result to the United States if a mistake were made now in connection with the control of atomic energy.

We are flirting with national suicide if this thing gets out of control. If one mistake is made we may face national disaster.

Mr. CLASON. You think it would not be financially wise for a big corporation to conduct any of this research work, like the fellow who provides an engine or a motor vehicle, or for any other purpose, in view of the fact that without that he could go no further.

General GROVES. It would be unwise from that standpoint, and also it would be unwise because there is not enough fundamental knowledge at this time, and they would not do it because they would not see any returns.

Corporations interested in doing research work with no returns are interested in doing more basic research, with financial support from the Government, in which case a patent of that character would go to the Government.

Mr. CLASON. If I get the picture, the public is not likely to get much benefit out of this development, if any, in the near future.

General GROVES. I think that is correct; from the power standpoint. From the medical standpoint, perhaps there will be some benefits.

Mr. CLASON. Why is it that you are interested in allowing colleges and universities to carry on in a small way in connection with research and do not want big corporations to do it?

General GROVES. I think we also have control over the colleges in the same way as the corporations.

Mr. CLASON. But you did furnish them with funds and train the men to do everything to help them out. It means a big thing, a big research program? Is not that true?

General GROVES. Many of the basic discoveries are made in the college laboratories, and by people proceeding on shoestrings, and it would be most unwise to say to them and have them feel that nobody in the United States can do that unless he has a license.

The CHAIRMAN. Does not that follow, that these private workers do work in harmony with industry, oftentimes, and that it is not unusual?

Mr. CLASON. It is not unusual, in many cases, but from the standpoint of financial investment it is certainly out of this picture under this bill.

General GROVES. No, sir; because at the present time there are big corporations interested in conducting research along these lines in cooperation with the United States. I think that would be one of the first things taken up by the new commission, that is the handling of that type of commitments in which the corporation would be doing this work for the United States without profit. Their profit is in the training of certain people for this particular field.

Mr. CLASON. Are they under the pay of the United States Government or the corporation?

General GROVES. In the normal instance, the corporation would naturally do research, and the United States would reimburse them for their expenses.

Mr. CLASON. As I get the picture, the United States Government would control everything from start to finish, and no private corporation or individual can go ahead under that method.

General GROVES. That is correct; he has to have a license from the Commission.

Mr. CLASON. The word "license" means that the Commission can still increase these wages, and the word "license" on page 28 of the bill includes "license, lease, loan, sell, furnish, make available, dispose, grant, any right or interest"?

General GROVES. Yes, sir.

Mr. SHORT. It is imperative that you keep it tight and rigid and make the control of this thing as absolute as possible?

General GROVES. Yes, sir.

Mr. SHORT. And that is the reason the Commission is granted practically unlimited power, as it should be?

General GROVES. Yes.

Mr. CLASON. After this bill is passed, Congress is out of the picture. I just want the facts for the record. I think we all agree that something has got to be done. But as I see the picture, after this legislation is passed, if it is passed in the form of this bill, Congress will have nothing further to do with any control over it excepting to pay the bill, as has been suggested, out of appropriations from the Appropriations Committee, and to receive expurgated reports, the President receiving the full report and the Congress getting something less. Is that right?

General GROVES. I think there is one thing that you have left out, and that is that the Congress at any time can change the act.

Mr. CLASON. Yes; but that has not been very easy to do in the past. Other than that, if the bill is passed, as long as it stays on the statute books Congress is out of the picture except as regards appropriations?

General GROVES. Yes.

Mr. DURHAM. Under this bill would a college be prevented from doing experimental work without securing a license from the Commission?

General GROVES. They would have to have a license.

A VOICE. No.

General GROVES. It depends on the quantity and on the type of experimental work it is. Subsection (d) on page 22 is the one that really applies to that. It provides as follows [reading]:

It shall be unlawful for any person to conduct research or experimentation involving the release of atomic energy in amounts deemed and to be prescribed by the Commission as constituting a national hazard or being of military or industrial value, * * *

You cannot have a thing of industrial value without its being of military value also.

Mr. DURHAM. I am interested in research work by the colleges in this country.

General GROVES. I believe that the effect of the bill will be to greatly increase the power of the colleges to do research, and will not diminish them in any instance.

Mr. MARTIN. General, with reference to the power to acquire property, it seems to be a rather broad power to acquire almost any property that the Commission deems essential or important in the development of this project for atomic development. After it gets the property, the Commission has the power to license the use of it to private firms or individuals; is that correct?

General GROVES. Yes, sir.

Mr. MARTIN. I wonder if there is any limitation needed on the power to acquire property and how far afield they can go in getting and then taking over property and licensing it just because it has a possible bearing on this field of development. I foresee some possible abuse of that power. I have seen mentioned in the papers recently the possibility of its extending out to the point of power institutions similar to TVA. We have one in the Middle West in which some of us are interested—the Missouri Valley Authority—and I wonder just how far the Commission can go in building up such an empire as that in the name of atomic energy development.

General GROVES. I believe that is measured by the statement on page 15, line 14—

which, in the judgment of the Commission, are peculiarly related to the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy.

Mr. MARTIN. The Missouri Valley Authority could be very peculiarly related to it, could it not?

General GROVES. I do not think so.

The CHAIRMAN. There is no Missouri Valley Authority yet.

Mr. MARTIN. I am not talking about things that are; I am talking about things that might be; and that is what we are called on to

consider. There was not any Tennessee Valley Authority when the bill was first enacted.

There is no limitation, as I see it, in this bill as to how far the Commission can go if, in its judgment, the development might have a sufficient bearing on the development of atomic energy.

General GROVES. I think that is correct. In other words, you are turning over to the Commission this subject, and you are turning it all over with the understanding that it is too complex to be handled by detailed advance legislation.

Mr. MARTIN. My interest in asking that question was just to call the attention of the committee at this time to the fact that this might be used as a cloak for future expansion of Government control of industry, and we want to go into this with our eyes open.

I will drop that matter at this point, and we will discuss it later in committee.

Another point is the matter of control of the individual. You answered Mr. Clason with reference to men who are not American citizens, but I think the question in mind was men who are American citizens. We know, in watching the activities of some industrialists in America, that they do expand into foreign countries, and we know of some firms of engineers who go into foreign countries to do developmental work there. As I understand it, you believe that the penalty section, section 19, and the security section, section 17, would be adequate for the checking of American citizens who have been employed by the Commission, leaving this country and selling their professional services to foreign countries where they might use the information gained in their experience here?

General GROVES. I believe it does not provide, and I do not believe it should, that an American who works on this is from then on restricted to the United States. He can go abroad; he can engage in business abroad. The purpose is to prohibit him from disclosing any information which is gained as the result of his employment with the Commission. It is awfully hard to cut out knowledge from a man's brain.

Mr. MARTIN. That is the reason I am asking the question. You made the remark a while ago when you were justifying the fields of secrecy, that in the industrial field it is well-nigh impossible to keep a man who has been closely associated with this development from using his knowledge.

General GROVES. That is correct. And it is the same in the scientific field. If, as the result of his experimental work, he sees a machine or an instrument used to make a certain measurement, and he is faced in his own laboratory later, 2 or 3 years later, with that same problem in front of him, he is going to use that knowledge, and you cannot strike it out of his brain.

Mr. MARTIN. The only place where he goes counter to this bill is in the security section and the penalty section, in the general statement with reference to using it with intent to jeopardize the interests of the United States. That is on page 27 of the bill, line 11.

General GROVES. It starts earlier than that, I believe.

Mr. MARTIN. That is the key, though, that determines whether or not he is violating the provisions of the bill.

General GROVES. Sections (a), (b), and (c) of paragraph 19 are all pertinent. They define different degrees of violation of security.

Mr. MARTIN. The intent to harm the United States is the principal test.

General GROVES. That is only section (c). As to the other sections, you do not have to show such intent.

Mr. MARTIN. To the extent that the penalty and security provisions are in here, we are dealing definitely with the matter of international effect of further research and development?

General GROVES. I think that is correct. If there were no international effect, there would not be the same need for security.

Mr. MARTIN. There is one general question I would like to ask you. You have been discussing here at some length the matter of other nations keeping up with us. I would like to ask you whether, in your opinion, we will be marking time during the 10 years that it takes them to catch up to the point where we now stand?

General GROVES. I do not believe we will, if we proceed wisely.

Mr. SHERIDAN. Is it permissible under this bill for the Commission or the Administrator to take property even before a hearing is held under petition?

General GROVES. I think that is correct.

Mr. SHERIDAN. It is so provided, is it not, on page 16, line 12?

General GROVES. Yes, sir.

Mr. SHERIDAN. Is not that violative of the very principles of our Constitution?

General GROVES. I cannot answer that. I am not a lawyer. I think that is really a legal question.

General ROYALL. There is plenty of custom for that.

Mr. SHERIDAN. As a matter of fact, once the Administrator or the Commission is established, there is no further provision except by limitation of authority?

The CHAIRMAN. That is a law question that we have got to settle; and this gentlemen is not a lawyer. We have statutes authorizing the seizure of property now, upon the payment of 50 percent of the value.

Mr. SPARKMAN. It is in line with the Second War Powers Act.

Mr. SHERIDAN. But the status of this Commission will be a peacetime status.

The CHAIRMAN. That is correct.

Mr. ELSTON. General, I do not think anybody can quarrel with you about the objectives of this legislation. I want to talk to you about some of the provisions of this bill. In the first place, did you have any thing to do with the drafting of this bill?

General GROVES. I sat with the interim committee, as the Secretary said, throughout its preparation of the bill, which was to lay down the principles. The drafting of the bill was under the charge of General Royall. I am in favor of the provisions of the bill. I have gone over it very carefully during that time. It incorporates everything I would want to see in it and it has nothing that I would not want.

Mr. ELSTON. In the first place, you set up a commission that has more power than has ever been given to any other commission in the history of this Nation, and yet you do not provide that the members of the Commission be even confirmed by the Senate.

General GROVES. Yes, sir; that is in here.

Mr. ELSTON. I am looking at the summary, and the summary does not mention it.

General GROVES. I am sorry, sir. It is on page 2, lines 23 and 24 [reading]:

which shall be composed of nine members, who shall be appointed by the President, by and with the advice and consent of the Senate.

Mr. ELSTON. I am glad to know that it is in there. General authority is given to the Commission, however, to have plenary supervision and control, within the United States, of all matters connected with atomic energy. It gives the Commission complete and absolute and unqualified control over atomic energy. Is that correct?

General GROVES. Yes, sir.

Mr. ELSTON. And that, of course, includes everything. It would preclude any company from proceeding with any research work at all with a view to developing atomic energy for industrial uses, without a license from this Commission?

General GROVES. That is generally correct. In other words, the Commission has the control there.

Mr. ELSTON. Of course in time atomic energy may take the place of all other types of energy, such as electricity, energy developed from coal, natural gas, and everything else. That is conceivable?

General GROVES. Many years in the future.

Mr. ELSTON. Well, it is conceivable; and yet it is all in the hands of this one Commission. That is correct, is it not?

General GROVES. Yes, sir.

Mr. ELSTON. I notice that the bill gives the Commission the right to make contracts without regard to provisions of law?

General GROVES. Yes, sir.

Mr. ELSTON. Do you conceive of any reason why they should make contracts without regard to existing law?

General GROVES. Yes, sir; a great many. For example, in normal times contracts must be given to the lowest bidder. This is not a case of selecting the lowest bidder. This is just as if you were securing a surgeon to do an operation. You are not interested in taking bids on that. That is because of the type of work. Things must be decided on reputation and what you think of the ability of the person.

Mr. ELSTON. Do you not think it would be better in cases of that kind to have the Congress specifically indicate in what respects existing law should be changed, rather than to give the Commission carte blanche authority just to go ahead and ignore the law in regard to any contract at all?

General GROVES. I do not believe so, because I do not believe that it is possible at this time—and I speak from my experience in the last 3 years—to determine just what problems this Commission is going to be faced with. It is faced with problems that have got to be decided promptly. If they are not, it is going to cost the Government tremendous sums of money. I feel that, with the national security so vitally concerned, mistakes, as I said before, may not be retrievable, and those mistakes may be of tremendous cost.

Mr. ELSTON. Congress is always in session.

General GROVES. That does not mean that we can necessarily have prompt action.

Mr. ELSTON. Just give us one illustration of where you would have to act without waiting for Congress to pass a law.

General GROVES. You mean, as to what might happen?

Mr. ELSTON. Yes. Just give us one case where you might have to act so fast that Congress could not consider it.

General GROVES. The Commission might have to, in the procurement of raw materials, proceed without any delay. If you are hunting for raw materials and someone else is only a step ahead of you or following where you are, you have got to move and you have got to move fast and you cannot wait, judging from the decisions that have had to be made in the last 3 years; practically instantaneous decisions. I mean decisions involving large sums and involving very important policies that had to be made in a few hours' time, whereas in normal times and under normal procedure we would get together and sit and argue for maybe weeks. That has not been possible, and I do not believe it will be possible in the future.

Mr. ELSTON. Congress can give you the power to make contracts for the purchase of materials without giving you absolute power to do anything you want to by contract and completely disregard the existing provisions of law.

You also ask in this bill that Congress give you the power to adopt regulations which shall be published in the Federal Register, and then for violation of whatever regulations the Commission may decide to make, people may go to jail for as much as 30 years.

Mr. SHERIDAN. Also they are not even subject to the General Accounting Office for audit.

Mr. ELSTON. I understand. But you are given by this bill power to make regulations which are hidden away somewhere in the Federal Register; and it is impossible for anybody to know everything that is in the Federal Register, and yet for the willful violation of one of those regulations it is possible to impose a penalty of \$300,000 and 30 years in the penitentiary.

General GROVES. I believe that the courts would consider carefully any excessive penalties; but I would like to point out that our practice in the past, and I believe it would be the Commission's practice, has been to require anyone who is employed by us or by any of our contractors to sign certain agreements of secrecy. He is put definitely on notice and he knows what he is doing if he violates it. I think that will be the main purpose of these regulations.

Mr. ELSTON. Congress can pass a law making it an offense to reveal secrets. You do not have to do it by regulation.

General GROVES. If we could anticipate all the things that might come up on this. The reason that we cannot is that this whole subject is approximately 2 years old, as far as getting into the complexities of today are concerned. You cannot sit and discuss the thing or explain it to people who have not had the background. You cannot explain it just because they have the education or training to understand it, because the whole thing is so staggering in its implications that you have got to have the background that comes with time.

Mr. ELSTON. I grant you all that; but I do not think that justifies giving legislative power to the Commission, power to make laws and hide them away in the Federal Register and send somebody to the penitentiary for 30 years for their violation.

The CHAIRMAN. Will the gentleman yield to the gentlewoman from Connecticut who has got to take a plane directly?

Mr. ELSTON. Surely.

Mrs. LUCE. General, I welcome this opportunity to ask you a question with reference to the past history of the atomic bomb. I think your answer to it will be conclusive.

When, in your opinion, was the atomic bomb as a weapon first ready for target release; on what date?

General GROVES. You mean, when it could have been released?

Mrs. LUCE. When could that bomb have been released, in your opinion; on what date?

General GROVES. I think that bomb could first have been released on the day that it was released.

Mrs. LUCE. When was the actual bomb itself ready to be released?

General GROVES. I cannot remember the exact date, but I believe it was about 3 days before it was released. It was ready to be assembled. It was not necessarily ready to go. We waited until the last minute to make certain final assemblies. But, as to the real intent of your question, it was ready 2 or 3 days before.

Mr. JOHNSON. You mean, before it was released?

General GROVES. I can recall now that it was ready on the 1st of August.

Mrs. LUCE. I bring this up because there was an astounding remark made—you may have seen it—in the newspaper columns.

General GROVES. I have seen a lot of astounding remarks. I think I know the one you mean.

Mrs. LUCE. That remark said that the bomb has been ready for release and the War Department had been so notified on January 15, 1945, and it was not released until 6 months later for political reasons or reasons of state.

General GROVES. It is very easy to answer that with a definite "No."

Mrs. LUCE. I know it does not make good sense, but as I get many inquiries about it I wanted to ask you that question.

General GROVES. The answer is "No," unqualifiedly.

Mr. ELSTON. Relating to the question that the gentleman from Pennsylvania asked about, and that is the power to requisition, I grant that in the past power has been given to requisition property, but it was purely a wartime act. There is no government that I know of that has the power in peacetime to requisition property without giving the owner his day in court. Under this bill this Commission could requisition any property, real or personal, anywhere in the United States, that it saw fit to take, without going into court first. There would be compensation afterward, but it could just take the property and decide afterward what it would pay for it. That power is in this bill?

General GROVES. Yes.

Mr. ELSTON. The Commission may take over an entire industry if it wants to, and nothing could be said about it?

General GROVES. There certainly could be plenty said about it.

Mr. ELSTON. But nothing could be done about it?

General GROVES. That is correct.

Mr. ELSTON. Do you think that is necessary?

General GROVES. I think it is. I think it is one of the many provisions that are in this bill that are necessary, because we do not know what the future of this thing holds for us, and we may have to move very quickly. It has happened in the past, in the course of our developments, where certain things suddenly became of importance to us.

and it was of the utmost necessity that they be obtained promptly and without any fooling around of any kind; and those items were not items which were necessarily due to the speed with which we had to work.

Mr. ELSTON. In the development of atomic energy so far have you requisitioned any property?

General GROVES. You mean, taken possession before a court order?

Mr. ELSTON. Yes.

General GROVES. I cannot state definitely. I cannot recall any offhand.

Mr. ELSTON. Then, if you have not had to do it so far, what makes you think you will have to have all this power to do it in the future?

General GROVES. I think the answer to that is that we just do not know what the future holds for us in this problem; but we do know that it moves fast and that a mistake in this can be national suicide, as I explained before. I feel that if the Commission is selected as we hope it will be, the Commission will not take advantage of those powers.

Mr. ELSTON. Well, it is a dangerous thing to just give them the power and hope that they will not take advantage of it.

The CHAIRMAN. Is that all, Mr. Elston?

Mr. ELSTON. No; I have another question.

The CHAIRMAN. Go ahead. I want to be able to excuse this witness finally, very soon.

Mr. ELSTON. I want to call your attention now to another section which authorizes the Administrator to license the Commission's property, including its funds, for research and experimentation, development, exploitation, and use of processes or methods for the release of atomic energy, and any use of such property where it is deemed advisable for the purposes of this act to retain control or supervision in the Commission over the property, its utilization, or disposition; and incidental and related purposes. Then you provide that no license for purposes (1), (2), or (3) shall be given by the Administrator to a foreign government or any person who is not under and within the jurisdiction of the United States, without the approval of the President.

You have asked for all these vast powers for the control of atomic energy, and yet you make it possible in the bill to give them all away to some foreign government by the act of one man, namely, the President of the United States.

General GROVES. Also the act of nine other people who have to recommend that, if they do.

Mr. ELSTON. I am assuming that the Commission recommends that. Then you give the President alone power to give it all away, and in that you include the atomic bomb and everything else. Do you think that is a wise provision?

General GROVES. All I can say is that that is getting into the international field, and that is really out of my sphere.

Mr. ELSTON. Well, it is in this bill.

The CHAIRMAN. I wonder if I can get an agreement from my colleagues and the other members of the committee that Judge Patterson and General Royall are both good lawyers and that we can discuss the legal aspects of the bill with them.

Mr. ELSTON. All right. Maybe I do not have any more to ask this witness.

The CHAIRMAN. I do not want to be disagreeable about it.

Mr. ELSTON. No, you are not. I do want answers to my questions, and I would rather get them from the ones most capable of answering them.

The CHAIRMAN. The witness is a mechanic and not a lawyer.

Mr. ELSTON. The Secretary, I know, is a very able lawyer.

I am through with this witness for the time being.

The CHAIRMAN. Mr. Sikes?

Mr. SIKES. No questions.

The CHAIRMAN. Mr. Harness?

Mr. HARNESS. I have a couple of questions.

General, would you care to tell us what research has been made and what progress has been made in developing a defense to this bomb?

General GROVES. I do not think that should be disclosed even to this committee. All I can say is that I think you know that we naturally would be interested in it and that we are not sleeping on it.

Mr. HARNESS. Would that be one of the functions of this Commission, to continue to study and develop a defense?

General GROVES. Everything pertaining to it. I would certainly feel that the Commission was decidedly negligent if it did not think of the defense as well as the offense.

Mr. HARNESS. There is nothing in the bill that directs them to do that, is there?

General GROVES. No, sir, but I feel that it is within their power. I also believe that the major defense for this will be the same type of defense as against anything else. There are two types, passive and active, and the best one is always the active.

The CHAIRMAN. Have you any questions, Mr. Pinero?

Mr. PINERO. No questions, Mr. Chairman. I only want to state that I think the United States should lead the world in the development of this atomic energy. I would rather stand on the past record of these scientists who have developed this weapon.

The CHAIRMAN. Thank you very much.

Mr. JOHNSON. In your opinion, General, does the Administrator have the same power as the Commission?

General GROVES. No, sir. He has some of the powers of the Commission, but there are certain ones that are reserved to the Commission.

Mr. JOHNSON. I see you use the words "Commission or Administrator."

General GROVES. In some instances; but the power of the Administrator is set forth in one portion of the bill.

Mr. JOHNSON. As I get your testimony, this has so many implications and is so dangerous that you cannot let it out at large; and that is why you want this type of procedure, where you can maintain secrecy and conduct experimentation?

General GROVES. And where we can make decisions quickly.

Mr. JOHNSON. If the control should get away from us you said it would result in national suicide. What do you mean by that?

General GROVES. For example, if this weapon had been developed by Germany it would certainly have been national suicide for us. The same thing might apply later. We do not know what the weapon may develop into. Until the international situation has changed, we certainly would be remiss if we did not provide for our national strength in this particular weapon.

Mr. JOHNSON. You mean that just our conduct might result in some other nation destroying us?

General GROVES. Yes, sir.

Mr. JOHNSON. It does not have any implications of danger in itself?

General GROVES. No, sir. We cannot destroy ourselves with it—that is, that we know of.

Mr. JOHNSON. This question has been asked several times, I know, but I want to see if I can get at it in another way. Last Sunday I read Mr. Byrnes' report, and you perhaps read it too. He gave the impression that these international conferences were largely at a place where they might bargain and trade. Under this bill would it be possible for the President to go to a conference in the next few months, and if he felt that he could get something that was worth while, for instance, some kind of an assurance that he thought would maintain peace perpetually or for a long time, he could trade off this secret?

General GROVES. As I said before, I cannot go into the international phases. I can only speak from the national side of it.

Mr. JOHNSON. But you sat in when they drew this bill, and you said that it contains everything you want and also that it does not contain anything you do not want. That is part of the problem that we have to pass on in passing on this bill. He can give away the secret?

General GROVES. He can.

Mr. JOHNSON. Through his representatives, and he can make up his mind to give it away for what we got back?

General GROVES. That is correct.

Mr. JOHNSON. Another thing: As I read the appointing power provided for, the members of the Commission must be confirmed by the Senate, but afterward even the President cannot remove them?

General GROVES. Yes, sir. There is a provision for that—inability to act, neglect of duty, malfeasance in office, conflict of interest, or because the continuance of the member in office would be inimical to our national interest.

Mr. JOHNSON. In other words, you think the President has the arbitrary power, if he thinks their continuance in office is bad for the public interest, to remove them?

General GROVES. I believe so. Of course, I am not a lawyer, as the chairman emphasized.

Mr. JOHNSON. Out in the University of California they conducted experiments on the breaking up of atoms. Would that type of activity by them in the future require a license?

General GROVES. Yes, sir. They are required to have a license.

Mr. JOHNSON. So that any extended experimentation by universities would require permission from the Commission? Is that a fact?

General GROVES. When you speak of the University of California, they had a tremendous project there. There was a large number of people, and they fall into the classification of what would be of military value.

Mr. JOHNSON. There are other colleges or universities carrying on a similar program today; are there not?

General GROVES. There are others that are carrying it on.

Mr. JOHNSON. And they would have to have licenses?

General GROVES. Yes, sir.

Mr. JOHNSON. Why do you think they would have to have a license?

General GROVES. If we are to maintain security we have to require that.

Mr. JOHNSON. Does it not boil down to this, that whatever the activity may be, if this Commission or the Administrator thinks that what they are doing might jeopardize the national security, they must procure a license?

General GROVES. Yes, sir.

Mr. JOHNSON. You mentioned the fact that we have to do this right now or in the next few days or weeks. From what you have said regarding the progress in other countries it may be years until they catch up with us. Why is it so imperative that we have to do this this week or month?

General GROVES. It is imperative because the project now is in the uncertain stage. It has been under very close control and responsibility. The people on the project want to know what the future is going to be so that they can decide whether they wish to remain with it. Also, from the security standpoint, we cannot get back information that is once disclosed. Any information we disclose now is disclosed forever. But the main thing is, as I stated in the introduction, that we have had very broad powers and we want to give up those powers. We would like to have a commission appointed. We would like to get the thing settled and made a going concern that is going to be a concern in the future, and not have people wondering what is going to happen. The people want to know where they can get assurance of what is going to happen. They want to know whether this thing is going to go on and who is going to run it and how it is going to be operated. We have laboratories that are being operated by universities because it was the only way we could handle it in time of war. Those universities do not want to continue operating. They have to be Government laboratories; and the people that we want to work in those laboratories want to know what the situation is going to be. At the present time I cannot give them any assurance as to position or salary beyond just the immediate future.

Mr. JOHNSON. Is it possible to divide this up and segregate those parts of it that might be useful for other purposes? For instance, the laboratory at the University of California was conducting experiments along medical lines.

General GROVES. It was; but it also cannot be separated from this. I think that is covered in the first line on page 23 [reading]:

In administering this provision, the Commission and the Administrator shall interfere to the least possible extent with small-scale experimentation in research laboratories of nonprofit institutions.

Mr. JOHNSON. All that resolves itself into the determination of one man, who is Administrator?

General GROVES. He has got the Commission there.

Mr. HARNES. Will the gentleman yield there a moment?

Mr. JOHNSON. Yes.

Mr. HARNES. General, you say that licenses are necessary for colleges and other people who want to delve into the realm of this science. Do you mean to say that that is to preserve the secrets that

our scientists have already discovered, or is it to protect the people of the country against some disaster that might occur as the result of further development?

General GROVES. It is to preserve the past secrets and the future secrets; and certainly if it were poorly handled it could endanger others.

Mr. JOHNSON. As I see your purpose, it is to get complete domination of this thing in the hands of the Commission and under the Federal Government?

General GROVES. Yes, sir.

Mr. JOHNSON. And that is for perpetuity, too?

General GROVES. Yes, sir.

Mr. JOHNSON. That is all.

Mr. MARTIN. General, are the penalties in section 19 broad enough to be applicable to those heretofore employed in this project?

General GROVES. Yes; they are believed to be. They are designed for that purpose.

Mr. MARTIN. That is all.

The CHAIRMAN. The committee is going to be in recess until 2 o'clock. I am sure you want to hear these famous scientists, Dr. Bush and Dr. Conant. Please be here promptly at 2 o'clock.

(Thereupon, at 12:10 p. m., a recess was taken until 2 p. m. of the same day.)

AFTERNOON SESSION

The hearing was resumed at 2 p. m., upon the expiration of the recess, Hon. Andrew J. May, chairman, presiding.

The CHAIRMAN. The committee will please be in order.

Gentlemen, Secretary Patterson will be available most any time we want to use him. We have some other gentlemen here from out of town who are busy men, and I have decided to call them next and let the Judge wait a little while and be available if we need him. Our first witness this afternoon is Dr. Vannevar Bush, Director of the Office of Scientific Research and Development. Doctor, will you come around, please, sir, and give us your statement?

STATEMENT OF DR. VANNEVAR BUSH, DIRECTOR, OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

Dr. BUSH. Mr. Chairman and gentlemen, the releases made by the President and the Secretary of War on the subject of atomic energy have been so complete that I do not need to elaborate upon the history of this project or its importance for the future.

Very briefly, the work was carried on initially under the auspices of the Office of Scientific Research and Development, of which I am Director, for a considerable period, after which it was transferred to the War Department and carried on under the Manhattan district. I continued to be associated with the matter, first as Chairman of the Military Policy Committee, set up under orders from the President, which passed on the policies governing the work of the Manhattan district and before which General Groves placed his plans and program before reporting on them to the Chief of Staff. I also served as a member of the Interim Committee under the chairmanship of the Secretary of War, which advised the Secretary and the President in

regard to various aspects of this subject, such as releases to the public and the preparation of legislation.

The release of atomic energy holds enormous possibilities for the future, both for good and for evil. It appeared, fortunately, in time to bring an abrupt end to the Japanese war and thus to save a very large number of lives which otherwise might have been lost in further struggle. It was a very expensive undertaking, because of its magnitude and difficulty, but its cost has already been saved many times over, and its importance for the future renders the question of cost a matter that can now be approached with equanimity. During the war full attention was paid to the development of an atomic bomb. This was done under enormous pressure, for there was a race on with Germany, and for a long time we did not know just where we were in that race, the outcome of which might be determining in regard to the entire future history of the world. That race was fortunately won by a wide margin. However, there was no time in such circumstances to consider possible future industrial applications of atomic energy. Now that peace has returned we need to think deeply of these things.

The application of the science of atomic energy is in its infancy. No man can tell what may emerge from this vast new field during the next generation. At the time that Faraday performed his notable experiments on electricity no one could have envisaged the great power systems and communication systems of the present day. No one can tell what lies ahead in this present field, but we can be sure that the opening up of this area gives new possibilities for the human mind and that the ultimate results may indeed be very great.

On the other hand, there are no immediate great commercial applications just around the corner. It is evident that there can ultimately be applications to the production of power within the reasonably near future, but the matter has not as yet been studied sufficiently to indicate just how economical these may be in comparison with other sources of power. Study by many minds and a great deal of experimentation will be required before the possibilities of industrial application even become clear. The situation in which we are placed at the present time, therefore, is one of great potential importance, but one in which practical results will certainly not come immediately.

Nevertheless it is essential that legislation be enacted at once or with reasonable promptness for the Federal control of all phases of atomic energy. This is an art which it is very dangerous indeed to practice. Merely for the safety of the people it is essential that it be carried on only under such strict regulation as will insure that proper safeguards are always taken. This can be done effectively only if the Federal Government establishes new means for the purpose.

It is also essential that the future of atomic energy in this country be controlled in a manner having due regard to the problem of national security. We all hope that means will ultimately be found for preserving the peace of the world, but it is equally clear that at the present time this country must pay close attention to its own military strength from every angle, and the angle of atomic energy is certainly an important one. The subject of atomic energy, therefore, has both military and civilian aspects and I believe that it is wise to provide for its control by a civilian commission as is provided in the bill before you.

I have been questioned by my associates in regard to many phases of this bill, but particularly concerning the phases bearing on research and on the proper preservation of security over aspects of the subject requiring secrecy. I believe that the bill as drawn provides for both of these matters in an appropriate fashion.

In regard to research on atomic energy, I believe that the bill is particularly wise. It provides for the full control by the commission of all research wherever carried out if it is of such magnitude that the public safety or the public security might be endangered. On the other hand, it provides for regulation by the commission which will enable universities and scientific institutions generally in this country to proceed with experimentation without interference by the commission whenever the amount of energy which they release in the experimentation is so small that licensing and control are not necessary to provide for the public safety. The bill also emphasizes strongly that one object is to increase the knowledge of atomic fission in this country, and it also emphasizes that the commission should encourage experimentation for this purpose in universities to the maximum extent consistent with the controls that it is necessary it should exercise. I believe this is a wise manner in which to handle this particular matter.

Last June, pursuant to a request made of me by President Roosevelt, I submitted to President Truman a report entitled "Science—The Endless Frontier." This embodied a plan for the promotion of scientific research in this country by the formation of a National Research Foundation. I have also recommended that the Research Board for National Security, concerning which this House passed the May bill, be continued until the final form of Federal organization for research is determined by legislation. Bills incorporating the primary recommendations of my report have been introduced in the Senate by Senator Magnuson and in the House by Representative Mills. Hearings on these bills and also on a bill by Senator Kilgore having somewhat parallel objectives are now being carried on by a joint committee in the Senate from the Military Affairs Committee and the Committee on Commerce. I have been asked whether there is any conflict between this proposal for a National Research Foundation and the present bill to establish a Commission for the Control of Atomic Energy. I believe that there is no such conflict. In fact, I believe that the proposals are supplementary, and that both steps are necessary. The commission here proposed is primarily a regulatory and controlling body. While it is enabled to do research to the extent that it deems necessary, it is instructed in the bill to further as far as possible the research done by other governmental agencies and by private organizations. If a National Research Foundation is formed it will undoubtedly wish to support research in physics and in chemistry on matters related to atomic fission. In so doing, and as far as the regulations require, it will obtain the approval of the Atomic Energy Commission. I believe, however, that the National Research Foundation as provided for in the bill introduced by Representative Mills furnishes a body which will be able to further scientific research in this and other fields to great advantage, and I believe that the Commission will agree with this point of view and will support the foundation strongly in its endeavors.

Another point which has been raised is the question of security of information. This is a matter which it is very difficult to judge. It is certainly true that some parts of our information in regard to atomic fission must at the present time be kept secret, and that every possible step should be taken to insure that this secrecy is not broken. On the other hand, we all know that research and scientific advance generally prosper best in an atmosphere of freedom and complete interchange among scientists. It is necessary to provide in a wise manner for both these aspects of the subject. I believe that the bill accomplishes this. It places in the hands of the Commission the duty of determining the rules which shall apply. It places under their control for security purposes quite completely the results attained by their own efforts, or by their contractors, or by those that they may license to operate in the atomic-energy field. On the other hand, it makes it quite clear that science will still be free in universities and research institutions to carry on experimentation of such nature that the Commission does not feel that the national safety or the national security require licensing. Judgment as to how far the clamp on information, internally in this country, should continue has to be exercised at some point, and I believe that the bill wisely provides for this judgment to be exercised by a Commission, guided by the language which is incorporated in the bill.

This bill has to do entirely with the control of atomic energy within this country. There are two parts to the problem of atomic energy: (1) Internal controls and (2) international relations. The bill deals entirely with the former. We are not concerned at this hearing, therefore, with the international aspects of the subject, which the President has indicated in his message to Congress he proposes to treat as a separate matter. However, I believe that the bill is properly formulated to exercise the internal controls in such manner that they will be appropriate whatever foreign policy is finally pursued on this entire subject after due consideration.

I find the bill adequate for its purpose, and it seems to me wise in its general provisions. I hence recommend that it be reported favorably and enacted.

The CHAIRMAN. Are there any questions?

Mr. THOMASON. I suppose, Doctor, that oil would be a very necessary commodity in the manufacture of the atomic bomb, would it not, or in connection with atomic energy?

Dr. BUSH. I think it would be used, but I do not think that it could be considered a material which was essential or especially concerned with atomic fission.

Mr. THOMASON. You would almost have to have it, though, would you not, in order to carry out the manufacturing end of it?

Dr. BUSH. Yes, sir. I think you would also have to have it to carry out the manufacture of narcotics, but I do not think it would be a material that would be considered subject to the regulations of this Commission.

Mr. THOMASON. The same would be true, as suggested by my colleague, as to electricity?

Dr. BUSH. Yes.

Mr. THOMASON. The first sentence of section 3 reads as follows (reading):

The Commission shall have plenary supervision and control, so far as the jurisdiction of the United States extends, over all sources of atomic energy and over

all matters connected with research on the transmutation of atomic species, the production of nuclear fission, and the release of atomic energy.

Would oil be included in that?

Dr. BUSH. No, sir; not in my opinion.

Mr. THOMASON. That is all.

Mr. DURHAM. Dr. Bush, I understood from your statement that of course there would be a continuation of research in colleges throughout the country, and it would be on an internal basis and not on an international scale. Suppose they carry on this experimentation in colleges and a college were requested by one of our good neighbors to enter 10 or 15 students for the study of atomic energy: how are we going to do that under this bill?

Dr. BUSH. I would have no fear, sir, that the universities in this country would not keep secret any subject that they should keep secret in the national interest, whether or not they had foreign visitors or foreign students. I depend on this experience for that answer. During this war we carried on throughout this country in a very large number of universities and colleges projects of great secrecy in regard to the development of weapons. I have yet to hear of one instance where there was any serious leak of information from such a laboratory. I believe that the record of the universities in that regard has been very fine indeed, and I believe that, given proper guidance as to what should be maintained secret and what should be disclosed, you can depend upon the universities and colleges of this country to do a very good job indeed in hewing to the line in that regard.

Mr. DURHAM. Certainly we would have a different student body in peacetime from what we had in wartimes, but we might have visitors from other parts of the world, depending on how far you were getting with this experimentation in colleges.

Dr. BUSH. I hope we will go very far indeed with experimentation in colleges. In fact, that is one reason why I urge that prompt action on this bill, consistent with proper deliberation, is very essential. Many of the universities and colleges of this country are anxious to proceed at the present time with research on this subject. They do not know whether they will be allowed to proceed or, if so, in what circumstances, or whether they can gain access to materials for that purpose. We hence have a pause at the present time which will continue until this Commission is formed to give the answers; but I think that in the interest of progress in the science of atomic energy the pause should be as short as we can make it.

Mr. DURHAM. Certainly we do not want to stymie it, because some other scientist might bring out a way of developing and manufacturing which would be cheaper than what you are doing at the present time. That is a possibility, is it not?

Dr. BUSH. That certainly is. At the present time if some scientist working in this country should find out, on his own initiative and working along the usual lines, some information that was very crucial, very important, there is no law that in any way controls his maintaining that secret in the public interest; and I believe that it is essential that we should have such a law as soon as we can.

Mr. DURHAM. You do not think that this proposed legislation would have any effect whatever to stymie it?

Dr. BUSH. This bill has been drawn very carefully in the attempt to secure a proper balance between the controls essential to provide

for the safety of the people, and the freedom of inquiry which we know is the best for progress in science. This bill enables the colleges and the universities and research institutions to proceed with a minimum of control and a minimum of interference, consistent with safety.

Mr. SHERIDAN. You just stated that the universities would proceed without interference from the Commission, is that true?

Dr. BUSH. Yes, sir. The bill instructs the Commission to interfere with the research work of the universities as little as is consistent with the maintenance of proper security.

Mr. SHERIDAN. But you propose to repose in the universities a certain degree of latitude in this realm of secrecy in the progress of science, is that true?

Dr. BUSH. I believe the Commission has the entire power to determine what is the region, the area, which shall be maintained secret, but after it is thus defined, the colleges are quite free to operate outside that area.

Mr. SHERIDAN. This bill would give them that authority, would it not?

Dr. BUSH. It would give the Commission that authority, that is right.

Mr. SHERIDAN. They only have to give what information they feel is necessary to the Congress, under this bill, is that true?

Dr. BUSH. I do not understand you, sir.

Mr. SHERIDAN. This bill provides that the only report made by the Commission is to the President, and the only other information will be given—

Dr. BUSH. I do not remember the exact language.

Mr. SHERIDAN. You have stated that universities have conducted research during the war. There has been no violation of secrecy, has there?

Dr. BUSH. They have followed the rules very well indeed.

Mr. SHERIDAN. For which they are to be complimented.

Dr. BUSH. Yes.

Mr. SHERIDAN. But still you do not want to repose such confidence in the Congress of the United States?

Dr. BUSH. I think you are drawing a parallel that is not quite exact, because what I said was this, that I believed that the Commission would leave the universities free to instruct and tell the entire world in regard to the results of their experimentation whenever, in the Commission's opinion, they would not in that way jeopardize the national security. On the other hand, the question of how much information of a secret nature the Commission divulges seems to me to be an entirely different question.

Mr. SHERIDAN. But you ask that this bill be passed favorably upon by this committee, and it provides that so far as the Congress of the United States is concerned, only such information as in the opinion of the Commission should be given, will be given to that body.

Dr. BUSH. I suppose that is still true today in regard to the War Department in its relations to Congress, and I judge that the Commission, in handling, for example information that they might have about the embodiment of atomic-energy products in new weapons, would have the same relation to the Congress as the War Department would on the same subject. In other words, it would not put such information into public reports. It would confer with the appro-

appropriate committees of Congress with regard to information, in executive session, and the matter would be handled in an entirely parallel fashion.

Mr. SHERIDAN. But that is a supposition without foundation. The War Department has no such authority as disclosed by this bill. This goes far beyond any authority ever delegated by the Congress.

Dr. BUSH. Yes, sir; I think it does, so far as my experience is concerned.

Mr. SHERIDAN. Even the powers we gave under the Second War Powers Act to the President during the war could not exceed the authority given by this bill in peacetime.

Dr. BUSH. On the other hand, Mr. Sheridan, this country has never faced a situation like this before, or such a necessity for rigid controls. That has never been so insistent as it is here. I certainly, as a citizen living in this country after the war, want to see rigid Federal control of what is done in this area. I certainly do not wish to think that some group of experimenters might set up a laboratory half a mile from my house and family and experiment on atomic energy carelessly, poison the neighborhood, or possibly blow it up. We have never before had a thing of this sort to control. Whether it needs exactly these powers, whether some go too far and some not far enough, I would not attempt to say. But, in general, I say we are faced with a very difficult thing to control. It must be controlled for the public safety, and I would create a very strong commission to do it.

Mr. SHERIDAN. You are aware of the fact that there were never such powers in this country as it is proposed to give to this Commission?

Dr. BUSH. But if Congress can set up such a Commission, it can also terminate it. If it can give these powers, it can also take them away.

Mr. MARTIN. Is this bill broad enough to cover related fields of development in this line? Suppose your further experiments develop some related product that might not be technically classified within the definition of atomic energy as described in this bill: Is this bill so drawn as to reach out and include those, or would they call for new legislation?

Dr. BUSH. That would call for new legislation. This bill, so far as its definitions are concerned, is very carefully limited to the fission of the nucleus and the release of energy by atomic fission, and nothing else. Perhaps new ways of doing it may be discovered in the future.

Mr. MARTIN. Will this bill cover all those methods?

Dr. BUSH. If it is a method of releasing large quantities of energy by nuclear fission, by a new method not now understood, yes; it would cover it.

Mr. MARTIN. If they got over into some family of cousins of this project, you would need new definitions?

Dr. BUSH. Yes; but I am well assured in my own mind that that will not occur for some time to come.

Mr. MARTIN. I was interested in Mr. Thomason's questions about oil; and as I read section 7 on the power to acquire property, you have a very broad grant of power there; and the last clause of section (a) relates to contracts, agreements, leases, and rights which, in the judgment of the Commission, are peculiarly related to the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy.

I believe that is the limitation placed on the grant of power for taking over property?

Dr. BUSH. That is right.

Mr. MARTIN. That leads me to ask this question, in view of my question this morning. Is the production of electric energy so classified that the bill would authorize it to be taken?

Dr. BUSH. I cannot see how it could possibly be, under the language that you have just cited.

Mr. MARTIN. I am interested as to your idea of how far this limitation clause limits the authority that the Commission would have to take over.

Dr. BUSH. Suppose I take your own example, electric power. That is certainly not peculiarly related to the transmutation of atomic species. It is related to many other things in addition. Certainly, therefore, the Commission has by this language no authority over electric power plants generally.

Mr. MARTIN. That is what I had in mind.

Dr. BUSH. I think that is clear.

Mr. STEWART. Dr. Bush, do you not think that the average Congressman is as trustworthy with regard to keeping secrets as our foreign professors who participated in these experiments?

Dr. BUSH. My experience with both has been rather pleasant. During the war I think our preservation of secrecy was extraordinary.

Mr. SHORT. More miraculous than the bomb itself?

Dr. BUSH. I think it was extraordinary. There were no leaks in spite of the fact that very many people had to know a good deal about it, including foreign scientists who worked with us and including Members of Congress.

Mr. JOHNSON. Dr. Bush, how long have they been experimenting with atomic energy in this country?

Dr. BUSH. It depends, Mr. Johnson, on how you define it. If you define it broadly, it is 50 years. If you define it narrowly, then only since 1939.

Mr. JOHNSON. They broke up the atom before the war; did they not?

Dr. BUSH. Yes; but there was a certain thing that happened that has to be remembered. The atom had been broken before that, but not with the release of substantial amounts of energy. It was only in 1939 that we got the key which showed how, by the breaking of the atom in the chain reaction, large amounts of energy could be released. And it is for that reason that all of this came to a head about that time.

Mr. JOHNSON. When was your group organized that you were the secretary of during the war?

Dr. BUSH. Shortly after those important discoveries in 1939 President Roosevelt set up a committee to study the question of whether the Federal Government should become active in this field or not. That was under the chairmanship of Dr. Briggs of the Bureau of Standards. In June of 1940 the National Defense Research Committee was formed, and that committee was transferred to its jurisdiction. Experimentation was continuous from the time that Dr. Briggs' committee was formed, on a very small scale at first, on an enlarged scale when the National Defense Research Committee was formed, and on an increased scale until 3 years ago when the matter was entirely turned

over to the War Department, except that the Office of Scientific Research and Development continued to do some auxiliary development in aid of the War Department's main effort.

Mr. JOHNSON. When you say "research," do you mean just on this atomic problem, or research generally?

Dr. BUSH. No; I am talking about this problem.

Mr. JOHNSON. At that time they conceived the idea that they could harness this energy, put it into a capsule and use it as a bomb?

Dr. BUSH. That really occurred in May of 1939. At that time information was brought to this country of experiments which showed that the atomic nucleus could be split with the release of large amounts of energy. Before that time no physicists knew how to make a bomb. After that time any competent physicist in the field of atomistics knew, theoretically at least, how to go to work to make a bomb.

Mr. JOHNSON. When was the Manhattan project set up?

Dr. BUSH. Three years ago, approximately.

Mr. JOHNSON. In 1942?

Dr. BUSH. Yes, sir.

Mr. JOHNSON. At that time you had thoroughly in mind that you were trying to harness that energy to use it in the war?

Dr. BUSH. At that time we had gone a long distance down that path. We had gone so far that the matter had come to the point where full-scale construction was needed, and it was at that point that the matter was turned over to the War Department.

Mr. JOHNSON. Was the nucleus of your idea really developed by civilians outside of the Government service?

Dr. BUSH. The basic ideas behind this were developed all over the world and over a considerable period of years. The work from 1940 to 1942 was in the Office of Scientific Research and Development, which is a civilian agency, and the work was carried on in various universities. After the project was turned over to the Manhattan district the same civilian scientists continued their work under the auspices of the Manhattan district, and, of course, their work was combined with that of engineers and industrialists, and so on.

Mr. JOHNSON. You mentioned a moment ago that there came to this country this idea. Where did it come from?

Dr. BUSH. It happened that crucial experiments on this were performed in Europe. In the science of atomistics there are a number of important milestones, most of which have been developed on the other side of the water. This country has contributed something, but I think in that field most of our physicists would testify that prior to this war we leaned heavily on Europe for our basic scientific research and development in this field—In France, Germany, England.

Mr. JOHNSON. Is the ore mixed with other metals, or is it found free?

The CHAIRMAN. I wonder if that is not going a little bit too much into detail?

Mr. JOHNSON. This is a very important bill, Mr. Chairman. It is just a preliminary question to something else.

Dr. BUSH. I do not think there is anything secret about that, Mr. Chairman.

Mr. JOHNSON. Any question that I ask you, if you think it is improper to answer it, just frankly tell me so.

Dr. BUSH. Shall I go ahead?

The CHAIRMAN. Yes. Use your own judgment.

Dr. BUSH. It is found as ore, as many other metals are.

Mr. JOHNSON. Is it found with coal, silver, or iron?

Dr. BUSH. It is found principally in pitchblende, which has been for many years the principal source of radium and is mined for that purpose. Uranium and thorium have been known for many years.

Mr. JOHNSON. I ask that question to find out if it exists in the strata of the mountains out in my country, where we have all kinds of ores.

Dr. BUSH. I think there is probably some in your country, but I suspect it is there in somewhat diluted form.

Mr. JOHNSON. I just wanted to see how far the Government might go in taking over things. What do you think of the future prospects of this? Does it have more of a future in its utility for civilian use or for military use?

Dr. BUSH. The immediate use is a military use. As I said in my opening statement, there will be, in my opinion, ultimately very important results in this matter of a commercial nature. But I put that a generation ahead, with some possibilities of some results in 10 years. The great, and the most important, application is the military application. The first application was to a bomb which ended the war. You will note that this bill is drawn with that strongly in mind. In the preamble, for example, one of the objects is to secure the national defense. There is a provision here that—

The primary objectives of all action taken under or pursuant to this act shall be the promotion of the national defense, * * *

Some of the members of the Commission may, under the bill, be officers in the armed services. I have no doubt that the Commission will and should pay a great deal of attention indeed to the military aspects of this subject in the years ahead of us.

Mr. JOHNSON. Is it your view, then, that it is so dangerous to our security and our national life at the present time that we cannot afford to let it get out of control; that some power, either military or otherwise, must control it absolutely?

Dr. BUSH. I think it should be controlled absolutely. I would rather see narcotics sold without limit and without control.

Mr. JOHNSON. Is it your view that you should trust to a university to experiment with something that may get out of control and may injure people?

Dr. BUSH. I fear that if there were no control of experimentation, some well-meaning but careless or ignorant people might perform experimentations that might be very dangerous indeed to the national safety.

Mr. JOHNSON. Do you mean that the experimentation itself will be dangerous, or that it will get into the hands of some hostile persons?

Dr. BUSH. The experimentation itself can be very dangerous indeed, if a substantial amount of atomic energy is released.

Mr. JOHNSON. During the development of this problem was there any loss of life?

Dr. BUSH. I believe there was no man lost by any accident inherent in the nature of the work. There were some men lost on construction, but they were construction accidents. I do not remember any instance of any man being killed by reason of the fact that he was

working on atomic energy as contrasted with working on something else.

Mr. JOHNSON. One other question. When you were up here talking about the National Academy of Sciences, in connection with the bill that we had here, did you have some of these things in mind then?

Dr. BUSH. I have not had anything more prominently in my mind in 5 years.

Mr. JOHNSON. Will the other bill be strong enough and broad enough to handle this?

Dr. BUSH. We have, sir, at least four bills on that subject at the present time.

Mr. JOHNSON. I am talking about the one we had before our committee.

Dr. BUSH. You had before your committee the May bill. It was set up to perpetuate the Research Board for National Security. That Board is in existence. It is at the present time being asked by the Secretaries of War and Navy to make a very comprehensive study of the problem of research on military weapons; and I believe that it can perform no greater service than to make that study at the present time. However, we have all understood that that organization was set up as a temporary organization to fill a gap; and that ultimately we should have, by some form of legislation, a permanent agency for research in this country; not as a continuation of the Office of Scientific Research and Development but to perform in peacetime those necessary functions in research in which the Federal Government should directly participate. There are several bills for that purpose. I recently made a report on the subject. My particular recommendations have been embodied in bills introduced by Senator Magnuson and Representative Mills. I hope those bills will be enacted, because I think we need that type of organization in this country. But I do not believe that there is any conflict between the foundation we would have then established and this Commission, for the reasons that I have stated.

To go into that for just a moment, this Commission is primarily a controlling and regulatory body, which will be created to handle these plants, to do the development that is needed in those plants, to control, license, and so forth. It is enabled to do such research as in its opinion it should carry on. But I believe that if a Federal research agency is set up for the explicit purpose of furthering scientific research in this country, the Commission will be very glad to lean upon that organization to carry on those parts of the research that are fundamental.

Mr. SHORT. But the chief functions of the Commission are administrative rather than experimental?

Dr. BUSH. Yes, sir. In my opinion, the chief objects of the Commission are to regulate and to control.

Mr. JOHNSON. While this bill is for internal security, you realize that you could have a situation where the President could give away the secrets if he wanted to?

Dr. BUSH. You have that situation now, so far as I know. I do not see that this bill will affect that one way or another. This bill says specifically that the Commission shall do nothing of that sort. That is limiting on the Commission. It says nothing else about the subject.

Mr. ELSTON. Doctor, it seems to me that our greatest concern is not so much the developing of atomic energy in this country as the developing of it in other countries. This bill does not regulate that at all. Why do you feel, for example, that American industry cannot be trusted with the development of atomic energy as the colleges and universities?

Dr. BUSH. I did not say so, sir.

Mr. ELSTON. You said you had all faith and confidence that the colleges would go ahead and develop this, under proper licenses, and that you had no fear that the personnel of the colleges, either the student body or professors, would reveal any secrets or do anything that would be detrimental to this country? Why cannot the same thing be done in private industry?

Dr. BUSH. It can. You are the first one that asked me about that. Now that you have brought it up, I would say also that American industry has a very fine record in this war in having kept its secrets well. It has certainly demonstrated during the war that it can be trusted with secrets.

Mr. ELSTON. Do I understand that the greatest fear is that if this is developed without all this grant of power people might be injured by dangerous experiments? Or just what is your fear?

Dr. BUSH. Well, there is plenty to fear. One fear that I have is that someone, thinking that he had a new idea on this subject, might start experiments in an attic with the idea that he would develop a new commercial process, and the result might be that he developed so much radioactive energy from this fission process that he would sterilize, perhaps, all of the passers-by. That is entirely possible. I think that sort of thing needs to be regulated by the Federal Government.

Mr. ELSTON. We now have bodies which regulate communications and everything of that kind, but we do not have to resort to any extreme grant of power as we do in this bill in order to have the kind of control you just mentioned.

Dr. BUSH. Communications, Mr. Elston, have their danger; but it is danger of a different order and nature from the dangers involved here.

Mr. ELSTON. Persons may experiment with electricity and with other things that accomplish the result you speak of?

Dr. BUSH. In experimenting with electricity they might possibly electrocute themselves. I can conceive that they might kill one or two people, but I see no possibility that anyone experimenting with electricity could blow up a section of the town or poison a whole neighborhood, and I do see those possibilities here.

Mr. ELSTON. You say it is impossible to regulate it except with these extreme and unprecedented grants of power?

Dr. BUSH. I say that I believe that in the regulation of a thing that is as important and dangerous as this, we need to be sure that the commission charged with the job of regulating has ample powers with which to do the job; and if we are going to err on either side I would err on the side of giving them too much power rather than too little.

Mr. ELSTON. You realize, of course, that this bill completely nationalizes the use of atomic energy?

Dr. BUSH. Yes, sir. That is the intention.

Mr. ELSTON. For commercial purposes as well as for purposes of national security?

Dr. BUSH. It places all commercial operations under Government license in this field; yes, sir.

Mr. ELSTON. Completely and absolutely?

Dr. BUSH. Under Government license; yes, sir.

Mr. ELSTON. Was there ever a time when it was necessary to place any other type of energy under the same rigid controls?

Dr. BUSH. Well, I do not think anyone can manufacture military explosives in this country without controls; but a military explosive is a very gentle thing compared with this explosive.

Mr. ELSTON. The question is whether you have to completely nationalize its control in order to have proper control.

Dr. BUSH. I think you have to.

Mr. ELSTON. Take oil, for example. You could not conduct the war without oil; yet we never attempted to completely nationalize the control of oil, and we got along all right, did we not?

Dr. BUSH. Yes; but you have long controlled narcotics by Federal control which is very rigid; and there are other things that affect the public safety which the Federal Government controls.

Mr. ELSTON. We do not control narcotics by any different method than you would control any other crime; that is, by enacting a statute which makes the use of narcotics an offense.

Dr. BUSH. Without a license. That is right.

Mr. ELSTON. You did not have to completely nationalize anything in order to accomplish that.

Dr. BUSH. I think the conditions are fairly parallel. Under this bill an industry can develop, when the time comes, atomic energy for commercial purposes. It can do that in a commercial manner, provided it is licensed to do so and, under the license, inspected in order to be sure that it is not endangering the public safety.

Mr. ELSTON. Under this bill could you grant to one company, say, General Motors, a license to experiment in the development of atomic energy, but deny a license to Chrysler?

Dr. BUSH. That is right; you could.

Mr. ELSTON. Do you think any board should have that power?

Dr. BUSH. Well, I think the board is bound to have that power. Someone is bound to choose which companies can be relied upon to do this well, which companies that wish to do it. I would depend upon having a Commission of such standing that they would use no discrimination that would be unfair; but they certainly must be enabled to use such discrimination as is necessary to promote public safety.

Mr. ELSTON. Suppose a company that claimed it was being discriminated against wanted to appeal from a decision of the Commission; is there any appeal under this bill?

Dr. BUSH. I do not see any specific provision for it.

Mr. ELSTON. You think that is a good idea?

Dr. BUSH. I see no harm in it.

Mr. ELSTON. There is no opportunity for appeal to the court on the ground that the Commission has exceeded its authority or abused its discretion?

Dr. BUSH. There is always a right of resort to a court if there is an abuse of authority or acts not contemplated by law. In this case

there is no need for special provision for this reason: What injury is being done to a company if it is not allowed to appear in this field? This entire field was developed with Government money and at Government expense. As it stands at the present time it was wholly put in its present situation by reason of experimentation carried on with Government funds to the extent of a very large amount of money indeed. If some company is now denied the right to appear, if some group wishes to utilize this knowledge but is denied the right to do so, nothing is being taken from it.

Mr. ELSTON. Yes, something is being taken from them, and that is their opportunity to develop an energy which would be of incalculable value to industry and to the Nation. That is a lot taken from them.

During the war private industry experimented with all types of weapons, with all types of explosives, and there was no control, was there?

Dr. BUSH. There was very rigid control, of course.

Mr. ELSTON. So far as development was concerned?

Dr. BUSH. Yes, sir.

Mr. ELSTON. What controls were placed on them?

Dr. BUSH. The controls exercised by my office were as complete as this: Any contract which we entered into was entirely under the supervision of the scientific officer named by me for that purpose. The contractor performed his work at all times subject to the full knowledge and approval of that officer, and there was always provision in the contract for termination on 30-days notice of any contract.

Mr. ELSTON. That is an entirely different thing. That is where there is a contractual relationship between the Government and the party where the Government was paying the bill.

Dr. BUSH. That is the way all research on weapons was conducted during the war, which I thought was your question.

Mr. ELSTON. Any company that was not under contract had a right to conduct any experiments it saw fit?

Dr. BUSH. I do not know of any companies that were working on the development of weapons during this war except under Government auspices.

Mr. ELSTON. That was because we needed them all; but this would deny them that right.

Dr. BUSH. Except under license, which I judge the Commission would exercise with due discretion and due fairness.

Mr. ELSTON. You do not know that it would be due discretion or that it would be fair.

Dr. BUSH. There is no guaranty of fairness, sir, except to get a commission of the highest possible caliber.

Mr. ELSTON. We provide for appeals to our courts of appeal, not because of unfairness but because they might be wrong.

The CHAIRMAN. Let us not argue with the witness. Ask him questions.

Mr. ELSTON. He is getting along all right. We will not have any trouble. It is very interesting to get his viewpoint about these things.

Now, Doctor, Mr. Johnson asked you about control over the sources of atomic energy. Those sources are very vast, are they not?

Dr. BUSH. You mean the extent of ores and materials?

Mr. ELSTON. The sources of atomic energy.

Dr. BUSH. The ultimate source is the material.

Mr. ELSTON. Those materials are what?

Dr. BUSH. There are only two named here, uranium and thorium.

Mr. ELSTON. But it extends to ores?

Dr. BUSH. The ores of those materials.

Mr. ELSTON. Does it extend, for example, to coal?

Dr. BUSH. No, sir.

Mr. ELSTON. As to any other ores or anything else that it did extend to, this Commission would have control over it, would it not?

Dr. BUSH. Yes, sir.

Mr. ELSTON. Complete control?

Dr. BUSH. Yes.

Mr. ELSTON. Although those same ores might be used for countless other purposes?

Dr. BUSH. No, sir. I know of no other use for uranium ore, except this, for which we see any commercial importance or significance.

Mr. ELSTON. Are they not experimenting to see whether or not this atomic energy may be gathered from other things?

Dr. BUSH. Oh, yes.

Mr. ELSTON. So it might be found in coal or in oil or other things?

Dr. BUSH. I think it is exceedingly improbable, sir.

Mr. ELSTON. But if you do not experiment, you are not going to find out, are you?

Dr. BUSH. That is right.

Mr. ELSTON. If it did develop in something else, this Commission would technically have control over those materials?

Dr. BUSH. Yes, sir; if you found other materials that were a source of power by the process of atomic fission, this Commission would have control. In my opinion, it is exceedingly improbable that other materials than uranium and thorium will be found to have those properties.

Mr. ELSTON. Do you know of any reason why the War Department and the Navy Department cannot proceed to conduct experiments just the same as they did during the war in the development of the atomic bomb? Why is it necessary to take it away from those services and put it into the hands of a civilian body?

Dr. BUSH. The War Department itself has recommended transfer to a civilian body. I think that is a very wise move on its part, and I think that really it is fortunate in having had a Secretary of War, and having him replaced by another Secretary of War; both of whom took such a broad-minded view as they did toward this subject. The War Department itself wishes this transferred to a civilian commission, because it believes, and I agree, that that is the proper way to control it in peacetimes. I thoroughly agree that it should be a civilian commission. I hope and trust that that Commission will not neglect the military aspects of this subject. I am sure they will not.

Mr. ELSTON. The War Department is subservient to this Commission. As a matter of fact, this Commission could refuse the War Department and the Navy Department the right to go ahead with experiments in the development of this, could it not?

Dr. BUSH. I believe it could, as far as this particular type of weapon is concerned.

General ROYALL. Except in time of war, or with the approval of the President.

Mr. ELSTON. You do not wait until the war starts to develop your weapons. You develop them in time of peace.

Dr. BUSH. I should have no fear, sir, that this Commission would prevent the War Department from experimenting.

Mr. ELSTON. But the War Department and the Navy Department would have to get permission from this Commission in order to proceed to develop any weapons, growing out of atomic power and energy?

Dr. BUSH. That is right.

Mr. ELSTON. Do you think that is a wise provision?

Dr. BUSH. I do not think it is necessary to put in the bill that the Commission must extend that permission. I cannot conceive that the Commission would deny permission to the War Department or the Navy Department to continue research on important atomic weapons.

Mr. ELSTON. The War Department has to come to the Commission to get the permission?

Dr. BUSH. I think that is very wise, in order that the Commission may have in its hands the entire information, the entire knowledge of what is going on, in order that it may properly correlate experimentation in military fields with experimentation aimed at ultimate commercial ends.

Mr. ELSTON. Do you subscribe to every part of this bill?

Dr. BUSH. Yes, sir.

Mr. ELSTON. Even this part that gives the President the right to give away atomic bomb secrets?

Dr. BUSH. I do not find that in the bill, sir.

Mr. ELSTON. Let me find it here. It says he may give it to other nations.

Dr. BUSH. I did not find that in the bill.

Mr. ELSTON. It is here.

Dr. BUSH. I find in the bill a statement that the Commission shall not divulge this information. I find nothing in the bill that says anything about the President.

Mr. ELSTON. There is a provision in the bill, but I cannot find it at the moment. But, if it is in here, do you think that is a good provision?

Dr. BUSH. I would call that a hypothetical question.

Mr. ELSTON. It is here all right.

Mr. ARENDS. The President could divulge it now if he wanted to.

Mr. ELSTON. This is the provision: "The Administrator is authorized"—I am reading from the summary, now.

Dr. BUSH. Where are you; on what page of the bill, please?

Mr. ELSTON. It is page 19. It is section 11:

(a) The Administrator is authorized to license any or all of the property available to the Commission, without regard to the provisions of the Surplus Property Act of 1944 or of any other statute, to any person or Government agency for (1) research and experimentation in nuclear fission or the transmutation of atomic species; (2) the development, exploitation, and use of processes or methods for the release of atomic energy; (3) any use of such property where it is deemed advisable for the purpose of this Act to retain control or supervision in the Commission over the property, its utilization, or disposition; or (4) any other purpose incidental or related to the purposes of this Act. No such license for purposes (1), (2), or (3) shall be given by the Administrator to a foreign government or any person who is not under and within the jurisdiction of the United States, without the approval of the President of the United States.

Dr. BUSH. Yes, sir; and I say that that is limiting upon the Commission, and in no way creates powers of the President of the United States.

Mr. ELSTON. But if the President of the United States and this Commission decide they want to give the secrets of the atomic bomb to any foreign country, it may be done.

Dr. BUSH. That is right, and the President can do it now without the Commission.

Mr. ELSTON. Do you not think it would be better if it were with the permission of Congress?

Dr. BUSH. I do not think that subject is before us, sir.

Mr. ELSTON. You said you approved of every paragraph of the bill.

Dr. BUSH. The bill has to do with internal control, sir, not with foreign relations.

Mr. ELSTON. This part deals with foreign relations, the part I just read. The question is whether you do not think that it is a wise provision that that be vested in Congress.

Dr. BUSH. I think it would be very unwise, sir, to deal in this bill with all of these difficult questions of foreign relations. The President has said that he is going to send a separate message on that subject. That is a very important matter indeed, which will require a great deal of discussion and thought in this country. I believe that this bill ought to be concerned with internal controls, that we ought to get it into operation for the internal controls, for which we need it very, very much indeed, and then we should approach the whole problem of foreign relations deliberately and properly, but I think it would be a great mistake to confuse this bill with that subject and thus to hold it up for a long time.

Mr. ELSTON. Aside from making appropriations and passing this bill, Congress has nothing to do with the whole matter of atomic energy, has it?

Dr. BUSH. No; but that is a very large exception, sir, as I know very well.

Mr. ELSTON. All right, that is all.

The CHAIRMAN. Mr. Holifield, have you any questions?

Mr. HOLIFIELD. I would like to ask Dr. Bush a question.

This question of national control has been discussed, Dr. Bush. In your opinion, if national control were vested in the Federal Government, would it not tend to prevent a monopoly of the use of it by any private patentee of any particular process? In other words, if research were done by any individual industrial company, that research would be made known to this Federal body, and any corporation in the United States that could come with clean hands before that Commission would have a right to use that knowledge where, if the secrets of the atomic power and energy were developed by an individual corporation without governmental control, they could so control it through the patent laws that it would automatically become a monopoly and therefore work a discrimination on any other corporations that wanted to use it.

Dr. BUSH. You will notice that this bill provides very definitely that the Commission can take over any patent in this field. I think that that is a wise provision. It would be very unfortunate, I think,

if we had a race among industrial organizations in this country on a patent basis for control of a process of this magnitude and importance.

Mr. HOLIFIELD. I agree with you perfectly, and it seems to me that so far as widespread commercial use is concerned of any of the benefits of this energy, it is more liable to accrue under a Government licensing system than under a private patent system, because through private patents monopoly is created, and discrimination against wide diffusion is also created.

Dr. BUSH. Of course, I am a great believer in the patent system, and I think it has been of enormous benefit to this country in times past, but I do not believe that it ought to operate in this field.

Mr. HOLIFIELD. In dealing with this we are not dealing with oil or coal or something that does not have within itself an inherent danger to civilization.

Dr. BUSH. No; and again, we are not depending here upon the initiative of industrial concerns to break new ground and open up new areas to anywhere near the extent that we are ordinarily in a new field, because Government has already broken the way.

Mr. HOLIFIELD. And is it not true that under Government supervision and financing we will get further in research and development of this thing, because Government, after all, is the only one that is financially able to go into this field and do it, and, therefore, that will be the quickest way to bring the benefits of this to the domestic scene?

Dr. BUSH. I think so, although let me repeat again that I think the time is still quite far distant when there will be any substantial influence of the use of atomic energy upon your daily life or mine. I think the potential importance is great, but the time before that comes into effect is long.

Mr. HOLIFIELD. I want to refer to one of the first clauses here in the bill, in which it says "insure the national safety." Can you conceive of us securing the national safety without cooperation between this Commission and the War and Navy Departments?

Dr. BUSH. No; I cannot.

Mr. HOLIFIELD. The question was brought up that you had a right to withhold this, but if you followed out the purpose of this bill, to insure the national safety, you would automatically cooperate with the Army and Navy and other defense agencies.

Dr. BUSH. The language runs all the way through the bill that indicates that it was expected that this Commission will further the military development of this weapon.

Mr. HOLIFIELD. We are dealing with a subject that is so big, and of such pioneer impact, that the ordinary laws relating to commerce, patents, and so forth, must be conceived in their relative insignificance with the subject under discussion.

Dr. BUSH. We are entering a new world. We are entering a new world that is very different from the one from which we emerged.

The CHAIRMAN. Any further questions, Mr. Price?

Mr. PRICE. No.

The CHAIRMAN. Dr. Bush, I want to make a statement here for the record, to the effect that this committee on two occasions passed legislation completely nationalizing one industry and taking it over. That is the helium industry; and in addition to that, it passed an act

before we even got into war prescribing a license system for scrap iron and steel shipments to foreign countries, neither of which was anything in comparison with this.

Thank you very much, Dr. Bush.

Now, gentlemen, we are favored with the presence of Dr. James B. Conant, the president of Harvard University. Dr. Conant, we will be very happy to have you discuss this subject with us, and appreciate having you here.

**STATEMENT OF DR. JAMES BRYANT CONANT, PRESIDENT OF
HARVARD UNIVERSITY**

Dr. CONANT. Thank you, Mr. Chairman.

Mr. Chairman and members of the committee, I shall try and make my remarks as brief as possible.

Together with Dr. Bush and as his deputy, I was associated with the early days of the development of the atomic bomb, when this work was done as part of the Office of Scientific Research and Development. Later I had the privilege of assisting General Groves in connection with certain phases of that vast undertaking, which he so successfully brought to a dramatic conclusion. I was also a member of the interim committee which prepared in the first instance the legislation which is before you.

I should like to associate myself with Dr. Bush in the statement which he has made to you. The need for this legislation, as has already been said, is obvious. The bill has been drawn with great care, taking into account the point of view of the type of people who will be affected by it: scientists, engineers, business executives, administrative heads of universities, and nonprofit scientific institutions. I think all that I could add to the discussion in these few remarks of mine is to try and emphasize two points brought out by Dr. Bush; first, the need for the extraordinary powers which are to be given to this Commission, and they are very extraordinary and unusual, as has been brought out in the questions from this committee; and second, the need for prompt action.

Speaking to the first subject first, I should like to call the attention of the committee to the first section of this bill, because it seems to me that has not been emphasized enough, perhaps, in the discussion, Findings and Declaration of Policy, section 1. The second sentence says—

The proper development and utilization of such energy will advance the national welfare, secure the national defense, insure the national safety, and promote world peace, to an extent and by means which cannot now be measured. The misuse of such energy, by design or through ignorance, may inflict incalculable disaster upon the Nation, destroy the general welfare, imperil the national safety, and endanger world peace. In the highest national interest, and to protect the national existence, it is essential that all further development and exploitation of this newly tapped source of energy be centrally directed and controlled for the benefit of the entire Nation.

It is very difficult, gentlemen, to one who has been so closely associated with this project so long, to try to convey to you my feeling as to the importance of those few sentences which I have read. As Dr. Bush has said, we are entering into a new world. Nothing like this has happened in the course of science or invention, unless it

be the invention of fire itself in prehistoric times. This is an extraordinary bill, drawn for extraordinary circumstances. It is not just another commission.

Perhaps you could realize the potential dangers to the Nation—the potential good, also—for civilization that may be involved in this tremendous energy, only if you had been, as I was, at the test of the bomb at the Alamogordo Air Base on that morning in July, and seen the effect, that tremendous illumination that burst all over the sky, which so surprised even those who had been anticipating the explosion and knew all about it in advance.

We are dealing here with something that is so new, so extraordinary and so powerful, gentlemen, that I, for one, feel that we are justified in setting up a commission with equally extraordinary powers.

Second, as to the need for prompt action, I hope this bill will be passed by both the House and Senate and made law as soon as possible, for I know from personal observation with the scientists with whom I have been associated in connection with my assisting General Groves, the present state of unrest and uneasiness which exists throughout the project, and which is losing us time and monumental effort. It is costing the country, from the point of view of getting ahead in further development of this weapon, and from the point of view of cutting down the time, whether 10 years or how long, the time when this energy can be used for peaceful purposes. There is also the possible loss of security. Present regulations under which the Manhattan district project is operating are based on war powers and do not give so much security on information as I think we should have, and I feel sure that this bill would provide it if it were passed. There is more of a chance of the secret's leaking away to some other country than if this legislation were now law.

And then there is the possibility—I do not know how great—that as long as the situation is in its present fluid and uncertain state, with the knowledge that this can be done, and published, of course, as a result of the two bombs, someone can initiate private research along these lines and step into a situation through patents or control of a certain know-how without the Government's knowing it, and perhaps jeopardize security, perhaps secure an unfair advantage.

Finally, there is the whole situation in regard to the basic research, the scientific knowledge in our universities. As Dr. Bush pointed out, this whole bomb was possible because of certain fundamental discoveries in basic physics which were made by men all over the world, in the laboratories of physics and chemistry, and it is that basic knowledge which must be extended in this country if we are going to progress in the use of atomic energy for peacetime purposes.

At present every university laboratory which is concerned with this subject, and they would all like to be, is in a position of stalemate. They cannot move; they do not know what the Government policy is going to be. They are not sure that the Government is going to allow any experimentation. I can illustrate it by a personal story, if I may.

One of the brilliant young men in this project who would like to devote his life to this subject, and who might make great advances if permitted to continue, said the other day that he was not at all sure he was going into university work. He thought he would go into

industry in another field, because he said the Government has not declared that it is going to do this work and, he said, "What is the use in my working on a subject if the Government will not let you do anything about it?" That reflects the point of view of a certain number of people.

So I sum up, gentlemen, by saying that I feel that the extraordinary powers granted to the Commission are justified by the extraordinary nature of the situation, and urge you to take as prompt action as you can.

That is my statement, Mr. Chairman.

The CHAIRMAN. Thank you very much, Dr. Conant.

I would like to say for myself, and speaking I think for this committee, that they are awfully proud of our country, with its scientists that have been able to accomplish so much in advance of our enemy. I can remember when I was a small boy, the first weapon I ever bought was a bowie knife. That was a two-bladed knife with a horn handle, and it was made in Germany. Ever since that day I have been led to believe that the greatest scientists of the world were in Germany, and they were ahead of all the rest of the world. I think now we have outclassed them through the leadership of yourself, Dr. Bush, and the War Department.

Dr. CONANT. Thank you.

The CHAIRMAN. Are there any questions?

Mr. CLASON. What type of commission organization will you have in the event that this becomes law?

Dr. CONANT. I really could not tell you. Do you mean the details of how the Commission would operate?

Mr. CLASON. No; how large an organization would be necessary to carry out the purposes of this bill?

Dr. CONANT. You really could not answer that until you learned how the Commission is going to decide a number of fundamental problems. It would have to take evidence from the scientists on the job. You will understand that my connection is such that I have been in touch with the scientists who know this sort of thing. If I were sitting on the Commission, for example, I should want first of all to find out what the various scientists in charge of the different compartments of the work to be done said should be done next, see what their budget was, the size of the plant, what is their next problem. I do not have the evidence on which to base an answer. I doubt if there is evidence available.

Mr. CLASON. How many persons have been employed in the development of this atomic bomb?

Dr. CONANT. I am afraid I do not know that. General Groves would know it. I do not. It is a very large number. It has been published. There is a break-down into scientists, technical men, assistants, operators, and so on. It is many thousands, I suppose.

Mr. CLASON. Would you assume that the properties which are now used in connection with the development of the atomic bomb would remain in Commission in the development of the atomic bomb further, and other uses for atomic energy?

Dr. CONANT. That I think you would have to tell by weighing the efficiency of the different plants and methods. It has already been stated in a public release that there are several ways. One would

have to make a study of that, and I could not answer your question in advance of making such a study.

Mr. CLASON. As I understand it, the important elements are two, both ores; is that right?

Dr. CONANT. Those two ores are very important at the present status of the work. That is correct.

Mr. CLASON. As I get the power of condemnation on page 15, they can condemn minerals, metals, ores, and other substances, and materials, real property, and everything. They could take over the entire field of petroleum, on the theory that this oil is necessary to run the machinery to run the plants that run the atomic energy.

Dr. CONANT. Not if I read the bill correctly. It is line 10 on page 15, is it not, that determines the powers of the Commission in that regard? They can do the things you mention which, in the judgment of the Commission, are peculiarly related to the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy.

Mr. CLASON. In other words, the Commission is the sole judge. There is no court that can pass upon it whatsoever; there is nothing that you can say that you can take to a higher tribunal. They can decide in their best judgment that they ought to take over helium or something else. They probably would not start with oil, because that would be obviously a very large and important segment of our domestic economy. But they might very well commence with going into other fields, on the theory that there might be atomic energy involved, and there would be no check on this Commission at all.

Dr. CONANT. I wish you would ask a lawyer that question. I am told by those who studied this that there would be a check, that you could come into court if you felt the Commission were trying to take over something that was not peculiarly concerned with the transmutation of atomic energy, and you would have a hearing, and thereafter it would be for the court to determine whether the judgment of the Commission had been reasonably carried out.

The words "peculiarly related to the transmutation of atomic species", if interpreted correctly, would enormously limit the field and would rule coal and oil and all those things out completely.

Mr. CLASON. You do not think there would be any possibility of oil or coal being included?

Dr. CONANT. None. I think there is a very important, and I believe sufficiently binding limitation, but of course on the law I bow to the opinion of lawyers.

Mr. CLASON. In this bill, will you tell me what the relationship would be between the Government and institutions like colleges? I do not mean research laboratories of private individuals, but, on the other hand, those of colleges. Do I understand that they would expect to receive some money to interest students and sort of develop the scientific branch of that particular university?

Dr. CONANT. No; I do not see anything about students in the bill at all. I should suppose that the Commission here, under the authority, which I cannot turn to for the moment, would have to license those universities. That was brought out this morning, I think, in the testimony of General Groves. Those universities where there is experimentation on transmutation of atomic species, the

production of nuclear fission, or the release of atomic energy would be included. That is a general phrase that covers this whole field, so far as anybody can see.

It is page 22, subsection (d), to which I should like to call your attention:

It shall be unlawful for any person to conduct research or experimentation involving the release of atomic energy in amounts deemed and to be prescribed by the Commission as constituting a national hazard or being of military or industrial value, without the consent * * *

And so on. So if an experiment were going on in physics which obviously did not involve a national hazard, was not of military or industrial value, or did not release any large amount of atomic energy, the Commission would presumably not pay any attention to the physics department. It would do so only if they were doing it on a large scale.

It has been suggested to me that you were referring to another section. I am sorry.

Mr. CLASON. I had in mind page 17.

Dr. CONANT. May I turn to that?

I think the advantage of having that in, just as with the provision I read, is to allay any thought on the part of the people in either universities or industrial concerns that this Commission was not going to try to do all that it could to encourage research under license, so that people would go ahead and make these discoveries in the best way possible.

Mr. CLASON. I was wondering, there. It says, "to utilize, encourage, and aid colleges * * *," and it occurred to me that that kind of language represented a little gift or grant from the Federal Government, but I understand from your testimony that you would expect the colleges to pay their own way on this research, experimentation, and teaching of the student body.

Dr. CONANT. On the last part. I would like to separate them, if I may. On the teaching of the student body, certainly; and on ordinary research. But if they were going in in a large way, into research that involved a lot of people and a lot of equipment, I think they might very well need Federal aid, which might flow this way or, as Dr. Bush has pointed out, through the other bills he spoke of, and which are now before Congress. I think if this thing were to be done in a big way in some universities it might need some Federal money.

Mr. CLASON. Then would you not think it would be only fair that all scientific schools and all colleges that are equipped to teach physics ought to receive a license or a permit to carry on the studies?

Dr. CONANT. Oh, I assume they would. It never occurred to me that they would not.

Mr. CLASON. There would be no limitation there?

Dr. CONANT. No; except for control; and any well-established place should carry on such studies. They would have to check in, however, to show that they were not going to run something that would blow up the college town or poison the inhabitants.

Mr. CLASON. I get the impression you take an awfully little piece of atomic energy and have a pretty big explosion. Do I understand you can work with it in such small quantities that if it goes off a whole lot does not go off with it?

Dr. CONANT. Yes. For me as a chemist it is as unbelievable as for anybody else, because this is the work of physicists. They can actually come pretty close to handling individual atoms. Some of their transmutations which took place and showed the possibility of getting atomic energy from a transformation of one kind of atom to another were actually done with only a few atoms, and the results were recorded by instruments and photographic plates, so that if you construed any act governing atomic energy very closely, you could say that even those experiments involved the release of atomic energy and, of course, they were perfectly harmless and they were done for years. The results were recorded by instruments and on photographic plates. It is only when you come into the realm of the material which the chemist deals with that you begin to get into hazards, and it is with that intent in mind that all this material was put in here.

Mr. CLASON. It is possible to have enough of the elements in the possession of the Government to turn them over to these colleges so that there will be enough to go around?

Dr. CONANT. Oh, yes; I think so. That, of course, is one of the things that the Commission would do. It would allocate materials, and that is one of the reasons the universities and industrial concerns are anxious to get some legislation established, and some authority, so that the green light can be given, licenses can be issued, and we can get ahead with this development.

Mr. CLASON. Then I understood from what you stated that you felt that 10 years might pass before any peaceful or useful purpose could be developed from atomic energy.

Dr. CONANT. Those 10 years were first mentioned by General Groves and spoken of by Dr. Bush. I do not know. It certainly is not going to happen tomorrow. I should be surprised if within 10 years there has not been some industrial use of this whole subject of atomic energy, but it will be a gradual thing. I think the impression that we do not want to leave is that within a couple of years everybody is going to be running automobiles with it, or anything like that. It is going to be a slow, gradual development, and no one can foresee the future, least of all in science and in technology.

Mr. CLASON. Will you tell us whether or not out of atomic energy at the present time any useful peaceful development has come?

Dr. CONANT. Certainly there has been none.

Mr. CLASON. The only known use for it at the present time is as a military weapon in a bomb?

Dr. CONANT. That is the only use of it that has been made. There might be a byproduct, but in that case it would be a byproduct in the sense that the radioactive materials—and I am not revealing any military secrets—have probably valuable uses for medical purposes, and to that extent you could say that the immediate future might hold some promise there, but that is not, strictly speaking, the use of atomic energy, but some materials made incidental to the release of atomic energy.

Mr. CLASON. Do I understand that from the expenditure of two and a quarter billion dollars up to the present time the only direct, tangible result has been the bombs which have been used in connection with the war, and there have been byproducts which have a value in medicine?

Dr. CONANT. I should say they would be negligible compared with the value which accrued to the nation by the dropping of the two bombs and the ending of the war.

Mr. CLASON. You would say at the present time the Government has developed nothing which it could turn over to industry to be used in any way for peacetime economy?

Dr. CONANT. As it now stands. They have the potentialities and beginnings of a great deal.

Mr. CLASON. They have the potentialities, but nothing has been developed far enough to be actually put into use?

Dr. CONANT. That would be my belief.

Mr. CLASON. Do I understand that you feel that this can be used ultimately or developed ultimately as a substitute for the types of engines which are used today, in case we run out of oil or coal or something?

Dr. CONANT. No; I would not want to predict as far ahead as that. I should think there would be some special supplementary uses for it as a source of energy, in special circumstances which I cannot foresee now. That is the way it would start. After all, all energies come in that way—special uses. Electrical energy first was used for very special things, where it would be better than steam. It will be a slow process.

Mr. CLASON. So far as you know, the Commission, if one is appointed, is not by virtue of this bill immediately taking possession of some valuable knowledge that is not generally known throughout the country, with the exception of its relation to war?

Dr. CONANT. That is correct, if you interpret the word "valuable" as being immediately valuable and rule out the value which is inherent in basic knowledge, from which something can be developed.

Mr. CLASON. Do you feel that the Government has now, with the expenditure of one and a half billion dollars in existing properties, expended all the money that is going to be necessary to continue its experiments and its work?

Dr. CONANT. Oh, no. Appropriations will be needed, of course, to implement this act.

Mr. CLASON. Can you give us any idea of how much of an appropriation you will expect the Commission to ask for in the first year after the passage of this act?

Dr. CONANT. I am afraid I cannot, for the reasons I gave. I am just not in a position to make those estimates.

Mr. CLASON. It would be a very large sum of money, would it not?

Dr. CONANT. I am not sure of that. After all, the word "large" has been changed around during the war as applied to sums of money.

Mr. CLASON. If you expended two and a quarter billion dollars in 3 years, as I understand it—

Dr. CONANT. That was for construction, of course, a large amount of it, as the general explained this morning.

Mr. CLASON. Would you expect any more construction to be necessary?

Dr. CONANT. Not on that scale.

The CHAIRMAN. Thank you very much.

Mr. MARTIN. Dr. Conant, I am interested in your comments about the young men who have been associated in this work, the Manhattan project. Has your force been demobilized pretty much by now?

Dr. CONANT. No. I have to speak here pretty much second-hand. You understand that these remarks would have to be addressed to General Groves, who has been in charge of it, of course. My information is from what I have heard from him, but it is my understanding that it has not been demobilized. Far from it.

Mr. MARTIN. This will enable the Commission to hold it intact and to build on from here?

Dr. CONANT. That is correct.

Mr. MARTIN. That is one of the urgent features of it?

Dr. CONANT. That is one of the arguments I am presenting for prompt action.

Mr. MARTIN. I have had some letters from young men working on this project, personal friends, who are wondering about the future of it and what they have to look forward to. They are naturally in a state of wondering what is ahead, for their own future occupation in this direction. That raised the other question I had in mind, and that is more nearly in your field, that of the universities and getting back to the rehabilitation of our research work in the universities of the country.

I gather from your testimony that you are particularly interested in seeing the Commission follow a rather liberal course in encouraging study in this field.

Dr. CONANT. Research in this field by all research institutes and the research staffs of industry as well.

Mr. MARTIN. The granting of these licenses to the educational institutions is more that of regulation in the interest of the national safety than it is to curtail or cut down the work in the experimental field by the universities?

Dr. CONANT. Quite.

Mr. MARTIN. With regard to this paragraph that Mr. Clason mentioned here, about aid to the universities, it is not your idea that this bill will be the vehicle for granting financial aid to the schools for that work, is it?

Dr. CONANT. I think it would be permissible, if I may use the word, as I read it. The Commission might decide they wanted to or not. They might do it directly or they might do it through the mechanism Dr. Bush spoke of when he was addressing you earlier.

Mr. MARTIN. The present situation, due to the war, is that of great need for encouragement of young men to go back into work of this kind. This undoubtedly would come in, or through individual work of the students through the GI bill, indirectly. Your idea is that the encouragement was more that of making the projects available, or in reach of the educational institutions, rather than individual help to the students.

Dr. CONANT. Yes. I had not thought of individual help to the students, or anything in regard to teaching, but if a research project were going on under a license, it might need Federal support.

Mr. THOMASON. What is the present supply of uranium, and where are the principal deposits?

Dr. CONANT. I am sorry I do not have that information.

Mr. HARNES. I would like to ask one question. It has not been made clear by any of the witnesses—maybe it is not proper for you to say—but could you give us a few more details on the effect of the

release of this energy, from your experiments in New Mexico and what you have learned from the two bombs that were dropped on Japan?

Dr. CONANT. Well, if I understand your question correctly, you are speaking of my statement that need of this legislation is very great because of the national hazard.

Mr. HARNESS. That is right.

Dr. CONANT. Therefore, let me distinguish between two kinds of hazard. One is the hazard incident to an explosion of the type which is brought about on purpose when you have an atomic bomb. I do not have to speak to that; the pictures have. It is an enormous explosion.

The other is the hazard which would be incident to an experiment that went wrong in industry or in a university laboratory, because, as it says here, of "ignorance or design." In that case the explosion would be of a different order of magnitude so far as its demolition on buildings and so on is concerned, an entirely different order of magnitude, but the health hazard would come from the materials produced, the rays and the radioactive materials which might be disseminated through the atmosphere. Dr. Bush spoke of the fact that a passer-by might be affected.

Mr. HARNESS. What would it do besides kill or destroy?

Dr. CONANT. That is all. It kills you. I do not know what more you want. I call that a major hazard to health.

Mr. JOHNSON. Do you think this development is more revolutionary than the discovery of gunpowder?

Dr. CONANT. I do. I would think so, because if you rolled together the discovery of gunpowder right up through dynamite and TNT into a couple of years, you would have had the same dramatic effect. You see, the development of the use of chemical energy was distributed over many centuries. If man had discovered gunpowder and woke up 2 or 3 years later and had all modern explosives, you would have a comparable situation. That is what has happened here—in a short time the enormous use of this energy in large amounts.

The CHAIRMAN. Thank you very much. We certainly appreciate your statement.

Secretary PATTERSON, will you come around, please, sir, for further examination? Mr. Thomason, have you any questions?

Mr. THOMASON. No questions.

Mr. CLASON. What I would like to know, if it is possible to secure it, Mr. Secretary, is how much money would be necessary in the way of appropriations during the first year after this bill is passed.

TESTIMONY OF THE HONORABLE ROBERT P. PATTERSON, SECRETARY OF WAR

Secretary PATTERSON. I have no idea, Mr. Clason. I can say this, that over the 3 years we have spent \$2,000,000,000. The bulk of that has been on construction, building and equipping two enormous plants and then a plant of somewhat smaller size in New Mexico. In fact, this high rate of employment that we have had on the project has been mostly on construction work. I think the high point was around 125,000 persons. It is way below that now.

Some question was asked here a few moments ago about the number of employees there. I am not certain of my figures, but the last ones I heard were about 60,000 now. Some of those are still on construction, but I recently went down there to the east Tennessee plant, called Oak Ridge. We call it the Clinton Engineer Works. I went down there 10 days ago. There was still some building going on there of an industrial character, but I should say that 90 percent of the building was done. That was what the great expenditure of funds was for.

Mr. CLASON. From your knowledge of the whole project, would you say that it would be in the interest of the Government to maintain in operation the various plants which the Government has been operating in connection with the development of the atomic bomb?

Secretary PATTERSON. I can only answer that this way, and with no particularly expert knowledge, that all of the scientists and engineers connected with the project are sure that some short cuts can be found, and that they will not have to pursue the same route, exactly, again, and that a great amount of economy and savings could be introduced if the thing were to be repeated with the experience of what they have done behind them.

Mr. CLASON. Do you feel that the Commission would have an employment list of perhaps 50,000 persons as they went ahead in the future?

Secretary PATTERSON. I just cannot say. My best estimate would be that it would be below that, but I would not know.

Of course, one of the great activities of the Commission, I am certain, will be to farm out portions of the research and development and practical application. There was some question addressed here a moment ago as to the part universities and colleges would play. I think, as Dr. Conant pointed out, that there are two sorts of activities. One would be the contracting by the Commission with certain universities for the carrying on in behalf of the Commission of developments in atomic energy, and then the other would be a license or permission, and the furnishing of materials, for others to go along and experiment and research on their own initiative.

Mr. CLASON. I think most Americans have the impression that it is only at these Government plants that there is the proper equipment and proper apparatus for continuing experiments with this peculiar atomic energy.

Secretary PATTERSON. A vast amount of work in this was done at certain colleges under direct supervision of the Manhattan Engineer District. The University of Chicago was one of them; Columbia, Princeton, California Tech, and California. A great deal of work was done there.

Mr. CLASON. I got the impression from reading the magazine articles that you still had to bring whatever they developed in these universities' laboratories into the central plant in order to get anywhere.

Secretary PATTERSON. That is true. The industrial development was in eastern Tennessee and in the State of Washington. That is true. The work in science was done at the universities, but that had to be translated into industrial use, and that was done at these large plants that I mentioned.

Mr. CLASON. Would it require the purchase of much real estate, do you believe, referring to this part on the right of condemnation all over the country. Do you have any idea that there is going to be any great amount of condemnation?

Secretary PATTERSON. No, sir; I would say not. If there are discoveries of the ores that are necessary, there would have to be some action on that line in order to control the substance that produces atomic energy, but so far as need of condemning real estate, taking it by eminent domain for industrial purposes, I would think that there was not much need of that. These plants that we have now involve very large tracts of land in Tennessee and Washington and New Mexico.

Mr. CLASON. It would be just a question of some uranium ore, or something other than uranium, being discovered, and then, to protect yourself, you have to buy it.

Secretary PATTERSON. I think so.

Mr. CLASON. Then I would like to know why, in this bill, it is felt that the expenditures of this Commission should not go through the General Accounting Office. We have had so many fights over that in Congress in recent years that it seems to me that—

Secretary PATTERSON. They go through the Accounting Office, all right. The only particular provision is that there shall not be disallowance of credit or withholding of funds. That comes back, Mr. Clason, to several other provisions of the bill that take this Commission out of the category of, oh, commissions like the National Battle Monuments Commission, and things like that, due to a feeling on the part of the interim committee responsible for the drafting of it, and the Secretary of War, and I believe of everyone connected with the project, that it is a matter of urgency, a matter of high national policy on safety and future welfare, that some leeway be given this Commission.

Mr. CLASON. Do you think yourself it is necessary to the extent that is involved in a provision of this type?

Secretary PATTERSON. Yes; I do; and I have no fears of any real abuse, no fear at all that they would try to take over the coal mines or the oil industry or any of those things. I do not think they would have any legal basis for it, and I am sure their common sense would tell them they should not do it.

The CHAIRMAN. John Lewis would not let them take over the coal mines.

Mr. KILDAY. Judge, I am interested in these eminent-domain provisions of the bill, because they are so broad and far-reaching. The only control placed on any of them is in the discretion of the Commission. Of course, we are dealing with a matter that is secret in all of its processes, so that we are creating by legislation a power of eminent domain controlled only by the Commission which we here create.

Secretary PATTERSON. The United States Government today, through the Post Office Department, can take over real estate for a post office in any location.

Mr. KILDAY. But it cannot take over all the real estate.

Secretary PATTERSON. They can take over and move in before the value is settled.

Mr. KILDAY. This says it can take all ores and minerals that in the opinion of the Commission are necessary. On the other one you have the question of public purpose, and that sort of thing. I do think that in executive session we ought to be able to get something from some of your legal staff to see if something might be done about that.

Secretary PATTERSON. They must be peculiarly connected.

Mr. KILDAY. In the opinion of the Commission.

Secretary PATTERSON. Yes. I think Dr. Conant pointed out that right now it is only thorium and uranium that are directly concerned.

Mr. KILDAY. And this Commission we create will, in the final analysis, be in complete control of it. Now, is it proper legislative policy for us to create a commission here to the extent that it becomes all powerful and supersedes the courts?

The CHAIRMAN. Let me ask this question, directed both to the witness and Mr. Kilday. Any condemnation under the power of eminent domain must be in accord with statute. This Commission could not go out and do it. They have recourse to the courts and there would be a judicial determination.

Mr. KILDAY. Here the public purpose passes out.

The CHAIRMAN. They have to find it for a public necessity before they can condemn it.

Mr. KILDAY. I think it is something we do have to consider.

Secretary PATTERSON. Some mention was made of the power of requisitioning this morning, and I said I did not recall in the Manhattan Engineer District a single case of requisition. In the War Department we had very few cases of actual requisition of personal property for war materials. Nevertheless the presence of that Requisition Act on the books had a wonderful effect when you had some fellow that was holding out for an outrageously high price. I mean by that that you were able to acquire the property at a fair price, where you would have had an awful gouging if you had not had that act on the books.

Mr. KILDAY. We have a new department here. We are going into the preservation of ores and minerals, and also the restriction of them from other people. We have an entirely new phase here.

The CHAIRMAN. Is there anything further, Mr. Durham?

Mr. DURHAM. What is the ratio between the civilian personnel and military personnel? What division was there?

Secretary PATTERSON. It was initially developed, of course, by scientists and taken over by Dr. Bush's Office of Scientific Research and Development, and when they were convinced that the theories of the scientists could be put to practical application in the production of atomic energy for a bomb or for a weapon of war, they recommended that it be turned over to the War Department, and at that point it was turned over to the War Department, I believe in 1942, and it has since been in charge of the War Department. But, of course, we have had a very large number of civilians working on the project—far more civilians than officers.

Mr. DURHAM. As to why I ask the question, I have quite a number of young doctors with doctors' degrees who have been farmed out there as privates, and they are still there. Of course, naturally, at this time they are wanting to get out and want to get some action somewhere, or something from this scientific branch to remunerate them so they can make a living.

Secretary PATTERSON. I will be glad to have their names turned over to General Groves. He may be able to use them.

Mr. MARTIN. Judge Patterson, with regard to the matter of appropriations here, I am not clear in my mind whether or not this bill, if enacted into law, provides that the appropriations under it would be charged up to the War Department.

Secretary PATTERSON. I hope not. One of the troubles we have now in getting appropriations is the large amount we have to take in for the Manhattan Engineer District, and if this bill passes, the appropriations for this project will go to the Atomic Energy Commission and disappear from our budget.

Mr. MARTIN. I am a little worried about that, too.

The other point is that this bill is following a pattern that is rather new in our experience. That is, it has no ceiling to it. When I first got on this committee, our general practice was to put some sort of a limitation on the over-all appropriations authorized. We had quite a battle on that early in the war because, being a war measure, we started taking the lid off. Immediately this committee lost all further control in the matter. In fact, it was then left entirely to the Appropriations Committee from there on, and this bill has that carry-over aspect on our wartime experience.

I just wonder if this is going to be a general practice of leaving the lid off wherever possible on authorizations.

Secretary PATTERSON. Our money does not come down to this committee. It would be all right with me if it did, but it does not.

Mr. MARTIN. The other question I had in mind was with regard to the penalties. I wanted to ask you about those penalties.

In your opinion, are they broad enough to cover all people, whether or not they have had any direct connection with the project or not?

Secretary PATTERSON. I believe so.

Mr. MARTIN. I wanted to be sure that they do have broad enough coverage in there to reach all individuals, whether they were over within the jurisdiction of the Commission directly or not.

Secretary PATTERSON. I believe they are broad enough.

Mr. MARTIN. That is all I have.

Mr. SHERIDAN. In your opening statement this morning you stated that many now attached to the Manhattan District project had left because of the vagueness of their future. How many are in that category?

Secretary PATTERSON. I do not know.

Mr. SHERIDAN. Have you any appraisal?

Secretary PATTERSON. No, sir. That was reported to me by General Groves.

Mr. SHERIDAN. Does General Groves have the figure?

Secretary PATTERSON. He will give it to you.

Mr. SHERIDAN. You also stated that much of the future experimentation will have to be farmed out to universities.

Secretary PATTERSON. I think it would be wise for the Commission to do it.

Mr. SHERIDAN. You said that is what it was proposed to do.

Secretary PATTERSON. They are directed by this bill to make use of existing institutions, and so on, insofar as feasible, and I am sure

that under that direction they would in fact contract out a great deal of work that they wanted to see pursued.

Mr. SHERIDAN. Would that not result in a most natural mathematical calculation that the project as it is now constituted would be reduced?

Secretary PATTERSON. That is quite possible.

Mr. SHERIDAN. So that those who leave now to private enterprise or go back to colleges would still be available?

Secretary PATTERSON. They are scattered all over. I think what General Groves is worried about is his organization, his team, with members, as he says, leaving, not pursuing the work as part of the team.

Mr. SHERIDAN. You do not have any knowledge of who have already left?

Secretary PATTERSON. No; I do not.

Mr. SHERIDAN. I am just trying to reconcile some of the statements that have been made here.

Have you any idea of approximately what the future appropriation may be with respect to this? Has there been any discussion as to the approximate amount?

Secretary PATTERSON. I have no idea as to what the appropriation would be. I have only pointed out that the bulk of the moneys that we have had appropriated to the War Department for this project went to construction, rather than to operation.

Mr. SHERIDAN. Approximately \$2,000,000,000 have already been expended; is that not true?

Secretary PATTERSON. \$2,000,000,000 is right.

Mr. SHERIDAN. How much remains that would be transferred over to the Commission? I see this bill provides for such transfer.

Secretary PATTERSON. I can find that out for you readily enough in the appropriation we have for the fiscal year ending June 30, 1946. There would be an item there under Corps of Engineers allotted for this.

Mr. SHERIDAN. What is that item? Do you know?

Secretary PATTERSON. No. I will have to find that out.

Mr. SHERIDAN. Does anybody here of your staff know?

Secretary PATTERSON. No. I can supply that. Of course, some of that has been spent already.

Mr. SHERIDAN. I figure that if we deduct that we will know how much remains that will be available for transfer.

Secretary PATTERSON. I can find that out for you.

Mr. ELSTON. Judge Patterson, I notice in this bill no provision is made for the War and Navy Departments to be represented on the Commission.

Secretary PATTERSON. Not directly; no. There is no requirement that they be represented.

Mr. ELSTON. Do you not think it would be a good idea that it be made mandatory that they be represented on the Commission?

Secretary PATTERSON. It was thought that if qualifications as to who could serve on the Commission were made it would ramify out and then there would be so many from industry, so many from labor, so many from the War Department, so many from the Navy Department, and so on, and that there would be no real play left there.

You will notice, Mr. Elston, that provision is made for the event of officers of the armed services serving on the Commission, because it provides as to what shall happen as to their still being eligible for pay, and there is mention made in several places in the bill of the military features of it. The very first section, containing the findings and declaration of policy, shows, in the final sentence of it, that the primary objectives of all action taken pursuant to this act shall be the promotion of the national defense, protection or the safety of the inhabitants of the United States, the safeguarding of world peace, and the furtherance of the acquisition of knowledge concerning atomic energy, and then the Commission is charged, over here, with safeguarding the national defense, and so is the Administrator, so that the phases of this work that relate to any military weapons are not lost sight of in this bill at all.

Mr. ELSTON. I appreciate that, but still that does not require the appointment of the Army or Navy personnel on this Commission.

Secretary PATTERSON. That is true.

Mr. ELSTON. Are you entirely in accord with the setting up of a Commission which might not have representatives of the War Department on it, to which Commission the War Department would have to go for authority to experiment in the development of weapons?

Secretary PATTERSON. Yes; I would abide by the wisdom and prudence of the Commission in that respect, particularly with these directions right in the law from Congress that they must promote the national defense.

Mr. ELSTON. That is a mere statement of policy, but there is nothing mandatory about it. You agree with me, do you not, that this bill, if passed, leaves out the War Department and the Navy Department entirely? They can only go ahead and develop weapons which are created through atomic power so far as this Commission gives them the authority to do it.

Secretary PATTERSON. There is an exception made here for time of war and national emergency, over here somewhere.

Mr. ELSTON. That may be, but most of your weapons are developed in peacetime and not in time of war.

Secretary PATTERSON. That is true.

Mr. ELSTON. You do not wait until a war is on before you develop them.

Secretary PATTERSON. I am entirely in agreement with you there, but I would have full confidence that the Commission would carry out the directives of Congress with regard to furthering national defense. It is not only in this preamble, section 1, to which I called attention a moment ago, but it is over in the provisions having to do with the powers of the Commission and also with the authority of the Administrator. I think it is section 10 on the Administrator, which mentions the exploitation and use thereof for military, industrial, scientific; or medical purposes, so that I am sure the military aspects of this measure have not been lost sight of. I quite agree with you that they are very important for the War Department and the Navy Department.

Mr. ELSTON. I am wondering if it would not be better for the bill to be drafted along the lines of our recent bill giving the Scientific Research Board and the Academy of Sciences power to receive appro-

priations from Congress to go ahead and make experiments and indulge in research work, but at the same time we took nothing from the Army and the Navy. They can go ahead and continue to have done the very fine work that they have been carrying on for many years. The other work is simply a supplement to it.

Would it not be better if this were set up as a supplement to the power and authority of the War and Navy Departments now existing to go ahead and continue research into the use of the atomic bomb or other atomic weapons in the national security?

Secretary PATTERSON. I would not have them do it independently of the Commission. I have no fear that the armed forces will not have the chance to assist in the development of weapons that use atomic energy under this bill and under the jurisdiction of the Commission.

Mr. ELSTON. But you are surrendering a lot of authority.

Secretary PATTERSON. We are surrendering the whole project thus far, because it has been the War Department's for the last 3 years.

Mr. ELSTON. Judge, did you participate in the drafting of this legislation?

Secretary PATTERSON. No, sir.

Mr. ELSTON. There is one provision that you perhaps heard me refer to before, and that is the provision that makes it possible for the Commission and the President to reveal the secrets of the atomic bomb to other nations.

Secretary PATTERSON. I recall the provision. Of course, the President has that power right today. The provision here is that the Commission shall not do it unless the President says so.

Mr. ELSTON. That means that if the President says so and six of the Commission concur, it can be delivered to some other country. Congress is left out of it entirely. Congress declares war and does a lot of other things in connection with the war, but it is deprived of the power and authority of passing on this very important question of whether or not this should be turned over to some other nation. It seems to me that that is more important than anything else, that these secrets do not get into the hands of other nations, yet that is not taken care of in this bill.

Secretary PATTERSON. I think that on all of these things on foreign relations we must bear in mind that the President indicated in his message that he would have more to say on the international aspects of this. This bill relates almost entirely to domestic control. I can conceive of conditions where it would be to our advantage to reveal certain matters, and the President has already said that he would not reveal the atomic bomb itself at all, but I can conceive of conditions where it might be to our advantage to reveal certain matters.

I think there was some discussion earlier about the employment of a foreigner by the Commission. I can conceive of cases where it would be to our own vital interest to employ a foreigner. I have no doubt that the Commission and the Administrator, too, would weigh the pros and cons of that very carefully, but we are indebted, heavily indebted, now, to foreigners for what we have done in the way of the production of the atomic bomb already. I would not want to see a square prohibition in this act against the employment of any person of foreign citizenship. I think we can safely trust the Commission, the people who administer the act, to employ them under proper condi-

tions, where they have a real contribution to make that perhaps our own citizens would not have. This knowledge is not confined to citizens of the United States by any means.

Mr. ELSTON. I am not referring so much to the employment of someone from another country, but this bill would make it possible, if six members of the Commission concurred and the President was agreeable, that the whole secret could be turned over to a foreign country.

Secretary PATTERSON. Mr. Marbury points out that it only says "licensed property."

Mr. ELSTON. If you give them a license you give them the secret. I do not think it makes much difference whether you give it to them one way or another, so long as they get it.

Mr. SHERIDAN. Will the gentleman yield?

Mr. ELSTON. Just a minute and I will be glad to yield.

The bill does make it possible to grant a license to a foreign country if the President approves of it. Now, in a matter of as great importance as this, do you not think it would be better that Congress approve of that, rather than the President?

Secretary PATTERSON. No; I do not. I think the provision as it stands is a wise provision. I think the power that the President has under our system in all kinds of ways, power involving the safety and welfare of the Nation, of his own determination, is proper.

Mr. ELSTON. You are familiar, of course, with the law that this Congress passed during the war saying that the President could not give ships belonging to the Navy to any foreign country. Congress did put some prohibition against the President in that respect. This is certainly of much greater importance than giving away some ships that belonged to the Navy.

Mr. KILDAY. Will the gentleman yield before he leaves that point?

Secretary PATTERSON. I do not think there is any real risk.

Mr. ELSTON. It might be better from the standpoint of the President. The President meets with representatives of foreign governments, and particularly right now they are asking for certain things, and some of them are granted and some of them are not. But they are rather insistent on certain things, and if we can believe some of the things that we have heard, I think it has even appeared in the press that some of these countries would like to have the atomic bomb secret. The President can say in those conferences, "I do not have the authority; that is up to the Congress." It would certainly relieve him of a tremendous amount of responsibility, and I think it would make the American people feel a little bit more secure.

Mr. KILDAY. Will the gentleman yield?

Mr. ELSTON. Yes.

Mr. KILDAY. This bill is supposed to take care of its control within the United States, and we are told there is going to be a request for other legislation with reference to foreign control. We set up here legislation with but one prohibition, that they shall not grant it to any other nation. It conserves it for the United States, and if it is to be used in international affairs, that is to be controlled by other legislation.

Mr. ELSTON. What I do not understand is, what is the objection to letting Congress approve of it, rather than letting the President have the sole authority?

Secretary PATTERSON. I suppose it is an Executive matter of management. As Mr. Kilday has said, the restriction on licenses is that they shall not be given abroad unless the President approves. It would seem to me that you might have licenses on collateral lines not relating to the atomic bomb itself directly at all, that the President would approve of. Dr. Conant pointed out that there are by-products and that there are other phases of the general subject that would be under the control of the Commission, and it is possible—I do not know; it is possible—that it might be advantageous for the President to direct or consent to a certain license given to a certain foreign government for limited purposes. I do not think there is any peril in it.

Mr. ELSTON. While it is true that the unimportant things are there, the serious things are there too. They can give the whole bomb away, the whole secret of it, under the provisions of this bill.

Mr. SHERIDAN. In line with your line of questioning, Mr. Elston, if you refer to page 1, Judge Patterson, I do not think you can reconcile your answer with line 9. The very purpose of the passage of the bill is to promote and safeguard world peace. Why could not the Commission, under the interpretation of the preamble, give it to a foreign government?

Secretary PATTERSON. They cannot do it under the specific language here in section 11, except by the consent of the President.

Mr. SHERIDAN. How would you interpret section 1, which you referred to in your opening statement, line 9, to promote world peace?

Secretary PATTERSON. So far as it would relate to any license given to a foreigner to promote world peace, it would be governed by the specific provisions of section 11, and the approval of the President required. There is no doubt of that.

Mr. ELSTON. I just yielded for a question, Mr. Chairman.

Judge Patterson, I notice in this bill that the Commission is given the authority to pass regulations, and those regulations have the force of law. Of course we know as a proposition of law that if Congress gives them the authority to pass the regulations, they do have the force of law.

Secretary PATTERSON. I never heard of a commission that did not have the power to pass regulations.

Mr. ELSTON. But Congress has not necessarily given them the power to pass regulations that have attached to them a penalty by fine or imprisonment such as we have here.

Secretary PATTERSON. It is very common.

Mr. ELSTON. It has been done, but it does not necessarily follow that the practice should be continued forever. The way this bill is written, the Commission can pass any amount of regulations they want; so long as they put them in the Federal Register it is sufficient notice to the world.

Let me call your attention particularly to page 26, section 19 (b), to the effect that any violation of the regulations promulgated by the Commission pursuant to section 17 of this act, shall, regardless of intent, be punishable by a fine of not more than \$500, or by imprisonment of not more than 30 days, or both; or, if willful or through gross negligence, shall be punishable by a fine of not more than \$100,000 or imprisonment for a term not exceeding 10 years, or both.

Now, would not failure to read the regulations in the Federal Register be construed to be gross negligence?

Secretary PATTERSON. Any regulations under section 17—

Dr. BUSH. Those are the security regulations.

The CHAIRMAN. The first one applies to the licensing of somebody like the Standard Oil Co.

Secretary PATTERSON. I do not see anything unreasonable in that. If it is unintentional, it is a small fine or a short penalty by confinement, and if it is willful or grossly negligent, by a much heavier penalty. There are certainly many, many precedents in the statutes passed by Congress within the last 20 years of power to pass regulations given to an executive body and making the violation of them penal.

Mr. ELSTON. And I do not know of a worse practice than that.

Secretary PATTERSON. It is done every day.

Mr. ELSTON. If you confine it to the last dozen years or so, they have piled regulations upon regulations until even a lawyer cannot today tell his client when he is violating the law, because they are hidden away somewhere in the Federal Register.

Secretary PATTERSON. I would not differ with you on some things that are of no very great moment, where some rather obscure commission may have the right to pass regulations and make the violation of them criminal; but I submit that on a matter of such high urgency as this, the power given to the Commission is a necessary one, and I think the making of the violation of a regulation penal is quite proper.

Mr. SHERIDAN. Even without intent?

Secretary PATTERSON. Yes, sir.

Mr. ELSTON. I should say we should not deprive the Commission of the right to make regulations, not for a moment. They have to do that. But would it not be far better, when you come to the penal provisions of the act, for the Congress to indicate in plain and unmistakable terms just what shall constitute a violation of the law?

Secretary PATTERSON. I do not think you can, except by reference to the regulations that may be passed.

Mr. ELSTON. We have been able to do it with respect to every other crime on the statute books.

Secretary PATTERSON. This differentiates between an unwitting violation and a knowing violation by the severity of what a man may be subjected to. I think that is entirely reasonable.

The CHAIRMAN. All right.

Mr. JOHNSON. I want to get your view on this, Judge. It provides for the appointment of nine Commissioners by the President, and the concurrence by the Senate. As I understand it, that means that once a man is appointed for at least 6 or 9 years he can retain that office so long as his term lasts.

Secretary PATTERSON. Subject to that removal power; yes, sir.

Mr. JOHNSON. Generally speaking, he can hold office to the end of the term. Would it not be wiser in a thing like this to give the President power to remove him? Suppose he became sick.

The CHAIRMAN. He has it in the bill.

Mr. JOHNSON. He must commit a crime or be guilty of misfeasance.

Secretary PATTERSON. Inability to act includes the case when he is ill. I think that is enough.

Mr. JOHNSON. Do you think that is broad enough?

Secretary PATTERSON. Yes, sir. I think that will require activity on the part of all nine men, activity in the affairs of the Commission.

Mr. JOHNSON. Suppose a man travels abroad for a year. You could remove him, or he could, for that reason?

Secretary PATTERSON. He could.

Mr. JOHNSON. I would like to give the President the power to remove him.

The CHAIRMAN. The President of the United States removed Dr. Morgan on his own will.

Mr. JOHNSON. Yes, and he removed Humphries; and we had to pay his back salary for 6 or 7 years.

The CHAIRMAN. Thank you, Judge. Thank you very much. Do you have any other witnesses?

Secretary PATTERSON. No, we have no others, Mr. Chairman. We will produce any witnesses this committee would like.

The CHAIRMAN. The purpose of this committee is to consider this promptly in the full significance of its importance and of the urgency of it, and with that in view the committee will meet in executive session tomorrow morning at 10 o'clock to start reading the bill for amendment, for consideration and final disposition.

The committee will go into executive session.

(Whereupon, at 4:20 p. m., the committee went into executive session.)

ATOMIC ENERGY

THURSDAY, OCTOBER 18, 1945

HOUSE OF REPRESENTATIVES,
COMMITTEE ON MILITARY AFFAIRS,
Washington, D. C.

The committee met at 10 a. m., Hon. Andrew J. May (chairman) presiding.

The CHAIRMAN. The committee will be in order.

We have met this morning for further hearings and consideration of H. R. 4280, a bill to provide for development and control of atomic energy. These hearings have been continued for the purpose of permitting a group of interested people, known as scientists, to present their views on the questions involved in this proposed legislation. We have five witnesses, and they have been selected at the request of the committee so as to give the viewpoints of four different groups of those interested in the subject.

I would like to add to my statement that there has been some criticism of the action of the committee in closing the hearings when they were closed, and that has been carried in the press and editorially commented upon. There was apparently an effort to make it appear that this committee was trying to rush things and unnecessarily doing so. I can say that up to this moment nobody has requested of me, as chairman of this committee, a hearing on behalf of the scientists except what came to me through the War Department by General Royall, who, while he did not request it, simply did not object, but rather encouraged further hearings on the matter. It is the purpose of the committee now to give patient consideration and hearing to those representing scientific work in the United States.

We have as our first witness Dr. Leo Szilard. Will you come around, please, Doctor? Let me say to you what I have already stated, that we are considering the bill H. R. 4280 which has for its purpose the development and control of atomic energy.

Please give us your name and your experience and tell us about your qualifications to appear here as a witness, and then you may make any statement that you wish to make with respect to this proposed legislation.

STATEMENT OF DR. LEO SZILARD, UNIVERSITY OF CHICAGO

Dr. SZILARD. My name is Leo Szilard. I was born in Hungary and am a naturalized citizen of this country. I was naturalized in 1943. I worked for a time, from 1925 to 1931, on the teaching staff of the University of Berlin. In 1931, when the German Reichstag began to pass legislation giving the German Government sweeping powers, I came as an immigrant to this country.

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In subsequent years I worked at the University of Oxford, England, and in March 1939 I began to work on the development of atomic energy at Columbia University. I have been working in that field ever since. From Columbia I was later transferred to the University of Chicago. I am at the present time working in this field at the University of Chicago.

The CHAIRMAN. You have read this bill, I take it?

Dr. SZILARD. I have read the bill and, with your permission, I would like to make a statement.

The CHAIRMAN. All right, sir. You may proceed.

Dr. SZILARD. I am exceedingly grateful to this committee for the opportunity to make a statement. I am not qualified to discuss the merits of the bill. It is written in legal language, and many others are more qualified to discuss the bill than I am.

I have to apologize for the very hastily prepared statement which I am going to submit. When I came down to Washington I understood that the committee had closed its hearings. Day before yesterday, late in the afternoon, I was notified that I was to appear as a witness. Subsequently I dictated my statement to a stenographer while she was operating a switchboard. In these circumstances, I hope to have your indulgence if the statement is not as clear as it might otherwise have been.

In the last few days I have discussed the Johnson bill with some of my colleagues who happened to be in Washington. This bill proposes to set up machinery presumably for the purpose of fulfilling certain functions which are not very clearly defined in the bill. My colleagues and I found it quite easy to reach an agreement on the following question:

What are the problems which face us in connection with atomic energy, and what are the functions for which we have to set up some Government-controlled machinery by legislative action?

We found that, after we had reached an agreement on this question of the functions for which we need machinery, we were in a position to discuss intelligently what kind of machinery we need in order to fulfill these functions.

There may be, of course, differences of opinion as to what kind of machinery may be best to perform any given sort of function, but at least if we all have the same function in mind we can avoid confusion in our discussion. It does not seem possible, to me, to have an intelligent discussion about the machinery which is needed if some of those who take part in the discussion believe that the function of this machinery is to construct and operate atomic power plants in order to supply electricity in remote regions of the United States, while some others who participate in the discussion believe that the main function of the machinery is to provide us with atomic bombs so that we can blast the hell out of Russia before Russia blasts the hell out of us.

I would, therefore, with your permission, like to outline the functions which, in my opinion, the machinery which you may set up by legislative action will have to perform.

One of the functions of such machinery will undoubtedly be the manufacture of two substances: Uranium 235 and plutonium. These two substances are at present manufactured in factories operated by large companies. These factories were constructed at the expense of the Government at an expenditure of \$2,000,000,000.

What are these two substances: Uranium 235 and plutonium? Uranium 235 is a heavy metal. It is a substance which is contained in natural uranium. It is contained in natural uranium in a very small quantity. Natural uranium contains less than 1 percent of this "light" uranium. When we say it is manufactured we are not quite correct. It is not so much manufactured as it is separated at great cost from the bulk of natural uranium.

How much of this substance can we hope to produce? If I am not mistaken, the United States imported in peacetime a few hundred tons of uranium. If all the light uranium should be extracted from, say, 400 tons, about the amount which was imported in one of the years preceding the war, we could have extracted from these 400 tons of uranium less than one-third of a ton of light uranium. We would have obtained this amount if we had extracted all the light uranium which was contained in 400 tons of natural uranium. If we used the methods which are applied in our factories at present a much smaller quantity could have been obtained only because these methods are not very efficient. But however efficient we may make our methods we can never extract more light uranium from natural uranium than there is in it, and this is a small quantity. From this you see that the future development along this line for purposes of power production will be necessarily limited by the scarcity of light uranium in natural uranium.

The other substance which we are manufacturing at present is called plutonium. This is also a heavy metal. It is derived not from the light component of uranium, but from the heavy component of uranium; and 99 percent of natural uranium consists of this heavy component. You can see, therefore, that we might ultimately obtain, roughly, a hundred times as much plutonium from uranium as we can obtain of light uranium.

What are those two substances good for? They can be used for either of two purposes, and they can be used for either of the two purposes in the near future. They can be used either for producing atomic power to supply electricity in remote regions of the United States which have no coal or oil easily available, or they can be used for manufacturing bombs.

We do not have to decide at this stage of the discussion for which of these two purposes we want to use the plutonium which we are manufacturing in our factories and which we shall manufacture in other factories to be built in the future. But let me not mention this subject without expressing my hope, which is at this time, I believe, the hope of all physicists, that a situation will be created with respect to our relations with other nations, that will permit us to use plutonium for the production of electric power rather than for the manufacture of bombs.

Here we have, then, the first function which the machinery which you propose to create by legislative action has to fulfill—and if I may have the use of the blackboard, I would like to make a diagram.

The first function of the machinery which is to be set up by legislative action would be to take care of a large manufacturing program operating factories which have cost \$2,000,000,000. I will put on the blackboard a possible scheme as to how this could be done. Many other schemes could be proposed, but I would like to concentrate on one scheme.

This function could be performed by a Government-owned corporation, the managing director of which would be directly appointed by the President. Advisory to the director would be two members appointed by the President, serving full time, at a high salary of, say, \$25,000. This [indicating] would be one piece of machinery that, in my opinion, might be needed and useful.

We must ask by what methods shall we manufacture plutonium and light uranium after this war. Is it necessary to develop new methods? New methods would be not only less costly but could produce a far greater quantity of plutonium per pound of uranium than our old methods. They would be both less costly and more efficient from the point of view of utilizing the available uranium. Moreover, we could produce really large quantities of plutonium which would become a factor in our national economy if used for the purpose of power production.

The answer to this question is, I believe, as follows: Some of the methods which we have developed and which are used at present might carry over into the postwar period, but not all of them. But even those methods which can carry over will represent only the first stage of this development. Behind this first stage we see already the outlines of the second stage represented by methods which are very different from our present-day methods. In order to find these methods we will have to engage in research and development. Therefore we will need another piece of machinery that can take care of research and development and that can carry the development into the pilot-plant stage. I do not believe that research and development should be separated. I do not believe that research, development, and the building of pilot plants should be separated.

You see, therefore, the need for another Government-owned corporation. This corporation [indicating on blackboard] will take care of research and development. It will have a director and two board members, the same way as the corporation in charge of manufacture as outlined earlier. I shall talk more about this phase because I am better qualified to talk about it than I am qualified to talk about the other machineries. One or two of these board members should be scientists, because scientists would have something to say about the function which this piece of machinery will have to perform.

In addition to these two pieces of machinery there may be another piece of machinery needed; and let me express the hope that it will not be needed. However, for the time being we have to envisage the possibility that it may be needed.

This would be an organization that could perform essentially the same functions which were performed by the project located in New Mexico. These functions include research, development, and manufacture; and since we might need a machinery for this function I shall, with your permission, put on the blackboard a third diagram representing a Government-owned corporation which will conduct our bomb manufacture, development, and research. I believe there should be a director, and two board members, all to be appointed by the President, and one of them ought to be a scientist, because research plays such a large part in future development.

Let me make it clear that these three pieces of machinery would not be capable of formulating policy. Therefore there is a need for a commission capable of formulating policy. I do not know how

many members it ought to have, but let us see how many members we need. I would say that these two board members [indicating] should take turns on this commission [indicating]. They are men with no executive responsibility, and have therefore time to study the functioning of their own corporation and to form an opinion of their own. Each one of the three corporations [indicating] would supply only one of its board members to the commission. These two corporations [indicating] would supply one board member each, and the same holds here [indicating]; so that you would have three board members serving on the commission who would have no executive responsibility but who would be men who are informed both about the technical problems and also about the qualifications of the managing directors of the respective corporations for the jobs for which they were appointed.

For reasons which I shall state later it seems essential that this commission [indicating], which is responsible for policy, should be tied closely to the Government. Therefore I am inclined to believe that we should have the Secretary of State or his representative, the Secretary of War or his representative, the Secretary of the Interior or his representative, and the Secretary of Commerce or his representative as members of the commission. In this way we may hope that the policy of the commission and the policy of the Government will be the same. If you wish you may add to this commission a number of public members, a representative of labor, of industry, and so on. How many you will need to add I do not know.

This is the picture which I visualize as representing the machinery which could perform the functions that need to be performed.

I shall not make any further comments on manufacture or on bomb development, but I would like to make some comments on the guiding of research and development.

I would like to explain why I believe that the Government must be in a position to do its own research and development rather than to rely on what research and development might be derived from universities or private industry. The reason for this is not my adherence to a particular social philosophy, but a reason which arises out of the nature of our special problem. In deciding along what line development should go we will have to make a choice. The choice is between these two alternatives: We might either go after the utilization of atomic power in the near future, and in that case we would make plutonium and use it for operating power plants in order to produce electric power. We could build such power plants in the very near future; and if we moved along this line we would have rather soon profitable applications of atomic power. However, while we would have atomic power soon, atomic power would not amount to much in the life of our Nation.

If we want atomic power to be an important factor in our national economy, we have to forget about these short-range objectives and we would have to guide the development along an entirely different line, develop different kind of manufacturing processes, refrain from using up in the next few years plutonium in power plants and aim to have 10 or 15 years from now atomic power available on a really large scale.

Why we cannot have both I do not feel quite free to explain, because I could explain it only if I told you facts which I cannot tell

you in open session, but I would very much appreciate an opportunity to talk about this subject, if it seems important to you, in executive session, where I would be free to explain that it is not my personal preference for Government-guided research and development, but the necessity of choosing between a long-range and short-range objective that makes me say that the Government will have to look after this task.

Mr. HOLIFIELD. May I ask the gentleman to please repeat his statement? I do not believe I caught the full import of it.

Dr. SZILARD. We have a choice between two different lines of development. We cannot have them both.

Mr. HOLIFIELD. Do you mean military and domestic?

Dr. SZILARD. No. I mean short range and long range. Use of atomic power could be attained in 3, 4, or 5 years. If we go along this line we will have atomic power soon, but we will not have it on a large scale. If we want to have atomic power on a large scale we have to renounce its use in the next few years and we have to guide the development into channels which will give us atomic power on a really large scale, some 10 years from now. If we utilized too soon plutonium in power plants we would not go along the line along which I think we ought to go.

Mr. HOLIFIELD. Your point is to retain it for seed rather than to use it?

Dr. SZILARD. This leads us into questions which I said I did not feel free to discuss in open session. If I have the opportunity to explain it in executive session I think I could say enough to convince you that it is not my preference for Government-conducted development, but rather a necessity arising out of the technical situation which makes me say that we ought to have Government-owned corporations authorized to carry the research and development which is needed.

Mr. HOLIFIELD. You believe, then, in full Government control of it as a matter of necessity, not as a matter of your own personal choice?

Dr. SZILARD. When you speak of Government control, let me say that as I understand the word, the Government should control an organization which can conduct development on a large scale along lines which the Government deems to be in the national interest, forgetting immediate gain and profit. I certainly do not believe that there should be a Government agency which is in control in the sense that it can prohibit other Government departments or universities or private industry from engaging in research and development.

Mr. HOLIFIELD. You mean control toward the acceleration of the development rather than toward restricting it?

Dr. SZILARD. I mean that the Government should have the power to carry out the needed development itself, but not the power to prevent other people from carrying out development work.

Mr. HOLIFIELD. But do you not believe that any private laboratory or university should make known to the Government any discoveries which it might make during that period?

Dr. SZILARD. I believe the Government ought to be kept fully informed by anyone who is working in this field. But Government control can be carried too far. According to the Johnson bill, the National Bureau of Standards could not conduct experiments without special permission.

The CHAIRMAN. Suppose we let the witness finish his statement.

Mr. HOLIFIELD. I am afraid I will forget some of these things.

The CHAIRMAN. You can put them down on a pad.

Mr. HOLIFIELD. All right, Mr. Chairman.

The CHAIRMAN. Proceed, Doctor.

Dr. SZILARD. As I said, what I am going to say now will apply only to the research and development aspect of our problem and not to the task of manufacture. As a scientist I am more concerned, and also more qualified to speak, about research and development than manufacture.

I believe that if we want to have a successful development we will have to incorporate into the organization of our Government-owned corporation in charge of research and development some features which are nominally operative in private industry. I believe that we will have to provide for some overlapping of work and a certain amount of competition within such a Government-owned corporation. I would like to indicate this also by a diagram.

This Government-owned corporation in charge of research and development could set up five or six branches, and it would be logical to locate them at the sites of great universities and institutes of technology. A branch might be located near Boston in the proximity of M. I. T. and Harvard; another somewhere near Columbia and Princeton; another branch perhaps near Austin, Tex.; a fourth branch might be in Los Angeles, where they have two universities, California Technology and the University of California, in Los Angeles, Calif.

What I am driving at is the following: If we want to avoid the mistake of putting all our eggs in one basket, it would be a fatal mistake to have a budget set for these branches by a central organization and have each work exclusively on the task assigned to it. Naturally the corporation will have to determine what budget each branch should have. I would like to see, however, this principle adopted (even though it might not be wise to write it into the law) that any of these branches should be free to use up to 40 percent of their budget, not for the task assigned to them, but for overlapping and competing with the work of the other branches. The men working at one site [indicating] may come to the conclusion that another branch located at another site is going the wrong way about the task which has been assigned to it by the central organization. In that case they ought to be free to use up to 40 percent of their budget to enter into competition with this other branch. I venture to predict that very often it would not be the branch selected by the central organization, but some other competing branch, which would deliver the goods. I am basing this remark on experience during this war in work which the Government conducted at various universities. Very often the methods selected by the central authority proved to be unworkable, and the method selected by some local group proved to be workable.

Mr. JOHNSON. You want 40 percent of the budget used for experimentation?

Dr. SZILARD. No. I would say it this way. The central organization assigns a task to a local branch and gives it a budget. I would say that it should be free to use 40 percent to go after some objective other than the objective assigned to it. For instance, an objective which was officially assigned to another branch.

I have not quite finished my statement, but it will not be long now.

The CHAIRMAN. Continue.

Dr. SZILARD. I would now like to make an attempt to visualize how these functions would be performed if the Johnson bill were passed. This, of course, is a guess, because we do not know who the men would be who would serve on this nine-man Commission. I am going to assume that those few men who sponsored and have spoken in favor of the bill will be the men who will serve on the Commission. If that were so, I think it is safe to assume that by and large the work of the Commission would be conducted pretty much in the manner in which the work on atomic energy was conducted under the OSRD, the NDRC, and the Manhattan District. In other words, I base my forecast on the experience which we had with those agencies in the past.

Mr. THOMASON. You mean, the military would run it?

Dr. SZILARD. No. The NDRC is not military; the OSRD is not military; and the Manhattan District is not entirely military. The Manhattan District had the advice of civilians acting as part-time advisers. It was not a purely military organization.

Mr. JOHNSON. Do you believe that the present lay-out would be contrary to your ideas?

Dr. SZILARD. No. What I meant to say was this. Assuming that the Johnson bill is passed and the men on the Commission are of the same type as the men who sponsor the Johnson bill—which is an arbitrary assumption, but I must assume something—then I am asking how would its functions be performed. I know how we operated during the war, and I can visualize how much of that would be carried over into peacetimes.

Mr. JOHNSON. In other words, you do not think it would be performed as well as it is under your lay-out?

Dr. SZILARD. I do not say it would be badly performed, but you can judge whether you are satisfied with the type of performance which I visualize or whether you will want a different type of performance.

If you will permit me, I will not talk about manufacture, because I know little about manufacture, but I will talk about research and development.

I believe there will be a tendency to carry out research and development, not in a Government-owned corporation which could try to enlist the most capable young men from our universities and induce them to work for the Government but rather by placing contracts. Contracts would be placed with universities and with industrial companies which have research laboratories. If that were done I believe the universities would fall short of their task, because they would fall short on the development side, and I believe that the industrial research laboratories would fall short on the research side. The industrial laboratories would not be able to attain the services of those spirited younger men who in the past have always preferred university or Government work to work in private industry.

Since it is much simpler to keep contact with a few big companies than to work with many small companies; I believe that the large companies which incidentally have also better facilities for development and research in their laboratories, would be given these development contracts. I believe that these companies would accept those contracts. I believe they would be offered cost-plus-fixed-fee contracts to develop what needs to be developed; and the Government

would tell the companies what to develop. I believe that the companies will not refuse such contracts. I believe they will accept them but they will accept them primarily for the following reason: The larger companies have a desire to watch this development. They want to be able to determine at what moment the development reaches a stage where it becomes profitable for the company to enter this field and start research and development at its own expense.

On the other hand, while these companies will accept the cost contracts they have nothing much to gain directly by the contracts. No patent rights will accrue to them; and in the circumstances I am quite sure that they will not put their best men to work on these contracts. They will save their best men to work on research and development within the framework of the normal business of the company, which is profitable. They will take the Government contracts because they have nothing to lose by taking them.

In saying this I am projecting into the future what is already going on at the present time.

I have talked now for a long time so I will skip what I wanted to say about manufacturing contracts and come to the point which worries me most at the moment.

I believe the most disturbing feature of the Johnson bill is the independence of the Commission from the Government and the fact that the Administrator is not appointed by the President. I believe that the greatest danger is that the operation of this Commission might adversely affect our foreign relations. If I have an opportunity to do so I shall be very happy to outline the different lines of our foreign policy which are conceivable. There are two or three different lines of approach in our relations with other nations which we might conceivably take, but we do not know at the moment in which of these possible lines of foreign policy we shall actually attempt to carry out in the future. The time may come when the Government of the United States, with the approval of Congress, may wish to establish collaboration with certain other countries and may wish to establish collaboration particularly in the field of research and development. Under the Johnson bill, if that time comes, this would presumably be carried out in this manner: The President would issue a directive to the Atomic Energy Control Commission and the Administrator would have to carry out the directive of the President.

What can happen under those circumstances is well known to those who have been associated with the Chicago project. We had such a case in the past. We had a directive which was presumably a Presidential directive, which was communicated to us, and instructed us to collaborate with a certain atomic energy project set up jointly by the British and the Canadians on Canadian territory. At the same time we received this directive, or shortly afterward, rules and regulations were issued by the Manhattan District which rendered this collaboration ineffective.

I am not saying that it is a good thing or a bad thing to collaborate with Canada. I am not voicing an opinion on this question. But I do believe that it is not a sound policy to have directives and regulations in conflict with one another; and that I believe would inevitably happen, or let me say it might conceivably happen, with disastrous results to our foreign relations, under the Johnson bill.

Let me repeat: I believe that our relations with other nations may be endangered if the organization which controls atomic energy in the United States is in a position to issue rules and regulations which render Presidential directives ineffective.

There are two more points about which I wish to speak, and I think I can speak of them shortly because I believe that others will take this matter up. I believe Dr. Anderson is going to testify today and may speak about them.

With reference to secrets, let me say that clearly the biggest secret was given away with the use of the atomic bomb, because knowing that such a bomb can be made is half of the secret. I believe that the other half of the remaining secret was given away when the War Department released the Smyth report, because that report clearly indicates the road along which any other nations will have to travel. If they do travel along that road they will step by step rediscover what we have discovered, and step by step they will obtain the same results we have obtained.

That does not mean that we have no secrets left. We have scientific secrets left and we have what you may call the know-how left. Almost all of the scientific secrets which we have left—and some are important secrets, I believe—relate to the development which may take place in the future. They have practically no bearing whatsoever on the kind of bombs we have used against Japan. This is one kind of secret. The other kind of secret is the know-how. The know-how is not a simple secret that you can write down on a piece of paper. It is something that is exceedingly difficult to transmit. I think the only way you can transmit know-how is to send a couple of engineers over to some other country. By taking blueprints along, explaining them and having consultations, they may be able to transmit the "know-how," but I am not sure even then whether it could be done easily.

In the past we had a very important secret, namely, the secret that the bomb existed. That secret was kept. It was not kept because employees of the Government were afraid of the Espionage Act. It was kept because we all understood it was important to keep it. I do not believe that secrets can be kept by any other method than by free cooperation of those who are in possession of the secret.

If a bill is passed which contains the type of security rules whereby the Commission could decide that what information should be transmitted between scientists who may work in this field at different sites in the United States. It will have two kinds of effects as to the rules which the Commission will issue, if they resemble the rules which we had during the war—well, there are two things I have to say about them. One is that it is impossible to keep them, and, the other that we do not want to keep them.

Mr. HOLLIFIELD. I would like to have the gentleman elaborate on that a little bit.

The CHAIRMAN. We will give him a chance, of course. Go ahead.

Dr. SZILARD. The rules about which I speak regulated how much information we could give to each other. Certain men were allowed to know certain things; certain groups were allowed to know certain things. They were not allowed to know other things.

I do not know whether you ever tried to learn basic English. In talking basic English you must remember which words you have to

forget. You can learn basic English, but I do not believe you can learn basic English if every month a new list of words is issued to you containing new words which you may use and possibly old ones which you used before and which you must not use any longer. This kind of rules could not be obeyed if you wanted to obey them. But we did not want to obey them, because we had to choose between obeying these rules and sabotaging or slowing down our work; and we used common sense in place of obeying rules.

Hardly a week passed that somebody did not come to my office at Chicago from somewhere wanting to convey a piece of information to which I was not entitled. They usually said that they did not ask me to conceal the fact that I came into possession of this information, all they asked was that I conceal from the Army the fact that they were the persons who had given it to me. These men went to such trouble not in order to please me, but because they thought I needed the information for my work.

I can assure you that if you pass the Johnson bill and if it is possible to keep spirited men in this organization, they will go on violating these rules. What will be their position? I do not believe that they will be sentenced to 10 years in jail because they told each other a piece of "secret" information. I think, however, that they would be in no position to speak up and say for instance that the Administrator or the Commission is no good. I think they would not dare to do that, because if they did so, someone might remember that on such and such a date this man violated the rules by passing on to a coworker an exceedingly important secret, so important that no one could be told what the secret was. He could then, under the Johnson bill, be dismissed or sentenced to 10 years in jail. He might be dismissed not only from employment by the Commission but from any other Government agency.

So, this part of the security regulations means that no one in the United States might be able to criticize the Commission. Those who have not been in the organization do not know what to criticize, and even if they knew, their opinion would carry no weight. Those inside the organization would not criticize and risk being put in jail. We do not have such stringent regulations now, yet our men are intimidated. With the passage of the Johnson bill many of the younger men would not want to lose their civil rights and would leave this field of work. They will not go on strike; they will not declare that they will not work, but they will prefer to accept other employment. Those who remain will conform. They will do their job; and if they come to the conviction that their assigned work is not really the right one, that to do something else would be more important, if they come to the conclusion that the nine men on the Commission do not live up to their responsibility, that each one of the nine thinks that the other eight are doing the job, if they come to the conclusion that the Commission is no good, they will keep that knowledge to themselves.

I am not qualified to speak about for the younger men. I think that the backbone of this project will be the men below 45, a class in which I do not belong. I think it will be the younger man who will count; and I do not want to speak for them. Mr. H. L. Anderson, is here to testify and he can tell you of his own personal reactions.

So I will close with one request. This morning I received a telegram from the Oak Ridge and the Chicago atomic scientists and who wish to make a statement, and they have asked me to submit their statement to you. If the chairman would permit me, I shall not interrupt this testimony by reading their telegram, but instead will ask Mr. Anderson, who will testify, I believe, after me, to read the telegram at the end of his testimony so that we do not interrupt the present discussion. I propose to hand the telegram to Mr. Anderson and he will read it later, if that is agreeable to the committee.

The CHAIRMAN. He is going to testify later?

Dr. SZILARD. Yes.

I have finished my statement.

The CHAIRMAN. Doctor, as I understand your position, it is that if this committee decides that a commission ought to be set up to control and regulate the production of atomic power, it ought to be composed of representatives of other agencies of the government which you have named?

Dr. SZILARD. No; I cannot say that. I am not in position to make really any proposal. I had not thought about it long enough. But I would prefer the type of commission I have mentioned to what you have now in the bill.

The CHAIRMAN. You have suggested already that in the set-up that you put on the blackboard there ought to be personnel from other agencies, Cabinet officers, for instance.

Dr. SZILARD. I would prefer this solution to the one which you have now. But I do not want to imply that I believe that by taking this bill and amending it piece by piece, replacing one paragraph by another paragraph, and by juggling with amendments, it is possible to produce a bill that will have the approval of the majority of the scientists.

The CHAIRMAN. You do favor, if it is controlled and regulated, that it be done by an agency of the Government rather than private industry?

Dr. SZILARD. Yes, sir.

The CHAIRMAN. Are there any questions?

Mr. THOMASON. If I understand you correctly, then, you favor giving the secret of atomic energy to foreign countries?

Dr. SZILARD. No, sir. I think that discussing whether we should give away the secret or not is putting the cart before the horse. I should be only too glad to elaborate on this if I can make another statement today or some other day. The question is, What shall be our relations with other nations? After we have decided that, the question will be, What kind of arrangements do we want with other nations? If we know we can get those arrangements, then as a part of the arrangements we will give as much of the remaining secrets as is adequate.

Mr. THOMASON. Did I correctly understand you to say that you do not believe it is much of a secret anyway?

Dr. SZILARD. Even if it is not much of a secret, it is still something. There is no such thing as the secret of the atomic bomb. I have read the Smyth report and I know a little bit more than was put into the report. Hardly anyone knows all the details.

Mr. THOMASON. What was your connection with the project?

Dr. SZILARD. My work was, since March 1939, to develop methods of producing plutonium, one of the two substances which I mentioned.

Mr. THOMASON. For whom do you speak in your testimony?

Dr. SZILARD. I am testifying for myself only. But the Chicago group and the Oak Ridge group have both sent a statement which will be read by Mr. Anderson.

Mr. THOMASON. What is your connection with the University of Chicago?

Dr. SZILARD. I am employed at the University of Chicago under a contract with the Government.

Mr. THOMASON. In what capacity?

Dr. SZILARD. I can tell you my salary, but I cannot tell you my rank. My salary is \$11,500.

Mr. THOMASON. By whom is that paid?

Dr. SZILARD. By the University of Chicago, but it is reimbursed by the Government.

Mr. THOMASON. Then you are paid by the United States Government?

Dr. SZILARD. No; I am paid by the University of Chicago.

Mr. THOMASON. But you say that they are reimbursed by the Government.

Dr. SZILARD. As far as I am concerned it is the private business of the university where they get their money from.

Mr. THOMASON. What is your educational background in that field?

Dr. SZILARD. I have been working in the field of nuclear physics since 1934, first in London and then at Oxford. I started to work on atomic energy in March 1939 at Columbia University. In October 1939 Mr. E. P. Wigner and I approached Professor Einstein to get his help to convey to President Roosevelt the need for Government activity in this field. Dr. Alexander Sachs, in New York, with whom Mr. Wigner and I consulted, took Mr. Einstein's letter to President Roosevelt, and President Roosevelt appointed, at the request of Professor Einstein the director of the National Bureau of Standards, a representative of the Army, and a representative of the Navy to serve as a committee to look after the interests of the United States Government. The committee was later enlarged and finally attached to the NDRC.

Mr. THOMASON. In any foreign countries were you employed in this field?

Dr. SZILARD. Only in England.

Mr. THOMASON. You were born in Hungary?

Dr. SZILARD. Yes. I left Hungary in 1920. I studied in Germany. I was on the teaching staff of the University of Berlin from 1925 to 1933.

Mr. THOMASON. What were you studying at the university—physics?

Dr. SZILARD. Theoretical physics, primarily.

Mr. THOMASON. How long have you lived in this country?

Dr. SZILARD. I first came as an immigrant in December 1931, but returned to Europe and lived in England from 1933 on. I have not left the United States since January 1938.

Mr. THOMASON. How long have you been a naturalized citizen of this country?

Dr. SZILARD. Since 1943.

Mr. THOMASON. I believe you have some patents of your own in the atomic field, have you not?

Dr. SZILARD. I made certain inventions in the field of atomic energy which I communicated to the Government. I did not apply for patents until after the Government took over this work and then the Government applied for patents in my name and these basic patent applications are the property of the United States Government.

Mr. THOMASON. Your inventions have been patented by the United States Government?

Dr. SZILARD. Yes, the Government applied for patents.

Mr. THOMASON. Did you give those to the Government?

Dr. SZILARD. Yes; The Government offered me the sum of \$25,000, which I refused to take. What I was willing to take was \$330 of back salary for the months in which I worked at Columbia University and in which I did not receive a salary, and my actual expenses. This amounted to the sum of about \$15,000, or \$10,000 less than what the Government wanted to pay.

Mr. THOMASON. Did you refuse to give the United States Government copies of your inventions?

Dr. SZILARD. No.

Mr. THOMASON. Did you refuse to give the United States Government copies of your patents?

Dr. SZILARD. No; certainly not.

Mr. THOMASON. Do they have them now?

Dr. SZILARD. They own them.

Mr. THOMASON. What about your applications and your blueprints in connection with the patents?

Dr. SZILARD. The United States Government has everything that I have invented in this field.

Mr. THOMASON. You surrendered them upon condition that you retain copies, did you not?

Dr. SZILARD. Oh, yes. I have always asked to be permitted to retain copies of my own applications.

Mr. THOMASON. What personal rights did you retain when you surrendered your inventions and patents to the Government and retained copies?

Dr. SZILARD. No rights.

Mr. THOMASON. Did you not reserve some personal rights to do with those patents and inventions as you wanted to do with them?

Dr. SZILARD. No. The only right I reserved is to retain a copy as my own property to be kept in safe deposit with the university.

Mr. THOMASON. What did you do with them?

Dr. SZILARD. I do not have them.

Mr. THOMASON. What did you do with the copies?

Dr. SZILARD. I do not have them.

Mr. THOMASON. What became of them?

Dr. SZILARD. They did not give them to me.

Mr. THOMASON. You did have copies of the documents you gave the Government?

Dr. SZILARD. No. The Government drew up those patent applications, I only signed them; and the Government filed them in the Patent Office. So they belong to the Government. I just asked them to let me have a spare copy so I could refresh my memory as to what I had done.

Mr. THOMASON. What did you do with that spare copy?

Dr. SZILARD. I don't have it. I just asked for it.

Mr. THOMASON. You know what it is and you can reproduce it if you wish?

Dr. SZILARD. I could not very well reproduce a hundred page document.

Mr. THOMASON. Are you personally the author of those documents?

Dr. SZILARD. Yes. Either the sole author, or a joint author.

Mr. THOMASON. There is nothing to prevent you, under your agreement with the Government, from reproducing them?

Dr. SZILARD. No, but I cannot reproduce them from memory.

Mr. THOMASON. Can you in any other way?

Dr. SZILARD. No.

Mr. THOMASON. What would you expect to do with them if you had them?

Dr. SZILARD. I would like to keep a copy of my own invention. I think every inventor likes to keep a copy of his own invention, just as every author likes to keep one copy of the book he wrote.

Mr. THOMASON. What is the nature of this patent or invention of which you claim to be the author and which you later turned over to our Government?

Dr. SZILARD. I am sorry. May I hear your question again?

Mr. THOMASON. What is the nature of the inventions of which you are the author and producer and which you later turned over to the Government?

Dr. SZILARD. It is a system composed of uranium and graphite and is a method for producing plutonium, one of the substances manufactured in our present factories of which I spoke.

Mr. THOMASON. In its final analysis it goes to the final manufacture and production of the atomic bomb?

Dr. SZILARD. If you wish.

Mr. ARENDS. Do you think there is any defense against the atomic bomb?

Dr. SZILARD. There is no military defense. I think our vulnerability will be much less if we relocate 30 million to 60 million of our population. It may be necessary to do that unless the international picture improves.

There is one more thing that can be done. Certain key factories and vital installations can be placed underground. That would be quite an effective defense. A defense in the ordinary sense I do not believe exists.

The CHAIRMAN. Doctor, let me suggest to you that you make direct answers without any more explanation than you can avoid.

Dr. SZILARD. I did not quite understand you, Mr. Chairman.

The CHAIRMAN. I just want you to be as brief in your answers as possible.

Dr. SZILARD. I shall be as brief as I can without being inaccurate.

Mr. BROOKS. As I understand your testimony, you feel that the penalties in the bill will not help to retain the secrets in any way?

Dr. SZILARD. Who will betray the secrets? If you take a man who wants to betray those secrets—I do not know for what purpose he would do so—if he wanted to do it he would do it in the same manner as spies do.

Mr. BROOKS. So you feel that penalties would do no good. Would they have the effect, in actual operation, of driving away young men, especially, who did not want to be in an industry subject to penalties?

Dr. SZILARD. Let me put it this way. It will do very little good and it may do very much harm. I would not say that it would do no good.

Mr. CLASON. It is your opinion that this commission which is set up in the bill is too rigid; in other words, it will keep the whole subject of atomic energy within such close bounds that there is not going to be a possibility for development for domestic and industrial use which might otherwise result?

Dr. SZILARD. Yes. I believe that the bill will give the commission powers which they do not need. We can figure out what powers they need and give them the powers that they do need.

Mr. CLASON. If persons have been working on the Manhattan project for the Government at considerable salaries, and if they were not further employed by this commission and the Administrator, all of the time which they have spent, all of the research and all of the development which they may be capable of, might be lost to the Nation. Is that so?

Dr. SZILARD. Not quite. They left their records behind. What they have done would not be lost. The men would be lost; yes.

Mr. CLASON. If they were not given a license or the privilege of working on research and development they would have to seek other paths in which to earn a living?

Dr. SZILARD. Yes. Their past experience would be lost.

Mr. CLASON. And you would expect that any commission which carries on this work in the future would be smaller in number of employees and scientists than the number that were employed during the war?

Dr. SZILARD. Vastly smaller; yes.

Mr. CLASON. And therefore the effect of it, under the terms of the bill as it is now drawn, would be to prevent a great body of scientists, physicists, chemists, electrical engineers, and others, who might not be employed by the commission in the future, from conducting their research along atomic energy lines unless they happen to get a license from the commission?

Dr. SZILARD. Let me correct myself in this respect. I believe that the number of scientists employed will be smaller than during the war. I do not believe we will lose as much in number as in quality. If you have a hundred physicists in a group and you take the 10 best ones away, the other 90 will be of no use at all. It is loss of quality rather than quantity that I believe will take place.

Mr. CLASON. After listening to you it occurs to me that there is perhaps a lot of information in regard to this research in connection with atomic energy which has not been brought out to the knowledge of the public. I notice in an editorial today in the Washington Post a statement that there apparently have been conferences and consultations with persons who might know, and it might not be a bad idea for the Government to proceed with its research and development, as at the present time, under the direction of the War Department and give considerable study as to the type of commission or corporation which the Government might wish to set up to actually control the development of atomic energy. What would you say as to allowing the War Department to continue for a time under such legislation as may be necessary to protect the interests of the Government, and at the same time give Congress and the public an oppor-

tunity to find out what the entire subject matter is, in order that a proper commission or corporation might be set up?

Dr. SZILARD. I would be wholeheartedly in favor of it. I believe the War Department should be encouraged to spend, perhaps even more money than it spends at present. I think it should be encouraged to carry on until Congress has studied this matter. I am wholeheartedly in favor of this proposal in the editorial.

Mr. CLASON. We have been advised that \$600,000,000 was being made available for this Commission, or, in the absence of the Commission, the War Department, to use in the further study and development and research along atomic energy lines. Would you say that that is a sufficient sum to carry on until July 1 of next year?

Dr. SZILARD. I do not know whether it is sufficient, but I believe the War Department should be given any reasonable sum which in the judgment of the administration would be necessary to carry on; and they should be encouraged to carry on.

Mr. CLASON. It seems to me that \$600,000,000 is at least a good start toward anything that they might need.

With reference to this Smyth report to which you have referred, I gather the idea from your statement that if a person has possession of the Smyth report and that person is one who is a trained physicist and is in position to secure additional information from other trained scientists in other fields, he would be in position to work out the atomic bomb within a reasonable length of time?

Mr. SZILARD. He would not have all the information by reading the Smyth report, but he would have all the information which he needs to know how to go about to find that information which he still lacks. Therefore, I think that lack of knowledge is not a limiting factor, at least not one which would slow down seriously the development. It is more a question of the know-how a mass of technical details which it might take 6 months or a year to work out. But this perhaps will give you the answer: The Smyth report brings the reader up to date to the knowledge which we in the United States possessed in the late fall of 1942. Whether it will take other countries longer than us to develop a bomb will depend on two things: Do they have raw materials available, and can they find the technically trained personnel which is needed to operate factories?

Let me make my position clear in this. The statement has been made that to construct these factories requires high precision work. It has been said that the whole gigantic structure is like a Swiss watch and only the United States, or possibly Switzerland, can do it. It may be true that many of the constructions, and perhaps all of the constructions, require, according to their present design, high precision work. I am familiar at least with one of the most important branches, however; and the reason that high precision work is needed in this branch only is because of the particular design which was adopted. The design had to be perfected in a hurry. It was not a good design. It was a bad design because it required high precision work. You know the story of the man who writes a 10-page letter and then apologizes for the long letter, saying he did not have time to write a short one.

The CHAIRMAN. We have four other witnesses appearing on behalf of some scientific organizations, and we cannot give all of the time to this gentleman. He has had an hour and 15 minutes now. Make your answers direct, please.

Mr. CLASON. I gathered from your statement that in a period of time, from 2½ years up, it may be possible for another country, given capable scientists and research people, plus the necessary elements, to develop the atom bomb just as the United States did during that time?

Dr. SZILARD. I would say that it is more likely than not that another country will have it in 6 years. In 2½ years it is possible; it might not be probable.

Mr. CLASON. The question was suggested by some of your replies which rather indicated to me that you felt that atomic energy can be used in peacetime for industrial purposes and for other than military uses?

Dr. SZILARD. Yes. It will take 5 to 10 years before it can reach a large scope. We could do it right away, but it would not be important.

Mr. CLASON. In 10 years we will get some real benefit from this investment, for industrial and domestic purposes?

Dr. SZILARD. Depending on how good the machinery is that you are going to set up by legislation. If the development work is well guided, 10 years from now atomic power could be a very important factor in our national economy.

Mr. CLASON. Then would you say that the kind of commission set up by this bill would be one that would restrict the development for industrial and domestic purposes more than is necessary?

Dr. SZILARD. I cannot say that. It depends, of course, on who those men of the Commission are. If you can find men who during the day do hard work in their own business and during the night can study the reports on atomic energy development, if such men exist who do not need any sleep, then the Commission may function well, inasmuch as its members would be well informed.

Mr. CLASON. Do you expect General Motors, United States Steel, or other great corporations to go ahead with development and research leading up to production and manufacture so long as they had licenses from some Government commission which might shut them out at any moment?

Dr. SZILARD. I am afraid I cannot speak for any of those companies.

Mr. MARTIN. I would like to ask a question as to your opinion of this particular bill. I gather that you favor some sort of interim control but that you are opposed to this bill as a permanent measure.

Dr. SZILARD. I would very much favor some simple bill which would provide for an interim control solution to give Congress enough time to study adequately all aspects of the problem.

Mr. MARTIN. Could not this bill be used in that way?

Dr. SZILARD. I doubt it, more time will be needed before a good bill can be adopted and the delay may be too long.

Mr. MARTIN. Would you rather see speed in the matter of developing permanent legislation?

Dr. SZILARD. No, but the choice may be between either speed in developing permanent legislation or an interim bill maintaining the status quo until the final bill comes through.

Mr. MARTIN. I have one question on the atomic bomb. Can an atomic bomb be stored indefinitely without losing its power or usability?

Dr. SZILARD. The answer to this question is not a simple one, and I would prefer to give you the correct answer in executive session. It is not exactly a secret but it had better not be discussed in an open session, I believe.

Mr. ELSTON. To what extent could atomic energy be used by private industry?

Dr. SZILARD. At once, or later?

Mr. ELSTON. When it is developed.

Dr. SZILARD. I would suppose that the first application would be supplying electric power in remote regions where coal prices are high, or in mining regions where transportation of coal is difficult. That may be first type of use.

Another use, of course, is the use of the byproducts. During the manufacture of plutonium we produce a large number of radioactive elements which can be used by industry. Industry could use them for research aimed at improving its manufacturing processes, provided they are available.

Mr. ELSTON. Can it be used to run locomotives and steamships and automobiles?

Dr. SZILARD. When you produce atomic power you also produce radiations. You have to protect the driver and the passenger against those radiations. That might mean that an automobile would have to carry 50 tons of shielding material, and that would be rather on the heavy side. For ships this might be possible, but I doubt if it would be very important. Application of atomic power for locomotives I also would doubt.

So I believe that stationary power plants would be the first application. Very large airplanes might be a possibility. But applications for transportation are farther away than for the production of electric power.

Mr. SHERIDAN. Does anyone present have the entire knowledge of what you refer to as the know-how in connection with the production of atomic bombs?

Dr. SZILARD. Put it this way—

Mr. SHERIDAN. Put it my way.

The CHAIRMAN. Answer the question directly, please.

Dr. SZILARD. May I be permitted to give a correct answer rather than a short one. This is my answer. There are persons who have access to all information. But if such a person is unintelligent it does no good to him. If such a person is intelligent he will not try to accumulate all the available information. He will pick out what is of interest to him. So I believe that among those who have access to that information very few, if any, will know everything about the different manufacturing processes, and so on, simply because a scientist is not curious about everything; he does not want to know what he is not interested in.

Mr. SHERIDAN. Suppose that one person or a number of persons should be struck down; would that destroy the know-how procedure that we have?

Dr. SZILARD. No. I believe if some of those persons who believe they know everything were struck down it would promote rather than retard the development of atomic power.

Mr. PHILBIN. Do you know of any defense against it?

Dr. SZILARD: I would discount any statements emanating from either the newspapers or the Naval Affairs Committee of the House in this respect. But defense is possible by relocating our population concentrated in our large cities, and by putting underground some key industries, some vital installations, we might very materially improve the security of this country. I believe the time might come when we may have to do it.

Mr. PHILBIN. There is no scientific device or invention presently being considered that might be able to explode this bomb or offer protection against it?

Dr. SZILARD. I cannot say that no one would invent some such thing. But if anyone invents a device for detonating the bomb at 3 miles distance I would undertake to perfect in about 1 month a defense against the defense, so that it would become inoperative.

Mr. JOHNSON. Who is Mr. Wigner?

Dr. SZILARD. He is from Hungary. He has been in this country considerably longer than I have. He is a professor of physics in Princeton University.

Mr. JOHNSON. Is he a naturalized citizen now?

Dr. SZILARD. Yes, sir.

Mr. JOHNSON. Who is Mr. Teller?

Dr. SZILARD. He is also from Hungary. He was a professor in George Washington University.

Mr. JOHNSON. Is he naturalized?

Dr. SZILARD. Yes, sir.

Mr. JOHNSON. Is Mr. Weisskopf naturalized?

Dr. SZILARD. Yes.

Mr. JOHNSON. Where is Mr. Fermi from?

Dr. SZILARD. He is from Italy.

Mr. JOHNSON. The Kaiser Institute did a lot of inquiry into this thing before we got into the war; did they not?

Dr. SZILARD. I think it was in May 1940. They were going strong in May 1940.

Mr. JOHNSON. Did any of those men have any patents similar to yours, or do they have?

Dr. SZILARD. Mr. Fermi is a coinventor on some of the patent applications with me. He has also other inventions. I know a number of inventions that he made during the war for which the Government has applied for patents in his name.

Mr. JOHNSON. They were all turned over to the Government of the United States?

Dr. SZILARD. Yes; but I do not know whether he owns any patents or retained any rights in patents he may have taken out before he came to America.

Mr. JOHNSON. What about these others? Do you know whether or not they have any patents on any processes?

Dr. SZILARD. As far as Mr. Teller and Mr. Weisskopf are concerned I doubt that they have applied for any patents except patents based on inventions made during the war, which belong to the Government.

Mr. JOHNSON. Is there a group of scientists who were not connected with this project that were also studying atomic energy?

Dr. SZILARD. In this country?

Mr. JOHNSON. Yes.

Dr. SZILARD. I do not believe they could have studied it very effectively, but they may have patents. Paper is cheap.

Mr. JOHNSON. Is it your opinion that the present development of this is so dangerous that the Government should retain complete control of it and dictate who may do the experimentation and handling of atomic energy?

Dr. SZILARD. I do not believe that there is any serious danger representing a health hazard. If that were the main danger I would suggest that the Commission be headed by the Surgeon General. I do not believe danger of this sort deserves serious consideration.

Mr. JOHNSON. You are about 50 years old; are you not?

Dr. SZILARD. I am 47.

Mr. JOHNSON. You made the comment here that you thought that the development of this would be taken up by younger men. In other words, you think that it is only in its infancy; is that correct?

Dr. SZILARD. I think it is only in its infancy.

Mr. JOHNSON. And that full development will probably come after your working days are over?

Dr. SZILARD. In 5 or 10 years.

Mr. JOHNSON. The electricity which you say you can generate by atomic energy would be generated in remote places like the Rocky Mountains?

Dr. SZILARD. It would be more interesting to generate it in remote places; because where coal is available there is no need for such a power plant. If you have a hydroelectric plant you must have very long transmission lines. If atomic energy is used you could produce electricity close to the consumer.

Mr. JOHNSON. In small quantities?

Dr. SZILARD. No; not very small. Say a hundred thousand kilowatts. That is comparatively small.

Mr. JOHNSON. You could take a town of 75,000 and build a little plant and develop enough electricity in that little plant to serve that city?

Dr. SZILARD. I think so.

Mr. JOHNSON. Is that what you consider the big future domestic use of it?

Dr. SZILARD. Yes; provided we refrain in the next 10 years from using up the plutonium which we may produce.

Mr. JOHNSON. Did any of these men work in the Kaiser Institute before you came over here?

Dr. SZILARD. No one worked there at that time. I had some connection with it before 1933. It was before I worked in the field of nuclear physics.

Mr. HOLIFIELD. Doctor, I am very much interested in this commission and have been ever since the idea was brought out. Your reason for having four Cabinet members on this Commission is so that the unity of the development shall be in the hands of the Government rather than a separate Government commission or a commission appointed by the President which would be absolutely divorced, you might say, from the general Cabinet knowledge?

Dr. SZILARD. Both knowledge and intentions; yes.

Mr. HOLIFIELD. You think it is important, therefore, that the Secretary of State be on that Commission because of the international implications of the research and development and manufacture adaptation?

Dr. SZILARD. Yes.

Mr. HOLIFIELD. And you think that the Secretary of Commerce should be on it to protect the business interests of America in the future development for commercial application?

Dr. SZILARD. Yes.

Mr. HOLIFIELD. You feel that the general staff should be on from the point of view of military adaptation?

Dr. SZILARD. Yes.

Mr. HOLIFIELD. And the Department of the Interior because of the sources of uranium and plutonium?

Dr. SZILARD. Because our natural resources have to be conserved. My answer is "Yes."

Mr. HOLIFIELD. And your idea is that as to the other three members, one should be brought from those boards and serve for a limited time and the other members retained on that board?

Dr. SZILARD. Yes. One board member from each of the three corporations.

Mr. SZILARD. They would have leisure to study all questions—and then have an opportunity to bring to the Board their knowledge. They will have time to acquaint themselves with the details of the technical problems.

Mr. HOLIFIELD. In other words, you feel that that would bring to the Board current knowledge, actual, current knowledge of these three different phases that you have pictured on the Board.

Mr. SZILARD. That is correct.

Mr. HOLIFIELD. And the men would at all times have access to the technical knowledge from men who were actually in the work, and doing the job?

Mr. SZILARD. That is correct.

Mr. HOLIFIELD. May I ask you—if you will pardon me, I am not thoroughly familiar with these scientific matters of this kind as I would like to be—and I hope you will pardon the facetiousness of the question I am about to ask you, if you would have the extra men on this Board that you have indicated, whether or not they will be appointed from the State of Missouri?

Mr. SZILARD. Every one of them might be appointed from the State of Missouri for all we know.

Mr. HOLIFIELD. On the secrecy question here, you have made the statement that practically half of this secret was revealed in this explosion itself.

Mr. SZILARD. That is true; it was.

Mr. HOLIFIELD. And practically all of the balance in the Smyth report?

Mr. SZILARD. No; I said that half of what remained is contained in the Smyth report.

Mr. HOLIFIELD. Would you have issued as complete a textbook, as the Smyth textbook, had you been charged with that duty?

Mr. SZILARD. No. I would not; and I warned against its publication.

Mr. HOLIFIELD. I believe that you say that a man who is aware of the things that are in the Smyth report, he could take those general statements that are set forth, and with the knowledge of the explosion, and with the facts in the Smyth report, he would have a pretty full knowledge of what you were about, and how you went about it.

Mr. SZILARD. He would have a pretty fair knowledge of how to go about the production of an atomic bomb.

Mr. HOLIFIELD. In other words, this explosion, and then the textbook would give them sufficient information as to how to make an atomic bomb?

Mr. SZILARD. Pretty much so. I would say pretty much so.

Mr. HOLIFIELD. I want to now ask you in regard to a statement you made which it seems to me is very important. You said that during the development of this bomb certain Presidential directives, or directives that you had been given during the course of the Manhattan project, or these other projects that were given you, and also administrative regulations were also given you scientists who were well acquainted with these directives?

Mr. SZILARD. That is correct.

Mr. HOLIFIELD. And you made a statement it was impossible to obey the administrative regulations that were given to you?

Mr. SZILARD. No. I did not mean to say that it is impossible to obey them, with reference to our collaboration with Canada. Those regulations were such that we could obey them. They merely prevented communicating or collaboration with the British-Canadian atomic energy project in Canada.

Mr. HOLIFIELD. Regardless of where they were given you in the procedure in the work, it prohibited you—in other words, you were supposed to be prohibited from consulting with any other department?

Mr. SZILARD. That is right. That was the idea.

Mr. HOLIFIELD. As to the knowledge that that other department had.

Mr. SZILARD. That is correct. With reference to various groups working for the United States Government.

Mr. HOLIFIELD. Were those regulations impossible to obey from a scientific standpoint, because you had to have access to this other knowledge?

Mr. SZILARD. Yes. We had to have that information in order to make good progress.

Mr. HOLIFIELD. In order to get a complete knowledge of the project you were working on?

Mr. SZILARD. In order to be able to work with intelligence and get somewhere.

Mr. HOLIFIELD. They were based upon the idea that this was a wartime project, and it was necessary for the scientific information not to be given from one department to another department?

Mr. SZILARD. There was some idea like that behind it, that communication should not be allowed on a number of topics.

Mr. HOLIFIELD. But you feel, regardless of the penalties imposed in this bill, that if they went on with research and development, with any such regulations which would put restrictions on scientific research, which might be placed on these departments, it would not prevent them from passing this information to and fro?

Mr. SZILARD. I think they would go ahead and disobey, and take the risk of the penalty; they could not get very far otherwise.

Mr. HOLIFIELD. You think they would just go ahead and disobey them, and take the risk of incurring such penalty?

Mr. SZILARD. I am confident of that; yes.

Mr. HOLIFIELD. Going to the point of a person who from a criminal standpoint was one who would want to disclose this information, any

penalty that we might write into this bill would not have any bearing with that man, if it were a man, or a group, or otherwise, from a foreign government, which would prevent him from giving out the information which he might obtain by virtue of the risk of the revelation of this secret?

Mr. SZILARD. That is quite so. I do not believe it would stop him.

Mr. HOLIFIELD. In other words, we could not write a penalty that would prohibit anybody from disclosing this secret?

Mr. SZILARD. If they really wanted to do it I do not believe you could.

Mr. HOLIFIELD. Then in your opinion it is impossible for the United States to keep the eventual know-how and secret from getting out from where it may now be known, to another nation?

Mr. SZILARD. Another nation can reproduce these, by carrying out research work of their own so that if nothing leaks out from here at all, and if the United States were to sink into the ocean, still the other nations would succeed rather soon, just by reading the Smyth report, they would be able to go into this field and follow the road step by step to a successful conclusion. This is inescapable.

Mr. HOLIFIELD. How many copies of this Smyth report are there?

Mr. SZILARD. I have heard about 50,000 were sold, but I believe that one sold would be enough.

Mr. HOLIFIELD. I bought one at a book store in Washington for \$1.25 and then I found that I could have gotten it down at the document room for 35 cents after I had done that.

Mr. SZILARD. It received wide distribution.

Mr. THOMASON. How long have you been in the employ of the United States Government, Dr. Szilard?

Mr. SZILARD. Since November 1940, I have been working in the employment of Columbia University which had a Government contract.

Mr. THOMASON. Have you signed applications over to the United States Government for all of the applications for patents that you have developed?

Mr. SZILARD. This question is not a very clear one. I have assigned all of my relevant inventions to the Government. The Government has prepared a number of patent applications which I have signed and which were filed by the Government. But there are other applications prepared by the Government which I could not obtain a copy to study, and I am not fully informed as to their propriety, and those as of which I did not have full information, I did not sign.

Mr. THOMASON. Do you have eight inventions in connection with the atomic bomb?

Mr. SZILARD. Do I have eight of them? That might be right. I have no record of them.

Mr. THOMASON. That you refused to sign applications for patents?

Mr. SZILARD. No, I have not done that.

Mr. THOMASON. Of course, the Government cannot get those patents unless you sign those applications.

Mr. SZILARD. I think my position in regard to those applications is quite clear, that I simply wanted the proper information in regard to them.

Mr. THOMASON. The Government cannot get them until you have signed the applications?

Mr. SZILARD. I am not a patent lawyer. I find it difficult to form an opinion as to the propriety of some of these patent applications.

Mr. THOMASON. How many of them have you refused to sign an application for?

Mr. SZILARD. I have not counted the number of outstanding applications, but this is the situation: the position I take is that I shall sign any application as soon as I am confident that the oath attached to the application is proper; you see, I have to take an oath.

Mr. THOMASON. What is your objection to taking that oath after you have been in the employ of our Government in the development of the atomic bomb, and you have the know-how, as you call it, at least the secrets, and you have proved and perfected to your satisfaction eight inventions, and then you declined to sign an application for each of these patents so that these patents could be issued, and because of the oath that everybody has to take, everybody that is trying to get a patent, that is what they have to do. I am not trying to be critical of you, I want you to understand that. I am not criticizing you. I want to get the facts. I am simply trying to find out what the facts are in this particular situation.

Mr. SZILARD. I have no objection to taking an oath, but I must know that the oath is proper. After all, you cannot ask me to take an improper oath.

Mr. THOMASON. Will you tell us just what the situation is in that regard? How do you feel about that? What is the reason?

Mr. SZILARD. In some cases I do not know whether the oath is proper, that I would have to take. I have to take an oath that a specific application is my sole invention, or that it is a joint invention. I have asked that a patent attorney be cleared so that I may have proper advice on the matter. I think that is only a reasonable request that I be permitted to talk to a patent attorney with whom I could consult on these technical questions. I have been told recently that a patent attorney would be cleared, but I have not been notified yet in writing. Earlier, a year ago, I was told that the War Department would not clear any patent attorney, that there is no one that they are willing to clear for this purpose. Even though you say that I have been in the employ of the Government for many years I am not prepared to take a false oath. I do not feel that I should be called upon to take a false oath.

Mr. THOMASON. Nevertheless, you have refused and continue to refuse to sign these applications?

Mr. SZILARD. No. I have not refused to sign any application when I reached the conclusion that it would be proper for me to sign it.

Mr. THOMASON. While you were in the employ of the Government, and in full knowledge of the secret of the so-called atomic bomb, and you perfected to your satisfaction certain inventions in which the Government was interested, deeply interested as a matter of fact, you had presented to you an application for this patent and you refused to sign it.

Mr. SZILARD. I have told you several times, no, I did not refuse to sign it.

Mr. THOMASON. You declined to sign that because you did not like the form of the oath that is prescribed by law.

Mr. SZILARD. No; it is not the form of the oath, it is the substance of the oath which is involved.

Mr. THOMASON. What is it about that oath that you did not like and would not subscribe to, which every other citizen in this country who desires to obtain a patent has to subscribe to?

Mr. SZILARD. The fact that in the oath I have to declare that I am the sole inventor or a joint inventor, on this question I need legal advice on this question if it arises. I want the advice of a patent attorney on that, and I think it is only fair that I should have it. I am not a patent attorney and I am not prepared to decide questions of this sort alone.

Mr. THOMASON. You do not need much advice, and did not need much advice when you came to discover the great secret that has won this war, and yet you are not willing to turn it over to the United States Government.

Mr. SZILARD. Why do you say that? These inventions are the property of the Government. And—

Mr. THOMASON (interposing). I would like to ask you this—

The CHAIRMAN (interposing). Let the witness finish his answer.

Mr. SZILARD. I did not refuse to turn them over. I cannot accept your statement.

The CHAIRMAN. Mr. Elston.

Mr. ELSTON. Did not you, when you accepted employment in the Government, agree to turn over to the United States Government upon request any patents which you had developed while you were in the Government, which were in the interest of the Government?

Mr. SZILARD. Yes, and I have no desire to repudiate that whatsoever.

The CHAIRMAN. Thank you very much, sir. You have consumed 1 hour and 40 minutes, and we are very glad to have you testify, and I think we have been very much informed by your testimony.

The CHAIRMAN. Our next witness is Dr. Harold C. Anderson of the University of Chicago.

STATEMENT OF HAROLD ANDERSON, PH. D., OF THE UNIVERSITY OF CHICAGO, SANTA FE, N. MEX.

The CHAIRMAN. Dr. Anderson, will you come forward and take a seat, and just tell us your name, and make a statement about this matter.

Mr. ANDERSON. I should be very glad to do so.

The CHAIRMAN. Doctor, you have read this bill, and we would be glad to have your statement in respect of this bill. You can either stand up or sit down as you please.

Mr. ANDERSON. I am very happy to be here, Mr. Chairman and members of the committee.

The CHAIRMAN. May I ask you, before you start in with your statement, that you state your qualifications, and then proceed to your statement.

Mr. ANDERSON. I do not have it embodied in my statement and I will be glad to give it.

The CHAIRMAN. Just give us your background, your education, your experience in connection with scientific research and development.

Mr. ANDERSON. Yes; Mr. Chairman. I was born in New York City in 1914. I was educated in the public schools of New York City.

I received my A. B. degree from Columbia University in 1935. I received my B. S. degree in electrical engineering from Columbia University in 1936. I received my Ph. D. degree from the same university in 1940. I began work on the atomic bomb in 1939, as a research assistant to Professor Fermi of Columbia University, and I continued to work there until the work was transferred to the University of Chicago, to the Metallurgical University. I stayed there until September 1943—November of 1944, I am sorry, and then I went to work at the Los Alamos Laboratory on the Manhattan district project in New Mexico during the past year, and at the present time.

The CHAIRMAN. Thank you, Doctor. Will you now proceed with your statement?

Mr. ANDERSON. I am grateful for this opportunity to present this testimony before this committee.

As a young scientist who has played an active part in the development of the atomic bomb, from the very beginning to the present time, and who would be eager to continue to explore the full potentialities of this development, I would like to present testimony on certain aspects of the May bill which are of deep concern to any scientific worker.

This bill grants broad powers to a Commission in the administration of the security regulations which it may choose to set up. In accordance with the provisions of this bill violations of the security regulations set up by the Commission governing the dissemination of information relating to research on the transmutation of atomic species are punishable if such information has at any time, before or after the passage of this act, come into the knowledge or possession of any person (1) by reason of his official duties, or (2) pursuant to a contract with or license from, or in the course of employment by the Commission, the Administration, any other Government agency, their agents, contractors or licensees, or (3) in connection with certain activities specifically mentioned.

That these provisions can reach any scientist becomes clearer when we consider that an astronomer, making inquiries into the nature of the stars, requires access to information on atomic transformations because the energy production in the stars is believed to be derived from just such atomic transformations. Indeed, he might argue, and with good reason, that to help progress in his field he should be provided with full and detailed information on the atomic explosion in New Mexico since this was the first man-made star.

The medical researcher who will find application of radioactive tracers in his study of disease will likewise seek information and material and will be able to do so only by subjecting himself to the rules and punishments provided for in this act.

Since there will be, no doubt, as a result of the large expenditures of the public funds contemplated in this act, development of devices and techniques which will be applicable in other fields, workers in these other fields will seek enlightenment and become subject to the security provisions of this act.

The penalties for security violation which are provided in section 19 of the act deserve the closest scrutiny. It is provided that "any regulation promulgated by the Commission can, in addition to other

penalties, be ground for dismissal from employment by the Commission or the Administrator, or for dismissal at the direction of the Administrator from employment by other Government agencies; or agents, holders of contracts, or licenses of the Commission, the Administrator, or other Government agencies, without regard to criminal prosecution or conviction thereunder." Thereby, the due process of law is set aside and any person accused of violation of the rules may have his work and livelihood placed in jeopardy at the direction of the Administrator, without recourse to the usual means of protection under the law. Thus, the act admits that any person who receives the great benefits placed at the disposal of the Administrator and who for any reason, as by criticism or in some other exercise of his civil liberties, incurs the displeasure of the Administrator, may have these benefits cut off and be subject to loss of work and livelihood.

Under the cloak of secrecy and in the name of security the Administrator can conceal the inefficiencies and the faulty judgments of his rule. Persons on the outside will have no information which might be a basis for complaint; those who would have access to the information will be afraid to speak.

These are hardly the circumstances under which it could be possible to lure the young college student to take up the discipline of science. They cannot be expected to be viewed with enthusiasm by any scientist who by reason of his past service in development of atomic energy becomes subject to rules of the Commission, and in some cases without knowing what they are.

If we are to advance the national welfare, secure the national defense, insure the national safety, and promote world peace, we need to stimulate the progress of our understanding and pursue the development and utilization of atomic energy. The greatest progress in understanding comes from research coupled with the fullest and most free discussion and dissemination of its results and the related ideas. Frequently, the best ideas are inspired by inquiry into fields having only tenuous connection. Thus, the studies in the field of atomic transmutations gave the clue to the source of energy in the sun; and conversely, many of the studies of the astrophysicists and astronomers proved useful in the development of the atomic bomb. No one can predict how much harm can be caused the progress of science through the limitation of access to information and no one can be wise enough to know what knowledge can be limited without hindrance in the advance to the final objective.

The very existence of provisions for security in an act of law imposes on the Administrator a responsibility to make rules and make a show of enforcing them if only to demonstrate that he is being active and vigilant in his job. Even if he felt it was wise to have no security limitations at all in certain broad and fundamental lines it would be a bold step indeed to make this decision because of the criticism he might receive from some quarters. Thus, I believe that General Groves, the Director of the Manhattan District Project, was bold to have made public so many of the secrets of our work in releasing the Smyth Report.

I do not mean to infer that in the national interest a secret is never a good thing to have. But we have laws governing espionage activities and we have ways of keeping secrets other than by legislative action. In 1939, when the implications of the discovery of nuclear fission were

first considered, the group of scientists at Columbia University, who started active work toward the development of the atomic bomb, enforced secrets on themselves. Through the initial efforts of Dr. Szilard, an arrangement was concluded with the American Institute of Physics to withhold publication of all papers dealing with the pertinent subject in the field of atomic transformations. My own doctor's dissertation which bore on this subject was the first paper withheld from publication and still resides in a locked file under the stamp Secret.

At the Los Alamos Laboratory, where the atomic bomb was built, secrecy was guarded by the scientists themselves, a security body was set up and the scientific workers, for their own discipline, accepted a fine or punishment for each offense. Thus, a file safe which was discovered unlocked at night was punished by a fine equal to one-half day's pay or by the requirement to check out for 10 successive nights at the security office. The close secrecy which was and still is being maintained at the Los Alamos Laboratory is a tribute to the intelligence of the security offices in the consideration of the scientific needs and the wholesome collaboration they gained thereby.

In the interest of international understanding which lies at the basis of any arrangement to insure a world peace, it is essential to avoid a dictated security. In the eyes of a foreign government, the enactment of legislation which shields possible military activities of a government behind a cloak of secrecy, is in itself an act of aggression. It is fraught with just the dangers of mutual suspicion which we must endeavor from the beginning to wipe out, and it will prevent the free intercourse and mutual appreciation which we have to have if we are to deal with other countries on a friendly plane.

I appeal to the Congress to take care not to place in jeopardy the civil liberties of their constituents, to beware lest in their zeal to control they stifle the very object of their control, and to leave open the road to international understanding and world peace.

Mr. Chairman, may I read this telegram before or after questions? I have this telegram which was sent to Dr. Szilard, and I would like to read it.

The CHAIRMAN. You may read this telegram now.

Mr. ANDERSON (reading):

We, the members of the Atomic Scientists of Chicago and the Association of Oak Ridge Scientists at Clinton Laboratories, have carefully considered the provisions of the bill now pending in Congress known as the atomic energy act of 1945. We are strongly opposed to passage of the bill.

It delegates to a commission and an administrator, not responsive to the electorate, the authority and duty of determining, and formulating, in addition enforcing all national policy in regard to atomic energy. Neither the commission nor the administrator are responsible in the asking or enforcement of policy to the President or any other authority. Further, they are virtually immune from outside criticism or review because their security regulations may prevent the disclosure of the actions or policies subject to criticism.

Some of the specific features which make the proposed bill objectionable are pointed out below:

1. Complete and arbitrary authority and power over all aspects of atomic energy, whose release has ushered in a new era of our civilization, is placed by the bill in the hands of nine commissioners who, once appointed, are practically speaking immune from removal.

2. Under the broad powers contained in the bill, the proposed commission and the administrator selected by it may restrict all scientific and industrial research in this revolutionary field to Government agencies, may place no restrictions whatever on such research, or may take any intermediate policy.

3. In the new fields, whose importance to our economic life cannot yet be foreseen, the proposed Commission and the Administrator may completely ban private enterprise, or may completely turn over development exploitation, and patents to private interests.

4. The proposed Commission may allow full and complete revelation of all present and future knowledge in the field of atomic energy, or may promulgate security regulations so stringent as to prevent discussion and interchange of information, the lifeblood of scientific progress, even between coworkers in the same laboratory, public or private. The scope of such regulations is not limited to those necessary for military security.

5. Under the proposed bill, the Commission has the absolute power to make grants to any person on such terms or conditions as the Commission or Administrator deems appropriate to its purpose.

6. The directives contained in the bill admonishing the Commission and the Administrator to use their broad and undefined powers for the promotion of general welfare and the advancement of science are unimplemented. No method is provided for their enforcement.

7. According to the bill, the Administrator and Deputy Administrator, who are responsible for the administration of both military and nonmilitary aspects of atomic energy, may be commissioned officers of the armed forces on active duty.

8. We believe that there is a great danger under the proposed bill of retarding the research and development of atomic energy. As citizens and as scientists who have worked to bring to fruition the promise of atomic energy, we believe that controls should and must be exercised by an administrative agency of our Government. The controls must be exercised for the military security and general welfare of our people, subject to international agreement for the preservation of world peace. We believe, however, that the limits and objectives of these controls must be defined by the people through their elected Congress. This may be accomplished only by a law drafted after the fullest discussion in Congress and out, of the meaning and possibilities of atomic energy and atomic bombs. It requires full presentation of the views of the armed forces, scientists, industry, commerce, labor, agriculture, and others whose lives and interests will be affected.

We propose that the present bill be abandoned and that steps be taken to prepare a new bill based on extended hearings and investigation. It should embody enforceable objectives and limitations on the controls to be exercised. If the demands for continuity of the work and military security require immediate action, we propose that Congress pass interim legislation enabling work and security to be carried on for 6 months in the present wartime manner.

Association of Oak Ridge Scientists of Clingon Laboratories: P. S. Henshaw, Chairman; W. E. Cohn, E. G. Bohlmann, S. G. English, H. S. Brown, R. P. Metcalf, J. G. Stangby, L. B. Borst, J. H. Rush, K. Z. Morgan, M. D. Peterson, R. N. Lyon; Atomic Scientists of Chicago: J. A. Simpson, Chairman; D. L. Hill, E. E. Rabinowitch, A. M. Bruce, J. J. Nickson.

Mr. CLASON. As I understand it, you agree to the conditions contained in the telegram?

Mr. ANDERSON. I did not say that I did, sir.

Mr. CLASON. I wonder whether you did or not.

Mr. ANDERSON. In the large, but not in specific details; no.

Mr. CLASON. In other words, you feel that it is necessary for the Government to have some manner of restriction and development of atomic energy?

Mr. ANDERSON. I would not like the Government to restrict research in any field.

Mr. CLASON. Would you say it would be better to carry on in accordance with the present program with the War Department rather than set up a new Commission?

Mr. ANDERSON. I would prefer to see a good bill passed which would permit work on a scale which would attract scientific workers of all competencies in the field.

Mr. CLASON. Did you envisage the Government developing this atomic energy not only for military purposes but for domestic and industrial purposes?

Mr. ANDERSON. I would envisage activities in all of these lines by the Government.

Mr. CLASON. In other words, you feel that the Government ought to have a commission so set up that the purposes for which the commission would seek out atomic energy will cover not only military proposals but also any industrial purposes or other purposes which might be of an advantage directly to the people?

Mr. ANDERSON. I think that is quite correct.

Mr. CLASON. If you set up an organization of that kind, would you expect it to be exclusively a research department of the private corporations and agencies?

Mr. ANDERSON. Absolutely not. I would not expect that.

Mr. CLASON. Do you feel that this bill, by virtue of the method in which it issues licenses and controls atomic energy for all purposes having to do with atomic energy is so restricted that it will prevent private individuals and corporations from going ahead with development as it would otherwise?

Mr. ANDERSON. I suppose the bill will be restrictive of certain development; that is my belief.

Mr. CLASON. Whereas the membership of the Commission—let us talk about that for a moment, the membership of the Commission; do you believe there should be several Cabinet members on it in order to have the people by their designated representatives always fully informed, whether they leave it to nine persons apparently unrestricted or not?

Mr. ANDERSON. Yes. I believe that is essential. I do not believe many people realize the far-reaching scope of this thing.

Mr. HARNES. Would the gentleman yield for a question?

Mr. CLASON. I will yield.

Mr. HARNES. Would you object to an advisory committee composed of elected officials from the House and representatives of the United States Senate to advise with the Commission?

Mr. ANDERSON. I would not object to any type of advisory commission. I believe, however, that there should be a close collaboration between the administration in the sense that it does deal with these international relations and the work of the Commission which would have to do with atomic energy.

Mr. CLASON. You would be perfectly willing that Members of the Senate and Members of the House should sit on the Commission, then, so that the people, through their duly elected representatives, would be directly represented thereon?

Mr. ANDERSON. I that, insofar as it may be a small enough committee, but I would not want it to be an unwieldy committee in numbers.

Mr. CLASON. How large a commission do you think it should be before it would be unwieldy?

Mr. ANDERSON. I am not prepared to say, but it seems to me that a Commission of nine is large enough.

Mr. CLASON. You suggested that if General Grove—first, do you understand that he let loose the Smyth report?

Mr. ANDERSON. The frontispiece of the report says he did.

Mr. CLASON. Would you, if this bill which has been proposed were put into effect, feel that if a person let loose such information that he would be violating the terms of the law and subject to these penalties which you have mentioned, feel that this would cover such a situation?

Mr. ANDERSON. That is a legal matter, and I am not prepared to pass judgment on that.

The CHAIRMAN. Mr. Johnson, do you have any questions?

Mr. JOHNSON. I have a few. Dr. Anderson, I noticed when you read that telegram you pondered over the first part of it for a little while. If it is a personal matter we do not want it in there, but if it is something that we ought to hear, I think that we should have it.

Mr. ANDERSON. No; the first paragraph is not a personal matter. It is addressed to Dr. Szilard. The first paragraph of the telegram reads as follows:

I understand that you agree to present orally the group statement on the May-Johnson bill. Please feel free to add your signature if you desire and have Nixon sign if he will do so. The statement reads as follows.

That is the part that I did not read. I am very glad to read it.

Mr. JOHNSON. You mentioned the matter of the dismissal of these scientific men by the Administrator. You do not believe that scientists should be under civil-service regulations?

Mr. ANDERSON. I certainly do not.

Mr. JOHNSON. Do you not think someone has to have the power of enforcing discipline and perhaps even firing or attending to the removal, having the power of removal of some of these scientists if the occasion should demand?

Mr. ANDERSON. I think it is correct; sometimes it appears that a scientist is not in a very good job for him where he can do his best.

Mr. JOHNSON. In that connection, will you tell me this: Whether there was any friction in the operation of the plant that you worked in?

Mr. ANDERSON. There is always some friction and gripes. Without that, I do not think you would get very much done.

Mr. JOHNSON. Was there anything that seriously affected the progress of the work?

Mr. ANDERSON. No, I really do not think there was. I do not think so.

Mr. JOHNSON. Is it your idea that at the present time we should have an interim bill and then have full hearings before we write permanent legislation?

Mr. ANDERSON. I think that it is of the utmost importance to arrive at a permanent bill at the earliest possible opportunity, not only to initiate and stimulate great progress in this work, and keep it going, but to prevent evaporation of the present personnel. On the other hand, I do not think that we should sacrifice in a poorly considered bill the possibility that this might never lead to fruition.

Mr. JOHNSON. It was stated here in the hearings that this bill was only a stopgap and there might be some permanent legislation affecting our relations with other countries, and the bill was designed primarily for immediate security until we could formulate a better bill in view of circumstances as we would then come to know them.

Mr. ANDERSON. I think that this bill is worse than our present condition under the War Department.

Mr. JOHNSON. Why do you say that, Dr. Anderson?

Mr. ANDERSON. I say that because I would prefer to see that we work during this time, and that it be continued during this interim under the War Department set-up until Congress has had time to consider carefully all the circumstances which it would wish to legislate and pass a good final bill.

Mr. JOHNSON. If the War Department continued the project, would that assure all the scientists that are now engaged in the work continuing in this mission?

Mr. ANDERSON. I am not sure that I can say that they would, but I rather think that the feeling of the scientists is that they are anxious to get back to their academic pursuits and unless—in fact one of the features that Dr. Szilard's plan does have is that it would provide that we would have Government laboratories in the vicinity of the universities, and this would permit close collaboration in the scientific world of these professors who are in the universities and the governmental work as well.

Mr. JOHNSON. Your idea is then that we should try to work out some plan that would capture the ability of these scientists and enable them to continue with their academic pursuits as well?

Mr. ANDERSON. I believe that is the better over-all plan, I think we have to have a plan which will keep the interests and the efforts of the scientists, who would now normally go back to university work, in this great field.

Mr. JOHNSON. Do you have any objection to the provision in the bill that provides for the licensing of the right to pursue this line of work to universities and things like that?

Mr. ANDERSON. No, I think that should be done.

Mr. HARNES. I would like to know what he means by that.

The CHAIRMAN. Let the reporter read the answer.

(The reporter read "No, I think that should be done.")

The CHAIRMAN. You may proceed.

Mr. HARNES. You think the Commission should be set up with full power and authority to control any scientific developments in this field, with the power to license anyone or everybody anywhere that was doing any work on it? In other words, they would have complete control of it?

Mr. ANDERSON. Yes, I think that the interests of Congress would be to provide legislation which will stimulate the work toward that end. There are dangers which I tried to point out in my statement, and I think that Congress should ask itself to take cognizance of those dangers in formulating the legislation.

Mr. HARNES. Do you mean this, that the Commission should have full and extraordinary power that this bill would give them, to either give to an individual or to a scientific group permission or to say to them that you cannot touch this field unless we license you?

Mr. ANDERSON. No; I would disagree with that point of view. I would prefer that the Commission be given no more powers than it is deemed necessary to carry out this kind of work in the best interests of the Nation.

The CHAIRMAN. That is precisely what we are trying to do.

Mr. JOHNSON. That is what the purpose of this bill is. That is all I have.

The CHAIRMAN. Mr. Martin, do you have any questions?

Mr. MARTIN. I have a few questions, Mr. Chairman.

Dr. Anderson, I would like to have your ideas over again about penalties. Did I understand you to say that you would leave the matter of penalties in the field of security regulations to the Federal laws which are presently on the statute books?

Mr. ANDERSON. Yes. That is precisely what I would do.

The CHAIRMAN. The espionage laws of the country?

Mr. ANDERSON. Something like that.

Mr. MARTIN. And not carry any penalties for violations of acts of that nature in this bill, or which would apply to people doing things like that?

Mr. ANDERSON. That is my belief. I do not believe they should be in here.

Mr. MARTIN. Just another question about this matter of the Commission's power to discharge these scientists. As I get it from your testimony, you objected to that power being placed in the Commission; am I right about that?

Mr. ANDERSON. I objected to the power insofar as it voided due process of law. I do not object to the power if there is some redress possible and it is handled in a regular and ordinary manner.

Mr. MARTIN. You mentioned another point about the matter of our procedure. You suggested that Congress make an intensive further study of this field to learn; I suppose, more of the features of the atomic bomb and the control of the work in that field. Do you have in mind in that point that we could in such a proceeding find out the nature of the atomic bomb as to whether it could be possible to successfully store it for long periods of time, and matters of that type, so we will know the general need for security provisions looking ahead, or do you have any ideas of that kind, or, on the other hand, do you have in mind something else?

Mr. ANDERSON. No. I believe there are certain pertinent points, and I believe one of those points which must be considered, and which most strongly indicates the importance of the point which Dr. Szilard commented upon, namely, that there is the question of conserving natural national resources. We cannot overlook the proposition of conserving the natural national resources in this country, particularly, of course in the field of uranium.

The CHAIRMAN. Just one moment. Off the record.

(There was a discussion off the record.)

The CHAIRMAN. On the record. The committee will have to recess at this time because we have to go on the floor. It is now 12:15, so we will recess until 2 p. m. Dr. Anderson, can you be back at that time?

Mr. ANDERSON. Yes. I can return at that time.

The CHAIRMAN. Very well. The committee will now stand in recess until 2 o'clock this afternoon.

(Whereupon, at 12:15 p. m., the committee recessed to reconvene at 2 p. m.)

AFTER RECESS

The committee reassembled at 2 p. m., pursuant to recess.

The CHAIRMAN. The committee will come to order. Dr. Anderson, will you come around?

FURTHER STATEMENT OF HAROLD ANDERSON, PH. D.

The CHAIRMAN. Mr. Johnson, I believe you wanted to ask a few more questions of Dr. Anderson?

Mr. JOHNSON. Not now. I believe I have asked all the questions I had in mind.

The CHAIRMAN. I want to ask the witness a few questions.

Dr. Anderson, in reference to the regulations that are proposed to be authorized by this legislation, of course, none of us know what they will be until they are written. But let us assume that after the Board is set up and licenses are issued to some university, the University of Chicago, for instance, or to some private industry, authorizing them to carry on experimentation and research, and it later develops that in issuing the license we issued it to somebody that was disloyal to this country, and turned out to be an enemy of this country, do you not think the regulations ought to be broad enough to allow the Board to remove that license fee?

Mr. ANDERSON. If you confine the use to the cancellation of the license, it might be, I might consider myself to be in agreement with that.

The CHAIRMAN. Let us assume that the Board makes a mistake and grants a license to the wrong party or the wrong industry, and they are not carrying on research work as the Government feels that it ought to be, or as I said they turned out to be German saboteurs, do you not think they ought to be allowed to eliminate them? In other words, to remove those licenses?

Mr. ANDERSON. It seems to me that there are laws which govern disloyal acts and acts of sabotage. I do not understand why that could not be applied in this case as well as in others.

The CHAIRMAN. What is the difference in a law by statute and a regulation which has the effect of law being applied?

Mr. ANDERSON. In my testimony I tried to point out that if the regulations were made which covered a proper field, then that is necessary, and there may be some reason for that, there might be some reason attendant upon those regulations, and I would feel that they were in the proper field of operation. It is my concern that the regulations might make certain misuse which would be the concern of the scientists which do the work in this field. I do not feel that the scientists in this field should be discriminated against in that way.

The CHAIRMAN. Dr. Anderson, you have not gotten around to my question yet. Supposing a wrong man gets the license, do you not think that the Board should retain the power under the regulation to revoke it?

Mr. ANDERSON. And if the man were considered to be a wrong man by reason of his disloyalty or sabotage activities, then I think that the F. B. I. ought to be called in.

The CHAIRMAN. That is an evasion of my question, young man, that I have asked you time and time again. It is a rather simple question and I cannot see why you cannot grasp it and give me a proper answer to it. I will ask you again, if a man was given a license as a licensee, and he turned out to be the wrong man, do you not think that we ought to retain the power under the regulation to revoke that license?

Mr. ANDERSON. No; I certainly do not think you should retain any such power. No, indeed.

The CHAIRMAN. You do not think it should.

Mr. ANDERSON. Emphatically no; I think that there are other means of taking care of that.

The CHAIRMAN. Well, at least we have your ideas on the subject at last. Mr. Johnson, do you have any questions?

Mr. JOHNSON. A few. Dr. Anderson, here is a thing upon which there has been some testimony. Is uranium and the byproducts of that so dangerous now that we should control it and say just exactly who ought to handle it?

Mr. ANDERSON. I do not think there are any more dangers than some of the other materials which we admit in the hands of workers in the field, and specifically I would say the matter of explosives which are in the field of research and industry.

Mr. JOHNSON. One witness made the point that the products and the method of making was one in which you had to make this which was so dangerous and in such a pioneer stage today that people might unwittingly be handling them improperly, and they could kill off a whole town; what can you say about that?

Mr. ANDERSON. Well, that possibility certainly exists; it is very possible. It is important that this be used properly and that those who use this material use them with due caution and exercise of care.

Mr. JOHNSON. Is that why you believe a license provision in this law will be proper or improper?

Mr. ANDERSON. I think that a license provision in this law would be a proper provision.

Mr. JOHNSON. That is the question I wanted to ask.

The CHAIRMAN. I would like to ask one other question: Do you believe that the control of this force ought to be left in the Government somewhere, or do you think that private industry could take it over and the Government let it go?

Mr. ANDERSON. I believe it ought to be left in the Government somewhere.

The CHAIRMAN. All right, sir. Thank you very much.

I have two letters here, one is a letter and one is a telegram, which I will read:

OCTOBER 12, 1945.

Hon. ANDREW J. MAY,
*Chairman, Military Affairs Committee,
House of Representatives, Washington, D. C.*

DEAR CONGRESSMAN: I am enclosing copy of a telegram concerning the bill on atomic energy under consideration by your committee, which I have just received from Dr. J. Robert Oppenheimer, Dr. Enrico Fermi, and Dr. Ernest O. Lawrence. These eminent scientists are members of the scientific panel which was formed by the interim committee to advise it on many matters relating to atomic energy, including, specifically, legislation for postwar domestic control over this field. As you know, the interim committee, which was appointed by the Secretary of War with the approval of the President, was responsible for the preparation of the bill now before your committee.

These men have long been associated with the research on, and development of, the atomic bomb. Dr. Oppenheimer was in charge of the work in New Mexico on the perfection of the bomb itself. Dr. Fermi, who received the Nobel prize for physics in 1938 for his work on the neutron and other nuclear phenomena, has worked closely with Dr. Oppenheimer throughout the project. Dr. Lawrence, winner of the Nobel prize for physics in 1939 for his development of the cyclotron, was the leading figure in the development of the electro-magnetic process for the

separation of uranium 235. Because of the importance of their work on the bomb project, it occurred to me that you and your committee would surely be interested in having the views of these three scientists.

I am also sending a copy of this telegram to Senator Johnson, acting chairman of the Senate Military Affairs Committee, who introduced the companion bill in the Senate.

Sincerely yours,

ROBERT P. PATTERSON,
Secretary of War.

SANTA FE, N. MEX., October 11, 1945.

SECRETARY OF WAR,
Chairman, Interim Committee on Atomic Energy,
Washington, D. C.

We would most strongly urge the prompt passage of the legislation now before Congress for the creation of an atomic energy commission. We know from our close association with the actual work in this field that delay will cost us heavily in efficiency, in accomplishment, and in spirit. We believe that with wisdom operations can be carried on within the framework of the proposed legislation safely, effectively, and in the best interests of this Nation. We believe that the broad powers granted the Commission by the legislation are justified by the importance and the perils of the subject. We think it necessary for the American people to understand in full the implications of the new technical situation, but we believe that the proposed legislation will make it possible for their desires and decisions to be responsibly and fully implemented. We assure you that in our opinion the legislation as presented represents the fruits of well-informed and experienced consideration.

J. R. OPPENHEIMER
ENRICO FERMI
E. O. LAWRENCE.

At this time we will call Dr. Arthur H. Compton.

STATEMENT OF ARTHUR H. COMPTON

The CHAIRMAN. Dr. Compton, we are glad to have you here as a witness. Of course, you know what we are discussing here today. We would appreciate you giving us your views on this matter in such a way as you look at it, and give us before that some testimony as to your experience and qualifications and then go into the matter that we have at hand. I wonder if you will be good enough to do that for us?

Mr. COMPTON. My name is Arthur H. Compton. Thank you, Mr. Chairman. I am an American, born in Ohio, 1892, educated in this country and abroad. So far as the atomic project is concerned, my first important contact with that was as Chairman of the National Academy of Sciences Committee on the Use of Uranium in War, which had the responsibility for recommending to the Government the program which has been carried through leading to the construction of the atomic bomb. I was assigned first to the O. S. R. D.; later carried on under the Manhattan District the task of developing the method of producing plutonium. At the present time I happen to be on the scientific panel that advises the Secretary of War. I suppose the most important statement I have to make, and I am making my statement quite informally, is that the need for some kind of control is clear and obvious, and that control, I believe, may well be placed in the hands of a commission such as is set up by the May-Johnson bill.

It is, however, at the same time unfortunate that in writing up a bill that is designed for the development and control of atomic power it becomes necessary to emphasize particularly the restrictive clauses.

Having realized as we do, the matter of insuring the safety of the Nation and the welfare of the Nation, it does become important. The safety of the Nation is only very partially secured by any kind of restrictive legislation. The thing that is really important with regard to insuring the safety of the Nation in connection with atomic power is that we should develop our own strength. And that development of our strength means the encouragement of research and of industry. One cannot get very far in the matter of safety of our Nation in the modern world by any kind of restriction. If one recalls that the other nations which may compete with us in the modern world will at the same time get ready and go ahead strongly that statement becomes rather clear. In order, in a competitive world, that we may hold our place the situation is as it has always been that the strong nation is the one that is going to come out on top and survive, in that strength we must rely and that strength is not constructive in this case, which is born of over-all development and vigor in the industry in the field very much like the situation that we have known in the present war where our strength depended in large measure on our manufacturing ability in connection with gas engines. We had a great industry in that direction, and when wartime came on we were able to put it to wartime use. In a somewhat similar way when the next show-down comes it is going to be the nation that has the strength in that field.

Now the difficulty I see with regard to the present legislation in that regard is that whereas this is called a bill for the development and control of atomic power, almost all of the bill is concerned with the implementing of controls and almost nothing is connected with regard to the implementing of the development of atomic power. I think one has to take into account the fact that some years down the line, maybe 10, certainly with 20 years, we can consider the atomic energy industry in the field of shall we say at billion dollar a year industry. If we think of it now from the point of view of our military defense it is already in that category. But I am thinking now of the peacetime industry and the indications it seems to me are clear, and I believe that that estimate would be supported by the industrial leaders who have taken the present situation into account.

With that in mind it would be reasonable for our Nation to invest a considerable amount of its effort in the research and development leading to making such an industry effective. Now, of the sums indicated by one of the members of the committee this morning, that talked of in connection with the support of this work during the next year, which the greater part of that, of course, is in connection with our production for military purposes, only a small fraction in connection with research and development, I would assume that it would be a reasonable estimate to put something like \$50,000,000 or \$100,000,000 at least annually for the next 10 to 15 years into a program of developing peacetime industry leading toward a vigorous national situation with which we can have a background for competition with any other nation in the possible struggle that may come in the future.

As I now see the situation of the present bill, this bill is aimed toward control. The control is I think important that it should be there. One has to recognize the dangers of control, and the dangers are primarily the dangers of preventing those individuals and those industries from engaging in this work that should, for the national

welfare, be engaged in it. I do not mean by that that the research man who could be doing valuable tasks in the study of problems relating to the problem of atomic energy, will go out of that field into one relatively useless field. The actual situation is that the demands of the country for research are so many and are so important that there is only a delicate balance, and if a man finds that work in the present field is under restrictions which make it difficult for him to do his work effectively, he will more or less get out of that field into another field which he feels can be developed with greater profit to the national welfare, and it does not take very much to make that shift. When one faces the restrictions which are necessary, it is important that they be limited to what is necessary and not go beyond. I might say in that regard that I think that it is a very valuable feature of this bill it puts control of work in the hands of a commission for which this matter becomes the major interest, and does not leave it in the hands of, shall we say, a congressional commission or congressional committee that has perhaps changes in its personnel frequently and can spend only a small fraction of its time on problems of this kind. I like that part of the bill that provides and puts it in the hands of a commission. I think that the commission should be encouraged to spend as much time as possible in this type of work.

If it is at all possible, and it is not at all impossible—I think this has to be considered—that there are many arguments for making research in the field of nuclear research that are open—that is a traditional direction in which work of this kind has been leading and tending to go for a long time. No restriction may apply that cannot justify itself. Any restrictions from complete openness would be considered by countries outside of our own as a threat. They would wonder: Is this being done for purely military purposes? Thus a country that plans this freedom of restriction would make it possible for our scientists to do the work that they can do most effectively, and will keep us ahead in this matter.

Mr. HOLIFIELD. Mr. Chairman, may I be permitted to ask a question at this point, or should I wait until he has finished his statement?

Mr. COMPTON. It will not interfere with my train of thought at all.

The CHAIRMAN. You may proceed, Mr. Holifield.

Mr. HOLIFIELD. I am very much interested in your statement, Doctor. In making freedom of research possible, you would at all times allow the Government to know about that research and the nature of it and the findings of it?

Mr. COMPTON. Absolutely I would do that.

Mr. HOLIFIELD. In other words, it would be all right to write into the measure that type of protection that any research should be done not under the control of directives of the Government, but with full knowledge of the Government pertaining as to the lines of research and as to such findings as are made.

Mr. COMPTON. That would be strictly in accord with what a research man would envision and would want.

Mr. HOLIFIELD. That would be freedom to go ahead in a scientific way, but it would make available to the Government those findings?

Mr. COMPTON. I believe it would.

The CHAIRMAN. Would you yield for a question?

Mr. HOLIFIELD. Yes, Mr. Chairman.

The CHAIRMAN. According to that, Dr. Compton, if somebody came in and reported that there is a rattlesnake in the back yard, and does not do anything about it, it would not do any good?

Mr. COMPTON. I do not get the import of your question, Mr. Chairman, or the implication.

The CHAIRMAN. The implication is that we hear of the dangers in the rattlesnake, and the dangers that you scientists see, and if we get nothing from them as to what they want to do to cure it, that would mean that must not do anything about it except tell you, just tell you that it is there, and what I think they should do that it is there and tell you what we should do in order to kill it or take care of the situation.

Mr. COMPTON. I see your point, Mr. Chairman. That is the reason why I like to have this matter in the hands of a commission. I was trying to indicate some of the reasons which may lead to the desire to have a complete freedom. I do not think that that is the kind of matter that ought to be written into a bill. I do not want written into the bill that complete freedom of research should be there, because I do not believe that that is the kind of thing that can be put in or determined, or can be properly drafted and determined by legislation put up and set up in a bill, but I do think that is the kind of thing that should be considered carefully on its merits by a commission which the Congress and the President feel is qualified to pass on such matters. If in the national interest such a commission feels that freedom of research is desirable, then it should be within the limits of the legislation for them to make that research free, and to determine just how it should be done.

Mr. HOLIFIELD. In my opinion, Dr. Compton, such a purpose could be written into legislation, and so far as carrying it out in detail that is another matter. I would like to ask you this, by the very nature of the military need to experiment with this uranium and plutonium would it not be essentially desirable and possible for research to be accomplished in private without the Government knowing about it, particularly if they controlled the sources which the Government does of uranium deposits? Would it be possible for security in research and development in an effective way to be done without great laboratory equipment and without the need of the Government supervising individual equipment in that way and individual research in that way?

Mr. COMPTON. I do not believe that it could be carried on to a dangerous extent without making it necessary to obtain such materials or information that it would come to the attention of those associated with the Commission, a commission of this type that is set up here.

Mr. HOLIFIELD. I understand it, or at least as I do understand it all the information in connection with uranium deposits is known. As I understand it all the Nation's sources of uranium are pretty much under the control of the Government at the present time, of the United States, and they cannot go out and get this material unless the Government knows something about it. If this project is written into this bill and becomes a law, saying that as additional uranium deposits or deposits of materials from which uranium and plutonium can be obtained in reasonable quantities, are brought to the attention of the Government, it will not of necessity mean that the Government

will have to take over thousands or hundreds of thousands of acres of mineral land, but simply a prohibition against the production of the raw uranium ores and the use of it without the Government knowledge; would that not effectively and in a proper way control it?

Mr. COMPTON. I believe it would be possible to write a statement in the bill, and that statement has already been made in almost adequate terms, which would make it possible to control such experiments in terms of the amount of material used. We have one qualification, but here I am afraid one is getting into details that one should hardly bother with at this time—I will, however, mention it—namely, that one should not attempt to prevent small scale experiments by private individuals and of a private individual type, because those are the ones that may lead to very important new results. But I believe that that in intention at least is already being covered by the bill.

Mr. HOLIFIELD. All such experiments should be known to the Commission.

Mr. COMPTON. It would be very difficult to have every experiment known because any student in any chemistry laboratory can do elementary experiments with small amounts of uranium.

Mr. HOLIFIELD. Could they obtain that uranium if the Commission controlled the sources of that uranium? Could they obtain that without the Government having knowledge of the taking of such a small amount, even if it were conducted on a small scale operation?

Mr. COMPTON. Yes; on a small scale they could do so because it is possible to obtain small amounts of uranium out of ordinary granite, and therefore, they could obtain their material in that way.

Mr. HOLIFIELD. But not in dangerous amounts?

Mr. COMPTON. I would say not in dangerous amounts.

Mr. HOLIFIELD. Those are all the questions I have, Mr. Chairman.

The CHAIRMAN. Mr. Martin, do you have some question, you want to ask the witness?

Mr. MARTIN. I wanted to ask the witness his views as to the nature of this Commission control.

The CHAIRMAN. Has he not already stated that?

Mr. MARTIN. I know he has stated some of it, but I wanted to ask about the matter of penalties. Would you place in the Commission any power to impose such penalties as provided in this bill?

Mr. COMPTON. Personally I consider it unimportant whether the penalty is there or not.

Mr. MARTIN. You would not object to penalties if they were put into legislation?

Mr. COMPTON. I think the penalties are much too drastic, but I do not believe that the penalties of the drastic type would ever be imposed.

Mr. MARTIN. How would you give the Commission a complete control in the matter of the hiring and firing of employees on this project? Or would you do that?

Mr. COMPTON. There is a point there that I would agree with you and certainly with one of the witnesses this morning, that it becomes a very critical situation if a man can be released not only from his own job, but prevented from reemployment by any other similar employer on the basis of evidence which does not need to be brought out into the public forum, and that particular provision of this bill I think is indefensible.

Mr. MARTIN. Dr. Compton, now, in the qualifications of the personnel of the Commission, would you want to have the Commission made up of men who are scientists and qualified in that field of work, or would you advocate having the men supervisors, and the Commission supervisory in its functioning, and not necessarily qualified to be in this field of science?

Mr. COMPTON. As one who was in this field and no longer am—I have ceased to be in the field of active scientific work in the last few months—I think I can speak for the scientists more freely than they can for themselves. I think in that regard, I might say, that it would be unwise for obvious reasons, to have a commission at all exclusively of men of scientific background, but it would likewise seem to me to be highly unwise to have a commission on which there was no representation of men who understood the interests, the psychology, the motivations of the men who are working in the scientific field, which means that there should be men with scientific background at least, and background of actual research, some men of that type on this commission.

Mr. MARTIN. Then it would be unwise or possibly impossible to write into such a bill as this any specific designation as to the make-up of this board or commission? How would you get it into the law, the principle that you have just now expressed?

Mr. COMPTON. I might say that among the scientific men who are doing work on this project, one of the active concerns is lest the importance of having some scientific representation be overlooked, and that the only desire to have or rather a main part of the desire to have some scientific connection and composition is traceable to the fact that this point, together with the point that Dr. Szilard brought up for the need of representation in various parts of Government is something that should be taken into account. I might say that my position would be that one would have to rely upon the President and his advisers in the set-up of such a commission, and choose wisely, and an indication might be made, however, in the bill that due recognition should be taken of the need to have representation of various types.

Mr. MARTIN. Then from your point of view you would not feel it necessary to put into this bill any definite directive or restriction of the personnel of the Commission, leaving that designation to the President?

Mr. COMPTON. I would prefer, I believe, not to have specific instructions as to how it is to be composed.

Mr. HOLIFIELD. Will my colleague yield on that particular point?

Mr. MARTIN. I will yield.

Mr. HOLIFIELD. I want to understand this particular part. You mean, after making your plea for scientific men on this Commission, and after Dr. Szilard that men of Cabinet officer rank and other representatives of the heads of departments of the Government be on it, do you mean to say that you think it would be unwise to specify that at least three men of actual science be on this Commission? If I wanted to, and I am asking you if you—well, I am not asking you to approve of this thing, but if we wanted to put down after Secretary of State, the Chief of the General Staff, the Secretary of Commerce, Secretary of the Interior, and others, and then leave maybe two more appointments, say for one Member of the Senate and one Member of

the House, do you mean to say that such a balance to the Commission could not be written into the bill? Certainly, to allow the President to use his freedom on these three men of science who would be designated by the bill, and six others, one to be chosen by the Senate, one from the House, do you not think it would be wiser to write into the bill some type of balance in the Commission rather than a blank check with no one specified? I would like to have your ideas on that. I think that is one of the most important things that we have in this bill.

The CHAIRMAN. Mr. Holifield, will you let him answer your question?

Mr. HOLIFIELD. I will. I just wanted to state it fully.

The CHAIRMAN. I think if you will let him answer your question, he will do so.

Mr. COMPTON. It would seem to me wise to indicate in the bill that due representation from these various fields should be taken into account in the appointment. I can readily see that changed conditions might want to make the number of representatives changed from time to time. At the moment, for example, this is a very live research field. Thirty years down the line the research may be so far along that it is no longer an important research field. It may be more important in industry. It might at that time be more important to have emphasis in a different direction, but at least I would like to see an indication in the bill that representatives of the various parts of the Government, of research, and perhaps of industry should be included as the Commission is named, but whether the exact numbers should be included or precisely which representatives are to be included would seem to me to be a matter of secondary importance.

Mr. HOLIFIELD. Thank you. I just wanted to get your views.

Mr. MARTIN. I do not know, Mr. Compton, that I am qualified to go into these things as deeply as I would like, but I am not sure that I am clear as to the estimate of what the difference of weight between industry and research and military use would be, those three fields, I do not know what members of the official Government agencies are qualified, or as far as that is concerned, possibly to sit on such a commission. We are trying to write a bill now that may be faced with very different conditions of weights and balances in the very near future. That is why I wanted to find out how you felt about attempting to write into this bill some such restriction.

Mr. COMPTON. I would like to have in the bill an indication that it is important that some representatives from all of these groups, and that one of the groups should be a research group.

Mr. MARTIN. Is not one of your principal reasons to see that the research end is not suppressed?

Mr. COMPTON. That is correct, that seems to me at the moment to be one of the things which will determine whether the United States remains in a strong position or falls to a weak position.

Mr. MARTIN. My reaction to the testimony of the scientists so far before us here was that as a group you are more concerned with seeing that you are not suppressed or retarded or discouraged in your research and development work than anything else.

Mr. COMPTON. I think that is probably an accurate statement.

Mr. MARTIN. That is your principal concern at the moment, Dr. Compton?

Mr. COMPTON. Yes; I would put it more positively—that my principal concern is that the bill's intention—that it be made clear that the intention of the bill is to permit the development of industry in the field of atomic energy rather than to make the emphasis, as it now is, in the direction of controlling those who do the work in this field. That change in emphasis seems to me to be, if it is possible to do it, a very important matter.

Mr. MARTIN. Those are all the questions I have, Mr. Chairman.

The CHAIRMAN. Mr. Elston, do you have any questions?

Mr. ELSTON. Just a few. Dr. Compton, I take it that the penalty part of the bill that you particularly object to is the clause which makes it possible for the Commission to make its own regulations and then act as judge, jury, and executioner in the enforcement of them?

Mr. COMPTON. That is precisely it, Congressman.

Mr. ELSTON. I certainly agree with you in that connection. We have too many agencies down here today that are passing rules and regulations, and they are hidden in the Federal Register, and then they send people to jail for violating them, and nobody ever heard about them.

The CHAIRMAN. You are speaking about the OPA?

Mr. ELSTON. About the OPA particularly, and about a number of the others in general. Dr. Compton, you do not object to the severe penalty for giving away secrets of the atomic bomb to a foreign country?

Mr. COMPTON. Really, I do not, because if it is on the basis of intentionally giving it away, no; that, however, is perhaps already covered by the laws in regard to espionage.

Mr. FENTON. That would be treason, would it not?

Mr. ELSTON. It would not exactly be treason because treason is defined by the Constitution to consist of only in levying war against them, or adhering to their enemies, giving aid and comfort to them. That is somewhat synonymous with sedition. Since this might be giving aid to another country in times of peace, certainly the penalty should be equal to the penalty for treason. You do not object to a very severe penalty if it happened knowingly and willfully that someone should give away any secret in connection with atomic power or atomic energy to any foreign country?

Mr. COMPTON. Beyond the limits that are set by this Commission that is correct. When you say that, I think one must consider—well, in that case they are no longer secrets, I suppose.

Mr. ELSTON. In any event, if there is any penalty, Congress has the right to write it clearly and definitely as to the acts that should be punished?

Dr. COMPTON. I really do not see any difficulty with having a severe penalty for willfully and knowingly and, shall we say, with malice toward our own country, giving away secrets which have clearly been described as those which should not, in the Nation's interest, be given away. I might point out in that connection, however, on this, which was reenforced by a statement made this morning—the fact that the Nation's safety is not safeguarded by retaining these secrets. The Nation's safety is safeguarded primarily by building up our own strength, and it is really only a very minor part of our safety that is

concerned with giving away any of this information. I would support completely the statement, I believe, which was made by Mr. Szilard this morning, to the effect that the actual information as to how to make the bomb, even though given would not greatly affect the time at which the rival nation would be able to have bombs ready to drop upon us. But the thing which will greatly affect our comparative situation is the degree of encouragement and number of activities of a scientific and industrial way, that we set up in this country in this field. If we find that by making severe penalties, imposing close secrecy conditions on our men we are retarding the development of the work in our own country, then is the time that we must face the fact that we have gone too far. It may have already done us severe damage. So that I—while I do not think that those penalties are out of place, I would like to have us get away from the notion, because I would consider it an aspect very close to treason, and I feel it has very little to do with the national safety; national safety has more to do with what we do to encourage or discourage the development of work in this country along this line.

Mr. ELSTON. You feel that this bill, as drawn, will discourage rather than encourage the development of atomic energy in this country?

Mr. COMPTON. I think that is one of the difficulties. I do believe we should so tone down this bill. I believe it is a good bill and that it can be modified in such a way as to get rid of this difficulty; at least, I hope so. I think that is the difficulty, but I do not think it is at all insurmountable.

Mr. ELSTON. In any event you do not see any reason to set up an independent agency that gives more power, gives more power to it than any agency that has ever been given in the history of this Nation, do you, Mr. Compton?

Mr. COMPTON. Instead of answering that directly, may I say that if that agency is necessary to supply the safeguards required, it should be set up. At the present time I am doubtful whether the extremely broad powers can be justified. They seem to me to have little to do with the question as to whether the field of research and industrial development of atomic power is encouraged, and again it is the encouragement of the field of activity which seems to me to be the primary concern of this Commission.

Mr. ELSTON. If you gave this Commission the authority that is requested in this bill you would make it possible for the Commission to completely nationalize atomic power if they wanted to, on the other hand they could use it entirely for industrial purposes, could they not?

Mr. COMPTON. They would appear to have tremendous powers under this bill. Just where they would take them I would not know.

The CHAIRMAN. I do not know whether that was the question or not, I think it was a statement more or less.

Mr. ELSTON. I said if you gave this Commission all the authority that is requested in this bill you would make it possible for the Commission to completely nationalize atomic power both for military and for industrial purposes, would you not?

Mr. COMPTON. And to that I would say "yes." I merely affirm your statement. There was one aspect with regard to the placing of the Commission in a situation with regard to the national policy.

We have here a Commission which in its present form has very broad powers. I believe perhaps the powers have to be broad, though perhaps not as broad as they are now. But there is one aspect of that—this continues longer than the President continues, because the person on the Commission continues for 9 years. That means it is not impossible for the national policy to be carried on by such a Commission beyond a change of national ideas with regard to international policy. With the very broad powers now written into this bill for this Commission to control atomic energy, it might be carried on under these conditions in a manner which is not in accord with the rest of the Administration's policy. That is a hazard that needs to be considered.

The CHAIRMAN. Do you have anything further, Mr. Elston?

Mr. ELSTON. That is all I have at the minute.

Mr. HARNES. I have this question too to ask the Doctor. Doctor, it is not clear to me just what we are trying to do here, we are setting up this Commission and giving all of this power in authority there for research and development of this atomic energy. Is it for the purpose of safeguarding any future development, or present development against some other nation acquiring it, or is it for our own safety in protecting us in the United States?

Mr. COMPTON. I believe—really, I am not the person to have you ask that question because I knew nothing about this bill until after it had come to your attention. But my impression is, I will say this, that it is important that some bill on atomic energy and work in atomic energy be brought into effect for our own internal, national welfare. It is dangerous to play with. We cannot leave it without restrictions.

Mr. HARNES. Dr. Compton, is it dangerous to experiment with high explosives; that is most dangerous, is it not?

Mr. COMPTON. That is quite dangerous from the standpoint of the explosives; yes.

Mr. HARNES. There is no restriction on that?

The CHAIRMAN. Oh, yes; there is. There are restrictions concerning the development of high explosives and the handling of them, and there have been for many years.

Mr. HARNES. Scientists and laboratories can do all the experimenting they want to in connection with high explosives.

Mr. COMPTON. I would put it somewhat more closely in comparison with people playing with narcotics, that it is something that is very dangerous if allowed to get out of hand. I do think that the kind of control that we have in the case of narcotics might be a rather good example of what should be followed here.

Mr. HARNES. Do I gather from that, then, that this development, and that this discovery is something that is dangerous and that it might destroy over a period of years our own people who play with it, and those who come around it?

Mr. COMPTON. The best answer that I can give to that is that in the several years that I have already passed during which we have been actually working with these large atomic bomb plants, some of them working at a very high level of density in all of our work there has not been one serious accident.

Mr. HARNES. Dr. Compton, I did not clearly understand then why you say you have to have this control for our own welfare—be

specific, tell us something about what it will do to an individual which makes it important for us to have that sort of thing.

Mr. COMPTON. It is very possible to kill people with radiation burns, and I would say that that is the chief hazard.

Mr. HARNES. Any more dangerous than the X-ray and electric energy?

Mr. COMPTON. By degree only, being perhaps thousands of times more intense than one has from X-rays. Both have the type of restrictions required, but in different degree. By that, however, the type of restrictions needed are comparable with this that we now have in the Pure Food and Drugs Act. I think the restrictions that are in the Pure Food and Drugs Act are somewhat similar to the ones that might be required here. I see no reason, for internal reasons, why the restrictions should be of a more severe type than those which would come into such a case. The only reason for this severe type of penalties or restrictions would perhaps be those with regard to letting information of a critical type get into foreign nations' hands. That would be the type of information that might be useful in connection with the construction of weapons.

Mr. HARNES. There is no law that could prevent that anyway, is there?

The CHAIRMAN. As to that, there certainly is.

Mr. HARNES. I mean, you cannot write a law that will prevent an individual from making a discovery. It might be right there in his brain, he might discover it right out of thin air, like you have discovered some of these other things. There is no law that will prevent them from discovering it.

Dr. COMPTON. No. It is possible, of course, if one wants to restrict the publication of the information.

Mr. HARNES. We might restrict in a measure his dissemination of the discovery.

Dr. COMPTON. I would prefer personally in that regard to leave the activities in connection with publications in the hands of a scientific group that knows the importance of these discoveries, but that is a question that can be determined by the Commission.

Mr. HARNES. Of course, you can gather, Dr. Compton, that I am confused about these things. I know so very little about these scientific matters, and it is difficult to get a picture of what we ought to do.

Dr. COMPTON. May I say again that I favor the idea of a Commission substantially now in the form presented in this bill which could, after the result of careful consideration as you are now giving it, determine what restrictions we should have for the Nation's welfare, and from that point of view, I feel it is good. It depends upon the personnel of the Commission to a great degree in any event.

Mr. HARNES. This would be a blank check of authority to the Commission to determine what is good for the welfare of the Nation?

Mr. COMPTON. That would be a blank check. Whatever restrictions Congress wants to make of the extent to which they want to go is something that should be written into the bill. I have not been able to think of any such restrictions that I would want to place on them at this time.

Mr. HARNES. Dr. Compton, I do not think I understood an answer to a question a few minutes ago just what you had in mind,

but something to the effect that in private industry or in private laboratories they could continue their research and study in this field, but it could not do any harm; is that correct?

Mr. COMPTON. I said that the amount of material they have would mean that the work they did in all probability would not do any harm.

Mr. HARNES. I just wanted to get that clear. In your opinion, in private industry or in private laboratories they could continue their research and study in that field but they could do no harm.

Mr. COMPTON. I believe that is correct.

The CHAIRMAN. Just a moment, gentlemen. We have a roll call now. We will recess now, and we will return and reassemble at 3:30 p. m.

(Whereupon, there was a short recess.)

The CHAIRMAN. Mr. Brooks, do you have any questions?

Mr. BROOKS. I have only one or two questions, Mr. Chairman.

Doctor, there has been a good deal of comment in the press and on the radio and elsewhere about the matter of whether or not the Nation should retain the secret of the atomic bomb. In the armed services in the past has it not been a matter of policy to retain our secrets, whether military or naval secrets, and not give them to other powers?

Dr. COMPTON. Yes.

Mr. BROOKS. Is there anything different in the atomic bomb in that respect that would cause one to come to the conclusion that we should not follow the normal policy?

Dr. COMPTON. With regard to the bomb itself, that is, the construction of the bomb and its effectiveness and all matters pertaining to it, I should say that it stands in precisely the same situation as other types of weapons. Atomic energy, however, has peacetime applications. The research which leads to the development of atomic energy and likewise to the improvement of atomic bombs has many other applications, and in that regard this differs from most of the other types of weapons with which we are familiar.

Mr. BROOKS. There is nothing in the potential peacetime usage of the atomic energy which would cause one to reach any other conclusion than to follow the normal policy of the Nation in maintaining its military secrets. Is not that correct?

Dr. COMPTON. With regard to those which are strictly military secrets, I would say, "yes."

Mr. BROOKS. Even gunpowder, if used for civilian purposes, and almost any weapon can have a civilian usage?

Dr. COMPTON. It has already been brought out that the so-called secrets leading to the development of the bomb, so far as they are concerned, were purely scientific information. They are so widely known that there is little of a secret to be released. The secrets that we have remaining are primarily concerned with technical know-how in connection with the production of the materials of which the bomb is composed and the construction of the bomb itself. Those remain secrets. So far as the growth of the field of knowledge and industry in connection with atomic energy is concerned, there is no reason why those should be made open, so far as I can see. But there is an important reason, so far as the national strength in the development of knowledge and industrial applications are concerned, in having exchange of ideas on purely scientific grounds.

Mr. PHILBIN. Are you aware, Doctor, that there are scientific developments to the extent that there is possibility of defending against the atomic bomb as a military weapon?

Dr. COMPTON. If you refer to a means of stopping the bomb itself, I am not aware of any. I would say that it is a possibility that should be investigated. But there is no reason that I know of why it would be easier to stop an atomic bomb than it would be a shell or a rocket or any other kind of explosive-carrying material.

Mr. PHILBIN. Science has not yet worked out any way by which any kind of bomb could be intercepted?

Dr. COMPTON. That is correct.

Mr. PHILBIN. As to the quality of the bomb itself, is it dangerous to have around? Is there any danger per se in having a bomb located close to habitation?

Dr. COMPTON. No. In making an atomic bomb explode it is necessary to do it intentionally. There is no reasonable possibility of its going off without careful preparation.

Mr. PHILBIN. So far as you know, there is nothing in existence now that can make it possible for us to be defended against it if used as a military weapon?

Dr. COMPTON. I know of no such possibility, and I do not see any on the horizon.

Mr. PHILBIN. That is all.

Mr. HOLIFIELD. Doctor, in your testimony I seem to see where you want to draw a clear line between the domestic use of this bomb and research and development for the purpose of domestic use and its military application. In order that I may understand your views, I want to ask you a few questions.

Let us assume that the production of this atomic energy is handled solely by the Government or Government licensees. Is it possible for them to give out a certain amount of this energy for domestic application?

Dr. COMPTON. Yes; it is.

Mr. HOLIFIELD. Let us take General Motors as an example. It is not necessary for that company to have an atomic energy production plant in order to place that energy in some kind of domestic application?

Dr. COMPTON. It depends upon the particular type of application which is desired. For some purposes it is not necessary for such an industry to have an atomic power plant. Perhaps it would be a great advantage for them to have it. But it is worth pointing out that it would not be at all necessary, in case they had an atomic power producing plant, for them at the same time to have the materials that would be necessary to compose the atomic bomb.

Mr. HOLIFIELD. In other words, there are two different fields. The atomic bomb is one field which is strictly military, you might say, and the other is the domestic application of atomic energy in the future for domestic purposes?

Dr. COMPTON. It is possible to separate those fairly sharply. It is true that some methods of producing atomic power might be transformed without too much difficulty into means of producing plutonium, which would be a possible source of an atomic bomb.

Mr. HOLIFIELD. You have no objection whatsoever to the Army using in a military way and keeping secret in a military way any

application in the way of constructing bombs or other weapons? You have no objection to that?

Dr. COMPTON. On the contrary, I think they should.

Mr. HOLIFIELD. But you want to divorce their complete control of scientific development in order that they may not have control over it because of the fact that you think it may minimize the domestic application. Do you think it would be wise to do that?

Dr. COMPTON. My belief is that the more freely we are able to discuss the scientific aspects of atomic energy the better will our Nation be defended; and that is primarily because of the increased knowledge that we will gain in our Nation because of the development of our atomic industry.

Mr. HOLIFIELD. It will be used in both phases?

Dr. COMPTON. It can be used in both phases; that is correct.

Mr. HOLIFIELD. I want to go back to the Commission for one question. Do you think that this Commission should be composed of part-time men or full-time men? Do you think, in other words, that the Commission can render a service commensurate with the importance of this affair and be composed only of part-time men?

Dr. COMPTON. I question whether as a scientist it is appropriate for me to give a positive answer on that. I would nevertheless give you my judgment for what it is worth, and that is that I would think it doubtful public policy to put a majority of full-time men on this Commission. The reason for that is that this Commission should consist to a large extent of men with broad interests. If a majority of the Commission consists of full-time paid employees, they will be passing really on matters in which they themselves have a direct interest. For that reason it would seem to me wise to have not many, not a substantial part of the Commission as full-time employees.

Mr. HOLIFIELD. Thank you. I want to ask you one other question. We had quite a discussion this morning in regard to patents. What is your attitude toward scientists retaining for their own private welfare or private financial interests patents on a thing that is fraught with such terrible world-wide consequences? Do you feel that any scientist should be allowed to retain patent rights or royalty rights on a thing as big as this?

Dr. COMPTON. With regard to control of patents I would say that the control must be in national hands.

Mr. HOLIFIELD. Let us say that Scientist A invents a method of procedure for the better production of this. Do you think that the Government of the United States should have to pay him a royalty for that knowledge?

Dr. COMPTON. It depends upon how that knowledge has been obtained. I would say that a person who makes an invention is entitled to fair compensation for the work that he has done in making that invention.

Mr. HOLIFIELD. I think that is so in the ordinary course of commerce; I thoroughly agree with you. But I am wondering if in this field, which has been developed mostly through Government money and which is fraught with so much world-wide consequences, those same private personal rights obtain.

Dr. COMPTON. So far as employment is concerned, if the man has already been compensated for his work in terms of salary or by some other method, then presumably the right to further compensation

no longer exists, because he presumably was employed so that he would make this invention. But if he has made the invention privately, I see no objection from the point of view of justice to appropriate compensation being paid him by the Government if it takes over control of his invention.

Mr. HOLIFIELD. Can you extend that into the military field? If this man invented some method of procedure which would be adopted by the military, do you expect the Government of the United States to pay him a royalty if it used that procedure in the construction of a superbomb, beyond that which we are now able to make?

Dr. COMPTON. I see no reason that the fact that it becomes of national interest lessens the Nation's obligation to pay the individual an appropriate amount for his services.

The CHAIRMAN. I doubt if that is pertinent to this issue.

Mr. HOLIFIELD. I think it is very pertinent.

The CHAIRMAN. We are not going to take patents away from anybody, unless they are military patents.

Mr. HOLIFIELD. That is what I am asking about.

The CHAIRMAN. The witness has stated his position. What more do you want?

Dr. COMPTON. I should emphasize this, however, that I do think that the Government should have a full right to take patents over and control them and to take them, if necessary, from the individual who has them, so that if this becomes a matter of national concern, if in the judgment of the Government it is of national concern, it has the power to take over the full rights to the patents.

Mr. PHILBIN. What proposals do you have regarding international control of atomic energy?

Dr. COMPTON. I would say that there are two stages of that. In the first place, the only type of international control that would seem to me to be successful would be to put in the hands of an international organization power to investigate what is going on in all the countries that belong to the United Nations Organization, and likewise the power to enforce any action by having ability to wage war with atomic weapons. I see no possibility myself of insuring that nations that have atomic weapons available will not use them if it comes to a desperate war. So that as for international control, it seems to me that in the first place the power of investigation by the United Nations, and, in the second place, the support of any action by the ability of the international organization to wage war, is inevitably called for by the present situation.

Mr. PHILBIN. Would that involve, in your opinion, necessarily, the disclosure of existing knowledge in the hands of our own Government and our own scientists to some international organization?

Dr. COMPTON. Eventually, yes. My own position on that would be, however, that until control can be securely set up it is essential for our Nation to look after its own defenses and maintain its own strength so we can reply effectively to any attack that might be made upon us.

Mr. DURHAM. Doctor, how long do you think it will take to develop this atomic energy?

Dr. COMPTON. If you mean, to the stage where one can secure atomic power as distinct from an atomic bomb—because there are two different stages there—a rough guess would be 5 years before

that stage would be reached. For an atomic bomb it would have taken twice that long if it had not been the emergency of a wartime development. That is my rough guess.

Mr. HARNESS. Doctor, after the war is officially over we will have no such control as is contemplated in this bill over business, radar, radio, high explosives, and other dangerous things. If you felt today that every other nation in the world, any of our potential enemies, knew as much about producing atomic bombs as we know today, would you still say we should have such a commission with all the powers that are granted in this proposed legislation?

Dr. COMPTON. I do not think that it is really necessary that this Commission have the broad powers that are given to it in order that the Nation's welfare should be secure under the conditions that you describe. The important point, as I said before, is that the Commission have the power to encourage the development of this field; and that power would be doubly important in case we were competing in an open field with other nations.

Mr. HARNESS. Don't you think that the ordinary scientist would want to pursue his studies in this field because of the remote possibility of its being used commercially, unless he was subsidized in some way by the Government that wanted the research made for military purposes and for national defense?

Dr. COMPTON. No. I apparently have not made myself clear. I do feel that if the field were free—it is from the scientific point of view—it is a matter of understanding what the world is like; and likewise, from the industrial point of view, quite in its own right, apart from the military aspect, it is a very interesting field and would, if left to itself, develop rapidly. I believe it can be developed more rapidly if subsidized and encouraged by the Government—considerably more rapidly.

Mr. HARNESS. That is the primary reason why you think there should be some further control?

Dr. COMPTON. That is correct. Associated with that development there should be control.

Mr. PHILBIN. To what extent do you think the Government should subsidize the development of atomic energy not only for scientific but for security reasons? How much money annually do you think the Government should provide for it?

Dr. COMPTON. Earlier this afternoon I gave the estimate that within 10 or 15 years I believed it would be industrially a billion-dollars-a-year business, something of that order of magnitude.

The CHAIRMAN. Mr. Voorhis, would you like to ask the witness any questions?

Mr. VOORHIS. No, sir.

Mr. PHILBIN. I think you may have misconstrued my question. The point of my question was to ascertain how much money you think Congress ought to authorize annually for research and development of atomic energy for scientific, industrial, and military purposes.

Dr. COMPTON. My reason for giving that figure was that if the United States were operating an industry they would presumably put into the development, roughly, the amount that would be eventually that annual turn-over, which would mean that they would roughly put into that development a billion dollars if they anticipated a billion-dollar industry afterward. On that basis, for purely peacetime development, one would expect the United States to put in

something of the order of \$50,000,000 or \$100,000,000 a year for the next 10 or 15 years. That is independent of the military requirements. The military requirements are already on the basis of, roughly, \$1,000,000,000 a year; and something of the order of \$20,000,000 to \$50,000,000 annually after that would be likewise appropriated for research and development. That would mean a research and development budget of the order of \$50,000,000 a year. That is only a part of the \$600,000,000 that was mentioned this morning as the present rate of expenditure, most of which goes into production for military purposes.

Mr. PHILBIN. That is all.

The CHAIRMAN. Dr. Compton, I do not want to detain you very long, but I would like to ask you just a few questions. One or two are general in nature. The first is this:

Do you agree that the President of the United States, regardless of the party he belongs to, is the person who ought to select and name the Commission.

Dr. COMPTON. Yes.

The CHAIRMAN. Do you agree also that, generally speaking, men in public office are honest and have patriotic purpose in the Government? Most men in the Government are honest, are they not?

Dr. COMPTON. We elect them because we believe that is true.

The CHAIRMAN. In other words, what we like to do is to assume that everybody is honest until the contrary appears. They mean to do their duty in public office generally and do what they think is about right.

Do you have any doubt about a commission being appointed by the President that would not be composed of honorable men?

Dr. COMPTON. The answer is that I have no reasonable doubt in that regard.

The CHAIRMAN. The very first section of this bill declares the policy of the Government with respect to atomic energy and the general welfare, and closes it with this statement in lines 14 to 19, on page 2 [reading]:

The primary objectives of all action—

And I call your attention to the word "all"—

all action taken under or pursuant to this Act shall be the promotion of the national defense, the protection of the safety of the inhabitants of the United States, the safeguarding of world peace, and the furtherance of the acquisition of knowledge concerning atomic energy.

Do you think that men who have the welfare of their country at stake, and who are under oath and acting as public officials, would not give reasonable encouragement to the acquisition of knowledge concerning atomic energy, when the Congress has declared that they shall do it, and makes it mandatory?

Dr. COMPTON. I believe that they would do their best.

The CHAIRMAN. The only question remaining would be competency?

Dr. COMPTON. Yes.

The CHAIRMAN. If you turn to page 5 of the bill you will find on the question of the administration of the act these words in line 19 [reading]:

In the conduct of its activities the Commission shall adopt the policy of minimum interference with private research and of employing other Government agencies, educational and research institutions, and private enterprise to the

maximum extent consistent with the accomplishment of the objectives of this Act.

Do you see any danger to private industry in that provision, from an act administered by reasonably honest men and reasonably intelligent men?

Dr. COMPTON. I would say that my difficulty with that statement is that it is a negative rather than a positive statement. It says, "shall adopt the policy of minimum interference with private research," and so forth. It does not say that it shall adopt a policy of encouragement.

The CHAIRMAN. We are assuming in the first section that what they are trying to do is to encourage research. It says that there.

Turning to page 17, where the question of the authority of the Administrator is provided for, it first provides for experimentation in the field of nuclear fission, the transmutation of atomic species, and then it has this proviso [reading]:

Provided, however, That it shall be the policy of the Commission and of the Administrator, in accord with the objectives of this Act, to utilize, encourage, and aid colleges, universities, scientific laboratories, hospitals, and other governmental, nonprofit, or private institutions equipped and staffed to conduct research and experimentation in this field.

There is the imperative "shall" again.

Dr. COMPTON. I think that is a very good statement. I like that sentence.

The CHAIRMAN. And you think that universities ought to be utilized in the development of scientific research in the future?

Dr. COMPTON. Yes; I think they should.

The CHAIRMAN. You mentioned the fact in your testimony that you were connected in some way with the National Academy of Sciences?

Dr. COMPTON. Yes.

The CHAIRMAN. What was your connection with that organization?

Dr. COMPTON. The official position was Chairman of the National Academy's Committee on the Use of Uranium in War. It was a committee appointed by the president of the National Academy at the request of the Office of Scientific Research and Development.

The CHAIRMAN. Do you think that the facilities of that organization ought to be utilized also?

Dr. COMPTON. It would be very wise, I believe, to bring them in in any way they could be used.

The CHAIRMAN. On page 21 of the bill the topic of control of activities is mentioned, and then you find on the top of page 23, line 1, this statement [reading]:

In administering this provision, the Commission and the Administrator shall interfere to the least possible extent with small-scale experimentation in research laboratories of nonprofit institutions.

You do not have any objection to that provision, do you?

Dr. COMPTON. No.

The CHAIRMAN. As a matter of fact, this bill, from your reading of it, indicates very strongly that the drafters of the bill were trying to provide a way in which this Commission could work along with private industry and private institutions?

Dr. COMPTON. I think that is correct.

The CHAIRMAN: And if the Commission is set up with proper personnel, capable and upright, there ought not to be any great danger of anybody suffering from it, ought there?

Dr. COMPTON. With the proviso that capable only means capable and qualified in the field which is being operated.

The CHAIRMAN. In other words, what you are suggesting is what I am thinking, that there should not be any Congressmen on it?

Dr. COMPTON. That was not my intention.

The CHAIRMAN. We might get politics in it if we had a Senator on one side and a Representative on the other side.

Dr. COMPTON. As a matter of fact, I have sat on more than one board with Members of Congress, to which they have contributed very effectively.

The CHAIRMAN. You have given us what I regard as a completely impartial and highly intelligent statement.

Mr. JOHNSON. I do not know whether this has been brought out or not, but, as I understand it, uranium is found in ledges in the mountains just like other kinds of ore. Is it found in the same strata or near the same strata as gold and silver and iron, for instance?

Dr. COMPTON. I am not well informed, Mr. Johnson, with regard to the occurrence of uranium, but it is widespread in its occurrence.

Mr. JOHNSON. Is uranium itself, without applying to it some industrial process, dangerous?

Dr. COMPTON. No; it is not.

Mr. JOHNSON. In other words, before there is any danger you have to put it through a process, capture it and confine it and then provide a way to explode it?

Dr. COMPTON. Yes; that is correct.

Mr. JOHNSON. The impression I got from the hearings was that any activity that has to do with uranium is dangerous. Is that a fallacy?

Dr. COMPTON. It is a fallacy. The only reason that one might consider it dangerous is because information might come out of it that might lead to something else, or something of that kind. But it is perfectly possible with safety to do experiments on a small scale with uranium.

Mr. JOHNSON. There are a great many commercial uses to which this element is put, which could be done in laboratories without any danger to anyone?

Dr. COMPTON. Yes.

Mr. JOHNSON. The only danger that has been exposed so far is the fact that you can put it together in a form where it is highly explosive. Is that correct?

Dr. COMPTON. Even that is exaggerated. Uranium, until it has gone through the process of separation to uranium 235, can at most produce atomic power and not atomic explosions.

Mr. JOHNSON. Then what do you think about the sweeping provisions of this bill which would allow the Government to take every possible source of uranium including any other metals mixed up with it?

Dr. COMPTON. It is justified, perhaps, on the basis that one does not want any possibility of an individual entrepreneur proceeding on such large scale developments of uranium as would make possible the accumulation of dangerous amounts of material.

Mr. JOHNSON. Is there any commercial use to which this element has been put now or before now?

Dr. COMPTON. There is a certain ceramic use. That is the chief use. It is used in making glass, in glazing porcelain, and matters of that kind. That is the chief use to which it has been applied. The production of radium likewise is one. Uranium ore is the source of radium.

Mr. JOHNSON. How long has that been going on?

Dr. COMPTON. Since about 1900.

Mr. JOHNSON. Is there any way in which any industrialist or mining concern or commercial outfit would ever get uranium and make it into a dangerous form without its becoming perfectly obvious to everybody around them?

Dr. COMPTON. The methods now employed are ones that would make it obvious. I would not want to say that methods cannot be developed, however, that would be otherwise. It would be more time consuming. I am thinking about what might be done in another nation rather than here; but even here a large industry might, if it wanted to carry on processes in certain buildings to which workmen would not have access in general, that might be dangerous.

Mr. JOHNSON. That is all.

The CHAIRMAN. Thank you, sir.

STATEMENT OF DR. J. R. OPPENHEIMER

The CHAIRMAN. Will you tell us something about your qualifications, your experience, and your connection with the subject embraced in this bill?

Dr. OPPENHEIMER. I have practically no qualifications, Mr. Chairman. I am a physicist who taught in California, in Berkeley and in Pasadena, before the war. In 1941 I became interested in the possibility of making atomic weapons, and since the inception of the laboratory at Los Alamos I have been its director. So I know a little bit about the making of bombs.

The CHAIRMAN. You may proceed with your statement, Doctor.

Dr. OPPENHEIMER. I have very little to add to the testimony which Dr. Compton has given and which has come out in the questions which the members of the committee have asked. But I think I may owe an explanation to the committee of the telegram which I sent the Secretary of War in conjunction with Dr. Lawrence and Mr. Fermi in which we urged the prompt passage of this legislation.

In the first place, there are two reasons why we would like to see legislation passed soon. One I might illustrate in the following way:

There are many things that ought to be done with atomic energy in a military and industrial and scientific way which are not being done now. One of them is a very small example. There are some people in southern California who would like to use the radiations from a small power unit to study biological problems to try to understand certain diseases and to try to find a cure for those diseases. They are not able to operate, not only because they have not the material with which to work, but because all of the information involved in the building of this particular unit is tied up under absolute secrecy at Los Alamos.

It is not, in my opinion, reasonable to ask the War Department to make fundamental decisions of policy on how such information should be handled. I do not think that the War Department is at present making such decisions, and information which might save lives and suffering is not being obtained because there is no authority to run the project. This is only one small example, but it is a true one.

The second reason is this: My own belief—and I think in this I speak for all scientists, or almost all scientists—is that the greatest possible future safety of this Nation against atomic weapons will rest in international control of atomic weapons. This is almost a negative statement. I believe that the people who have the responsibility for negotiation would prefer to do so with a satisfactory national organization. I have been assured of this, and I think it is true.

In addition to that, I would say a word or two about the bill. I did not have anything to do with the drafting of the bill, and I am not competent to judge of its adequacy.

It is certainly a bill which does not establish policy; it establishes a framework within which the policy agreed on by the Congress, by the American people, and expressed by the President, may be executed.

I share the confidence that the chairman has expressed in the ability of this Nation, in a matter of such great importance, to find nine reasonably intelligent and conscientious men to carry out whatever policy the country decides is right. I share his confidence that an administrator can be found who will carry out these policies in practice. No one that I have talked to would claim that the May bill makes it impossible to operate properly the many complicated and potentially dangerous elements in this project. The most that people claim is that it is not written into the bill just how these policies are to be formulated and how they are to be carried out.

In that connection I have one thing to add. The bill was drafted with the detailed supervision of Dr. Bush and Dr. Conant, with the knowledge and the agreement of the former Secretary of War, Mr. Stimson. I think that no one in the country carried a greater weight of responsibility for this project than Mr. Stimson. I think no men in positions of responsibility, who were scientists, took more responsibility or were more courageous or better informed in the general sense than Dr. Bush and Dr. Conant. I think if they liked the philosophy of this bill and urged this bill it is a very strong argument. I know that many scientists do not agree with me on this, but I am nevertheless convinced myself.

I would go one step further. It would in some ways be desirable to have a bill in which the powers of the Commission were much more carefully defined than they are in the May bill. I think that has not been done, for a good reason. It has not been done, because the subject is not only very important; it is very new. I think if we had tried to write a bill on atomic energy in 1941 everyone would have agreed that you could not do it, that the subject was not yet old enough. It is my conviction that the subject is still not old enough to write a bill under which operations can continue with the rapidly changing technical situation. Even if we forgot the matters of policy connected with industrial exploitation, the matters of policy connected with international relations, the dangers of war and the possibilities of further war, we would still have the fact that even the

science in which this is working is changing from day to day; and I hope it will change very much in the next 10 years, because it is in these changes that our real progress lies. And many, at least Dr. Bush and Dr. Conant, were very much impressed by the rapidity with which they had seen ideas change, by the rapidity with which they had seen new possibilities brought in. They would have found it unwise to write specific directives, such as control of this material and no control of that; let this experiment be done, but not this one; let this industry be uncontrolled and that industry be controlled—because they did not know, and I am sure I don't know, how to set these limits. I think, therefore, it is fair to say that the May bill has been written largely from the point of view that we must have confidence in the Commission; we must have confidence in the Government of this country. We are not in position to write detailed directives that will be binding for any reasonable period in the future. With the understanding that as the issues become clear it is appropriate to reconsider the legislation, that it is appropriate not to regard it as a scheme for all eternity, but as a measure which for the moment is the best that we could do. In that sense I think it should be supported.

I want to say one thing purely as a representative of scientists.

Scientists are not used to being controlled; they are not used to regimentation, and there are good reasons why they should be averse to it, because it is in the nature of science that the individual is to be given a certain amount of freedom to invent, to think, and to carry on the best he knows how. Most of the scientists with whom I have talked would like the assurances which are now in the bill, somewhat reinforced, about the intention of the Congress to direct the Commission not to interfere with scientific work except when there is a national hazard involved. This could not be said very much more strongly, but I think there are a few words that might be said, that the Commission should in no way interfere with or control research except insofar as the national safety and the national security are involved.

I believe that the War Department would be glad to support such amendments, and I believe it would do a great deal of good in reassuring the academic scientists of the country if such amendments were written in. There may be others. I do not want to go into details.

Mr. JOHNSON. Do you think the present bill is too sweeping and covering more than the necessity for security?

Dr. OPPENHEIMER. I am sure it is too sweeping, but I do not know how to make it less sweeping and still make it good. I am sure that if you say to the Commission, "Don't control anything," you will not have control. That has already been said.

Mr. JOHNSON. Do you think we could wisely leave it to the Commission to determine?

Dr. OPPENHEIMER. It seems to me that is the intention of the bill, and I agree with it.

Mr. HOLIFIELD. Would you be perfectly satisfied if a high Army officer should be appointed as the Administrator and a high Navy officer as Deputy Administrator? Do you think that such an appointment would be conducive to full and free scientific research in all the fields of atomic energy?

Dr. OPPENHEIMER. I cannot think of an administrator in whom I would have more confidence than General Marshall.

Mr. HOLIFIELD. Would you be perfectly willing to put the Administrator and the Assistant Administrator in the hands of the military completely?

Dr. OPPENHEIMER. I think it might be unwise, but I think it is a matter not what uniform a man wears but what kind of a man he is.

Mr. HOLIFIELD. That is very true; but don't you feel that if research and development were to be completely in the control of the military, it might be done along military lines rather than along civilian lines?

Dr. OPPENHEIMER. It might. It would certainly be so—

Mr. HOLIFIELD. Naturally, would it not?

Dr. OPPENHEIMER. No. I was going to say that if the administrators were chosen as representatives of the services to carry out work of consequence to the services, then it might be so.

Mr. HOLIFIELD. I am highly in favor of that. I think they should have control of all military applications; but I would hesitate to turn over all control of development and research and channel it into the hands of the military. They might not look upon civilian development with as complimentary a glance as others might.

Dr. OPPENHEIMER. That may be. You see, this legislation is legislation to get control of the project out of the War Department, not to put it into the War Department.

Mr. HOLIFIELD. I am not so sure of that.

Dr. OPPENHEIMER. That is what my friends of the War Department, for whom I have labored, tell me.

The CHAIRMAN. The War Department discovered the weapon. Why can they not keep the secret?

Have you completed your statement?

Dr. OPPENHEIMER. I am completely through, Mr. Chairman.

Mr. JOHNSON. Dr. Oppenheimer, this work has been done by a great many noted scientists?

Dr. OPPENHEIMER. Yes, sir.

Mr. JOHNSON. I think you ought to put into the record, if you know, who the men are who received the Nobel prize, who worked on this project.

The CHAIRMAN. Dr. Oppenheimer is one of them.

Dr. OPPENHEIMER. No; I am not, but there are many of my friends who are. There is the great Danish scientist, Bore. He contributed enormously. Sir James Chadwick, an English scientist; Dr. Compton, Dr. Lawrence, Dr. Anderson of the California Institute of Technology. I am forgetting many important names. There are many.

Mr. JOHNSON. That is all.

The CHAIRMAN. If there is nothing further, we thank you very much, Doctor.

Is Dr. Harold C. Urey present?

Dr. SZILARD. He is in Senator Taylor's office. He left word to call him if he was wanted.

The CHAIRMAN. He may put a written statement into the record.

Is there anyone else who wants to be heard?

Mr. VOORHIS. I would like to say a word, Mr. Chairman.

STATEMENT OF HON. JERRY VOORHIS, A REPRESENTATIVE IN
THE CONGRESS OF THE UNITED STATES FROM THE STATE OF
CALIFORNIA

Mr. Voorhis. Mr. Chairman, I recognize the temerity of an individual like myself asking to be heard after so many distinguished people have been heard. Everybody will understand that I am in no sense a scientist, but I am an American citizen and I am a human being and I am deeply concerned about this whole matter. I have read everything that I could get my hands on and have talked to all the people that would let me talk to them, including some of the scientists. I feel that the essential thing to be remembered by the American Congress in connection with this matter is that the tremendous advance in the field of natural science may readily become the most terrible curse that has ever been known unless advancement in the field of self-control on the part of human beings can in some measure catch up.

I would like to make one or two comments about the bill which is before the committee. The bill, as I understand it, is limited to the domestic problem. To my mind it is unfortunate that the bill does not carry a section on policy for the United States with regard to the international aspects of the problem. If it did carry such a section the suggestion that Dr. Compton made would be, to my mind, the one that ought to be carried. Indeed, what he said is almost exactly what is incorporated in a bill which I introduced.

To my mind, the principle that should govern our policy domestically is very brief—that the basic rights to atomic power should belong to the American Nation. By that I do not mean the right to development or use, but I mean the basic right to ownership of all patents in that field and the ownership of the original source of the power itself.

In saying that I believe that so far as the future is concerned I am advocating a policy which will offer the greatest hope for what people know as private enterprise of any policy that could be pursued, because, if I understand anything about this, the possibility of monopolistic control of it by a few great corporations might lead to a complete deterioration of our whole economy; and I see no way for that to be avoided except by national control.

I would like to say, Mr. Chairman, that in my judgment the board is all-important in this bill, but I do not think that board should be composed of part-time people. I think it should be composed of faithful, full-time employees of the United States Government, and I think they ought to be paid not less than \$50,000 a year apiece. I think it would be proper for the bill to prescribe that a certain number of those places be held by scientists. I think it is evident that some of the places should be held by people from the armed forces. I think it is of equal importance that the balance of the positions be filled by outstanding people who would, roughly, cover all phases of American life and population, because this is the American people's problem.

I shall not speak further about that, Mr. Chairman, but I would like to see the strongest possible emphasis given to a section already in the bill, that is found on page 20, where it says that the function

of the Commission and the Administrator is to adopt the policy of widespread distribution, so far as possible, of such licenses and consents on equally equitable terms to all qualified persons, etc.

I might call it an antimoniopoly section.

I would like to say very frankly that I am a very reactionary individual, Mr. Chairman. Some of the members may not believe that, but I am. Were it possible to move the hands of time back and to take out of the world some of the inventions and discoveries that have been made, I would do it. That is not possible. We have got to face the future as courageously as we know how. We have got to live with this new force in the world. There are two principles which, in my judgment, have got to govern: One, the most widespread dissemination of its benefits to the people, and, two, the prevention of a war in which atomic weapons will be used.

Mr. Chairman, upon that latter point, if I believed for a single moment that it were possible for the United States to retain in its sole possession any effective secrets about the production of atomic weapons and then to say to the rest of the world that we would never utilize those things in war unless some other nation broke the peace, I would be for doing that. I wish such a simple solution were possible. It is not. At the same time the overwhelming preponderance of evidence from people who know, is to the effect that no effective secret even now exists excepting that connected with the know-how of production, and that this will unquestionably be developed by other nations within a very few years.

Under those circumstances it seems to me that the most short-sighted policy that could be followed would be for the Congress, either by enactment of a bill or by failure to make clear its purpose, to set in motion an unlimited armament race in the field of atomic weapons which ultimately must lead to an atomic war, because the kind of armament competition which this would constitute would be the kind which could only be successful by a surprise attack made by some nation possessing these weapons.

I do not want us to give away our knowledge. I am not for that. I do believe we must use it with all the statesmanship at our command as the one instrument that might enable us to effect a genuine peace-keeping mechanism in the short time that remains to us while our Nation is still predominant. It seems to me that it is our move, and that we might save humanity. I believe that can only be done if World War III is somehow prevented. I want the country to go ahead with developments. I am in favor of our keeping ahead, but I want to make it clear to the world that we are trying to do that for the sake of the peacetime benefits, and that so far as America's use of this weapon is concerned, development is being carried on pending the time when it will be possible for us to get from all nations an agreement that if this knowledge is pooled among the nations they will every one agree to opening their laboratories, their colleges, their munition plants of every sort to an inspection by an international group in which, of course, our own people would be included. Under those circumstances all nations would know what was happening in other nations.

I cannot see that it would make any particular difference with regard to the know-how, but I think it would be the only way to create

an international situation in which agreements among the nations for the control of this terrible force could actually be enforced and kept.

In my judgment, it is either going to be a time in which we will succeed in the greatest crisis for statesmanship in all the world, or else we may learn at some future date what it was that Christ meant when he said "The meek shall inherit the earth."

I can foresee a time, unless that statesmanship is forthcoming, when the great nations of the world might destroy one another.

My testimony in defense of this position is not just my own, but the testimony of the very scientists who developed the atomic bomb. Ninety-six percent of them have joined in issuing the statements which follow and which I hope will be read not only by every member of the Military Affairs Committee but by every Member of Congress and every American citizen.

(The statements referred to are as follows:)

A STATEMENT BY SCIENTISTS OF AN ATOMIC BOMB PROJECT

1. We, as scientists who knowingly contributed to the development of atomic power and the atomic bomb, feel keenly the responsibilities we accepted in helping to create this force, first used as a weapon of destruction. These responsibilities are now shared by every person of every nation. Therefore, we feel that it is essential that every individual be made aware of the entirely new conditions this force imposes on the nations of the world and their relations with one another.

We cannot and do not presume to speak as international statesmen or politicians; however, as scientists who produced the weapon, we possess special knowledge of great pertinence in formulating our country's policy with respect to this epochal development.

2. No individual, group, or nation can keep new scientific discoveries secret as long as human minds can function anywhere. In this particular case, the fundamental principles of atomic energy and its release were widely known before the development of this project. The only remaining "secrets" are technical and engineering details of processes, plants, and devices. The fact, as announced in the Smyth report, that several different processes have been successfully employed on these projects, the fact that other independent attempts can be made with the knowledge that the goal is achievable, and the fact that many countries possess the scientists and resources which are necessary, make it a practical certainty that our efforts can and will be duplicated in other countries within a few years.

3. We submit that anything less than a single world policy with regard to atomic power and weapons can result only in catastrophe. The only way in which atomic bombs can bring security is by using them first. The tremendous industrial capacity of this Nation, of such tremendous importance in winning the war, will not be a factor in any possible future conflict involving atomic weapons, for no nation will dare to initiate war until it feels sure that it can accomplish complete and immediate annihilation of its enemies. Thus, no nation can find security in the preparation of stocks of atomic bombs.

4. We feel that participation by every nation in some plan for a single world control of atomic energy is an inescapable conclusion. This most certainly means a loss, in some respects, of national sovereignty. We do not propose to postulate any specific international mechanism for accomplishing such an end, but it appears to us that international control is the only way in which the misuse of atomic energy can be prevented.

Every war of modern times has seen the development and demonstration of some new offensive weapon; it seems obvious that some form of atomic-energy weapon is the ultimate and mankind has reached the point where it can no longer afford war. The world is too small, the power too great.

That the advent of the age of atomic energy signifies a revolutionary change in the nature of our civilization has been recognized, to a greater or lesser extent, by all men, but the crisis which we face will not be successfully overcome unless misconceptions are laid bare and the problem exactly defined. Either the leaders of mankind resolve the difficulties arising from the necessary integration of nuclear energy with the present international and national social structure, or the world will be faced with catastrophe.

As a prelude to intelligent thought, a myth which has already taken considerable hold in the public mind must be dispelled. We do not have and never have had a monopoly on the scientific ability, fundamental principles, or technological resources necessary for the large-scale release of nuclear energy. The important role of foreign scientists in project and preproject nuclear physics, the publications on uranium fission in foreign journals, the official Smyth report itself, all provide incontrovertible evidence of the truth of this statement. The dangerous delusion that the security of our Nation can be attained or even aided by secrecy is one that must be dissipated, for it will inevitably lead us into a line of action which will court the very disaster we seek to avoid.

Let us now suppose that, ignoring this fact, we embark on a course of narrow nationalism and irrational secrecy; what are the inevitable consequences? An atomic-armaments race proceeding with ever-greater acceleration; a deepening of mutual suspicion, distress, and fear; the growth of the psychological necessity for striking first in order to feel any assurance of safety; and ultimately war on a scale so horrible as to defy description. It is clear that the outcome of this policy will not be national security but world-wide chaos.

The only reasonable alternative is for us to lead all nations toward collective security. A World Security Council must be made the only custodian of nuclear power in the world. The prestige of the United States at this time will make it possible for us to insist on the adoption of all necessary safety measures; in a few years this bargaining power will have vanished, for many nations will have atomic bombs. An international technical panel responsible directly to the World Security Council should be set up. Its first duty be the investigation of all sources of critical materials; immediate and complete control of such sources by the Council should then be established. Provision should be made for further thorough geological surveys and the extension of control to new areas; no nation, whether or not it is a member of the United Nations, may be permitted to interfere with this program. Second, all nations must agree to complete and intimate periodic inspections of all scientific, technical, industrial, and military establishments by the panel, which is to make public all findings. The inspections must be universal to be effective; international inspectors must be backed by the full might of the Council. Third, all relevant scientific and technological advances, regardless of publication elsewhere, must be reported directly and immediately to the technical panel of the Council which is to be charged with responsibility of universal dissemination of all such information; all scientists should and will be honor bound to the implementation of such regulations. It is only after the adoption of such a policy as this that we of the United States can feel a reasonable assurance that the nuclear bomb will not be used for our own destruction.

There remains the danger of failure no matter how carefully the plans are drawn. But consider the alternatives: Either national security through collective security, or atomic war. Can there be any serious doubt that we must make a success of international control of nuclear power? Any feeling of choice in the matter is purely illusory. Our country today stands in a position of prestige and power never attained by any other nation. If we do not use this advantage in a manner worthy of our long tradition of freedom and democracy, if we do not take the first step in demonstrating our good faith and our hope for the future, our civilization is doomed. We must recognize at last that it is only through mutual understanding and trust that mankind can hope to banish forever the fear of war.

THE CONTROL OF THE ATOMIC BOMB

(A statement by scientists of a major atomic bomb research laboratory)

Man has entered the age of atomic energy. The explosion at Hiroshima on August 6 slammed shut a door on the past. We cannot go back; we dare not stand still. We must face facts as they are. What are these facts?

1. *There is no secret to be kept.*—It has been known for 40 years that this form of energy exists. The principles required for its release have been the common property of scientists throughout the world for the last 5 years. Each one of the advanced civilized nations possesses scientists capable of working out the details required for the accomplishment. Each one of the advanced civilized nations has access to some of the resources required for production of an atomic bomb.

All atomic bombs will not prove equally efficient but they will all be extremely effective compared to any weapons of the past. A nation does not have to make

the best bomb in order to be in a very favorable position for aggression. The retention of your technical secrets consequently offers no protection to this Nation or to any nation against atomic bomb attack.

2. *There is a possibility of world disaster.*—One bomb destroyed a small city, and it was made obsolete by the next bomb. Bombs of the future will probably make obsolete those of the present. A few hundred bombs dropped throughout the world will destroy all urban civilization and all modern means of production. Atomic energy can force our unwilling regression to the status of primordial man. In the hands of the fearful or the stupid our knowledge may mean our downfall and our end.

3. *World security can be attained.*—All solutions to the problem of preventing world disaster depend upon one condition: No more than one group in the world may be permitted to possess atomic bombs. How may this be achieved?

We have atomic bombs now. We can try to conquer the world and thus eliminate competition. If we choose this course we must do so immediately and be prepared to police the world.

Atomic bomb manufacture by any group can be prevented by destroying all vestiges of modern science and technology, including scientists, libraries, laboratories, and industries. This must be world-wide to be effective. It means the end of modern civilization, but we will be sure of existence.

It is clear that we must acknowledge the fact that atomic energy is the world's problem. We must acknowledge that military protection is impossible. We must acknowledge that, since there is no real secret, what knowledge we have has to be shared by all for the good of mankind. We must acknowledge that the problem to be solved has to be solved jointly by all. We must acknowledge that new forces require new solutions unprejudiced by old notions.

Therefore, we must urge among the nations a cooperative unified control of forces which would otherwise destroy us.

That is all I have to say, Mr. Chairman.

The CHAIRMAN. That is a very fine statement, Mr. Voorhis, and we are very happy to have you here.

If there is no other witness present, the committee will adjourn until tomorrow morning at 10 o'clock. The hearing is closed.

(Whereupon, at 4:45 p. m., the hearing was closed, and the committee adjourned until tomorrow, Friday, October 19, 1945, at 10 a. m.)

(The following was submitted for the record:)

STATEMENT BY HAROLD C. UREY, TO THE MILITARY AFFAIRS COMMITTEE, HOUSE OF REPRESENTATIVES, RELATING TO H. R. 4280, ON THE CONTROL OF ATOMIC ENERGY

My criticisms of the May bill relate to the method by which the Commission and its Administrator are appointed; the terms of the Commissioners and its organization; to the powers granted to the Commission; to the security provisions of the bill. Also I believe the bill is drawn completely from a wrong point of view, and I wish to discuss this. My remarks will take up these points and attempt to make suggestions for improvement of the bill.

The members of the Commission are appointed by the President, with the advice and consent of the Senate, to serve for 9-year terms. They are expected to be part-time men. The Commissioners appoint an Administrator and Deputy Administrator, who will be full-time men. They are removable by the Commission. Because of the complexities of the problems of atomic energy, I believe the part-time Commission will have little knowledge of the whole field and the Administrator and Deputy Administrator will become, by various means, but largely because of their superior knowledge, the directors of the Commission instead of the reverse. Because of the extensive powers of the Commission, this places a very powerful individual—the Administrator—in a position not accessible to removal by elected representatives of the United States Government. This I believe to be fundamentally a bad arrangement.

I should like to make two suggestions in regard to this point. The first is that the Administrator be appointed by the President, with the advice and consent of the Senate, and that the Commission be advisory. The objection to this suggestion is that the Administrator may become a political appointment changing with

each administration. This could be guarded against by making his term of office 9 years with the provision that he could be removed by the President for proper causes. The second suggestion is that the Commission be smaller and be composed of full-time men appointed by the President and removable by him. Any administrative officers would then be under their control. If the appropriations for the work of this Commission are sizable, several full-time men of top quality must be expected to help with the administration. Further, I would suggest that salaries for these men be placed higher than \$15,000 and \$12,000, for I do not believe that we can attract the quality of men required for these jobs at these relatively small salaries.

There is a question in regard to the necessity for the broad scope of the Commission's powers. Many phases of these powers lie outside the experience of scientists, but it seems to me that the Commission needs to have control over hazards, control over all fissionable materials from the mine to ultimate destination, and control over security provisions. I do not believe that it is necessary for the Commission to own all mines and patents, nor do they need to have such broad powers for the condemnation of private property. It would seem to me that a nonexclusive license of all patents would be sufficient for the protection of the Government. Provisions that all patents owned by other persons must be licensed for experimental work and that all patents must be licensed for industrial or military work at reasonable royalties would be sufficient to protect the activities of the Government. It is difficult for me to see how we can attract industrial organizations into the development and exploitation of atomic power with the present provisions in the bill. If I were in charge of a large industrial organization, I would do my best to avoid any contact with the Commission for fear that such contact might result in the condemnation of valuable property of the company. No rewards are held out to industry to compensate them for this disadvantage.

The security provisions of the bill are almost fantastic. In particular, section 19 (a) makes possible very drastic punishment for violation of security provisions with no relief or, at most, indirect relief through the courts. These provisions will have a tendency to drive scientific men from the field. Life under the Espionage Act of the United States in time of war is very disagreeable, and it seems to me improbable that scientific men would readily live the rest of their lives under these conditions. Particularly, it is difficult for professors in universities who have the responsibility of instruction for young men, for these provisions would almost stop all discussion of scientific facts in modern physics at the year 1940. We recognize that with the international situation as it is, some security provisions are necessary. The objective should be a minimum amount of secrecy with a nonessential leak of information to outside sources. I believe that the lines should be drawn far to the side of free discussion. In any case, someone must draw the line, and the question is, who should do this? I believe the fears of scientific men in regard to the security provisions would be greatly alleviated if a security council were set up with a majority of the council being scientific men. Only scientists understand how severely scientific work is hampered by security rules. I am sure that the general public, and particularly, the armed forces, have little concept of this point. While scientific men appreciate these points, they also understand very well the problem of placing information on the hands of potential enemies. Witness the fact that the whole atomic energy problem was brought to the attention of the United States Government by scientific men on their own volition. I believe that we can trust them to protect the interests of the United States in the future as they have in the past.

In general, there are three serious objections that I have to the bill as a whole founded upon its method of approach to the problem.

1. This bill presumes an armament race and is notice to the world that we are starting such an armament race in atomic bombs. This will lead to disaster. The bill, if enacted into law, will hamper all attempts to secure international control of atomic bombs.

2. The bill offers no incentives for work on atomic energy. It seems to be the opinion of the drafters of this bill that both scientists generally, and industry, are very anxious to work on atomic energy. This, I believe, is definitely not true. Certain limited phases of atomic energy are of interest to a limited number of scientists, but most of the work that must be done to secure atomic energy for power or military purposes is drudgery in a scientific sense. It has no more interest for the man working on it than almost any technical job of the lowest grade. In order to secure maximum work, we must appeal to the emotions which prompt people to put effort into their work. This country has grown great upon

the methods of private enterprise. The patent laws have greatly stimulated American industry. The bill practically wipes out all private enterprise and patents so far as the field of atomic energy is concerned. Maybe it is unnecessary to have these motives, but I do not see how to replace them completely in the next few years. Hence, the whole approach to the bill from this angle, in my opinion, is wrong.

3. This bill, I understand, is essentially a War Department bill. Specific arrangements are made permitting the Administrator and the members of the Commission to be from the armed forces. Members of the armed forces will maintain this is wrong, but you will find, on analysis, that most of their development and research work is carried on by other organizations which they hire to do it for them. To leave the control of atomic energy either for military purposes or industrial purposes under the control of the Army or Navy, or both, will be fatal to rapid development in this field.

On the opposite side, the approach to the bill should be that it is primarily what it purports to be, namely, an atomic energy bill for power purposes and not primarily what it actually is—an atomic bomb bill. I would feel happier if it were sponsored by the Department of Commerce, which would place a proper light on this development work. Such an approach would avoid misunderstanding on the part of foreign countries in regard to the motives of the people of the United States in developing atomic energy, as well as keep our own thinking on the subject straight. We should recognize that we have a new frontier of great magnitude to develop, and we should consider carefully how we can get a maximum of energy from scientists, engineers and industry interested in a maximum effort in this problem. When the railroads were thrown across the country the United States Government made grants of land to them to encourage them in these undertakings. Had they not done so the railroads would not have been thrown across the United States as soon as they were, and the whole country would have been slowed down. The Government should be thinking of ways of granting subsidies to industry in order to secure its help and cooperation on this problem. In the airplane industry mail contracts supplied such incentives for its development.

In view of these criticisms I find it difficult to believe that any amendments to the bill could possibly meet my objections. The whole bill should be rewritten by other men who have an entirely different point of view about the whole program.

STATEMENT BY THE ASSOCIATION OF OAK RIDGE SCIENTISTS AT CLINTON LABORATORIES TO BE PRESENTED TO THE HOUSE OF REPRESENTATIVES MILITARY AFFAIRS COMMITTEE CONSIDERING H. R. 4280, ATOMIC ENERGY ACT OF 1945

The Association of Oak Ridge Scientists at Clinton Laboratories comprises more than 90 percent of the technical and scientific personnel at Clinton Laboratories and has a membership of more than 170 persons. The association has arisen spontaneously as a medium for the expression of the convictions of its members concerning the use to which the United States should put the atomic bomb and atomic energy. The members of the association have had ample opportunity to consider the course the United States must follow to prevent this great technological achievement from becoming a curse to humanity. The association stands as a tribute to the unanimity of opinion held by the scientists at Clinton Laboratories.

Members of the association had made known their desire to testify before the House of Representatives Committee on Military Affairs at the brief public hearings of October 18. Since this opportunity was denied its members, the association wishes to express its views for incorporation into the record of the Military Affairs Committee on H. R. 4280, known as the Atomic Energy Act of 1945.

As scientists who have aided in the development of the atomic bomb, we feel strongly the need for legislation which will enable the United States to maintain its position as a leader among nations. The scientific achievement we have accomplished places upon us a responsibility unknown to scientists in the world's history. Our knowledge has been restricted due to the necessity for military security to such a degree, that we now find ourselves perhaps no more than a thousand strong, unique among the citizens of the United States in our understanding of the force which we have created. We, alone, have had opportunity to consider the effects of atomic energy and the atomic bomb for a period of

years. It is our duty, therefore, as scientists and as citizens to emerge from the fields of our specialties and to take part in the efforts of our Nation to effect an enduring peace.

The world is at a cross road, and the United States may well determine which path the world will take. We citizens must determine in our own minds what course our Government shall follow, for it is the people of the United States and of the world who will suffer. A false step made by our Government may precipitate upon the world that worst of all nightmares, an atomic war. Such a war would bring ruin to all nations, victors and vanquished, for reprisal and retaliation would be the only courses open to the nation attacked. The bombs we have used are primitive compared to those which may be developed. The devastation of Hiroshima and Nagasaki will be repeated many times over.

The benefits which may accrue to mankind may dwarf those of the steam engine. We scientists have had no opportunity to develop the bountiful side of our discovery. Products and materials unknown, may in our time become commonplace. Industry will find many applications for these materials. Medical uses as important as the X-ray are well on the way. The generation of power by an engine requiring little fuel is perhaps only a few years away. A new era is dawning. The world is awaiting our efforts to turn our engine of war into an engine of peace. These peacetime accomplishments, if well directed, may well be used to found new industries and to combat postwar depression.

We may take the road of strict nationalism by which we preserve what we know, and race other nations for supremacy in military production and development. This, we feel, is the direction in which the May bill points. We may, on the other hand, attempt to make international arrangements concerning the control and use of the weapon, which will permit us to explore and develop the peacetime uses of atomic energy.

The choice is grave and the time is short, yet the time is not as short as to require us to take action without adequate study and consideration. It appears to us that the rapidity with which the May bill is being acted upon in Congress is such as to permit no adequate formulation of public opinion. The urgency is not such as to require our abrogation of the democratic process. We feel, therefore, that interim legislation should be passed, permitting the projects to continue on their wartime basis for 6 months. This would permit the people sufficient time to consider the choice and select the road they wish to follow. Since the people will reap the harvest, the people must sow the grain.

Our objections to the May bill are many. As scientists, we are unable to judge the legal aspects of the bill. We believe, however, that several provisions obstruct the peacetime development and use of atomic energy.

The scope of the bill covers "all activities connected with research on the transmutation of atomic species, the production of nuclear fission, and the release of atomic energy." This will mean that a very large fraction of modern physics, chemistry, biology, and medicine will fall within the jurisdiction of the act and, therefore, if not actually controlled by the Commission, can only exist through its sufferance. When coupled with the retroactive security regulations, this will act as a powerful deterrent to young men who might enter the field, or to industry interested in developing applications not connected with the development of atomic energy in appreciable amounts. The transmutation of atomic species other than those associated with fission or the release of atomic energy in appreciable quantities, should not fall within the scope of this bill.

The structure of the administration proposed by the bill appears to us unsatisfactory. Commissioners are immune to removal except after specified violations. The Commission consists of part-time men selected from civil life, Government, or the armed forces. The importance to the Nation and to the world of their task would appear to be ample justification for appointing the best men on a full-time basis. The relation of the Commission to the rest of the Government is not clear. It must act "in accordance with the basic principles established by the President in the promotion of international peace, the development of foreign policy, and the safeguarding of the national defense." No mechanism is described to implement these admonitions.

The Administrator and Deputy Administrator are twice removed from the will of the people. They are protected by the Commission which may set up such regulations as to prevent criticism. They may be members of the armed forces, interested only in military developments.

The broad powers of the Commission and Administrators will permit them to shape the nature of research, development, production, and use in this new field along highly restricted lines if they so choose. Their only limitation consists of

an admonition to "interfere to the least possible extent with small-scale experimentation in research laboratories of nonprofit institutions." The work may be restricted to Government agencies or may be unrestricted. There is no assurance that the policy may not change from time to time.

Security under this bill could be so administered as to stifle progress in the military development as well as the peacetime uses of atomic energy. Research in the physical sciences has never thrived where strict controls were imposed. The history of American science during the past few years is a case in point. During this period, American scientists have expended enormous effort in the technical development of the atomic bomb. The statement has frequently been made that there is no secret. The fundamental discoveries were made before the war when science still had an international structure. The very fact that our achievement is due to the exploitation of our prewar stock of fundamental information makes us aware of the scarcity of the fundamental discoveries made during the war. The national emergency forced us to choose between rapid development of a military weapon and free scientific pioneering. This choice was made knowingly at the expense of free inquiry. To keep its preeminent place in science, our nation must permit many of its scientists to return to fundamental research. To maintain national security, if a nationalistic approach to world peace is chosen, we must keep some of our leading scientists at the job of developing atomic energy. Conditions must be such that research, both pure and applied, can progress at a rapid rate.

If properly administered, the May bill could insure such rapid progress. It would require on the part of the Commission and the Administrators great restraint in the use of their broad powers. If these powers were to be applied in an adverse manner, as permitted under the provisions of the bill, twentieth century science would cease to exist. The scope of the bill is so broad and the limitations upon the Commission and Administrators are so few, that they can direct American science and technology in any direction they may choose. Whether this direction chosen is for the good of the Nation and civilization will depend largely upon the wisdom and integrity of one man. The Commission, consisting of part-time men, must lean heavily upon the advice and judgment of their Administrator. Once the decision is made, little can be done to alter the course of the Nation, for censorship and security regulations can be used in such a manner as to prevent criticism.

We believe that rapid progress in science, and strict security regulations involving particularly the compartmentation of information, are mutually exclusive. As the bill is constructed, the Commission may establish whatever security regulations it sees fit. These regulations need not stop at the limits of military necessity. Any regulations not required for military security will serve only to impede the progress of the work. Security regulations should be made known to the scientists involved, for to inform a man of a regulation only at the time he is accused of violating it is not living up to our American tradition.

We strongly urge that the May bill be withdrawn and new interim legislation be introduced to provide for continuing operation of the Manhattan District projects on their present basis. In the meantime, investigation and study of all aspects of the atomic energy development should be undertaken for the purpose of drafting permanent legislation which shall not violate the American tradition of government by the people.

Submitted to and approved by the Association of Oak Ridge Scientists at Clinton Laboratories in its meeting of October 24, 1945.

P. S. HENSHAW,
Chairman, Executive Committee.

STATEMENT OF W. S. AMENT, FORMERLY ENSIGN, USNR, NOW ON INACTIVE DUTY; AT PRESENT ASSOCIATED WITH THE NAVAL RESEARCH LABORATORY, WASHINGTON, D. C.

The United States should propose to Russia some such arrangement as the following: "You people know that we have a terrible weapon in our atomic bomb, and we have to suppose, since there are many events in your country that we do not see or hear of, that you have developed enormously destructive weapons which are unknown to us. Our people have become suspicious of the secrecy which veils your military development—as suspicious, perhaps, as you are of our secret production of the atomic bomb. We therefore propose, in order to wipe out the suspicions that are growing between us and to prove our claim

that we are a peace-loving Nation, that Russian scientists appointed by your Government will be given the privileges for all time of freely inspecting every military installation, factory, and laboratory in this country, and of freely reporting their findings back to your Government, providing our appointed scientists enjoy exactly the same privileges in Russia."

Our nuclear physicists say that any country can develop an atomic bomb even more destructive than ours by the expenditure of sufficient money and engineering ability. Therefore we certainly have much to gain and nothing to lose by making such a proposal as the foregoing one. For if the Russians do not accept the proposed agreement, our suspicions will be strengthened and we shall pour billions into atomic bomb and other military research—but this we are now doing anyhow, because our anxiety is already too strong for us to do otherwise. If the Russians accept in bad faith, we shall at least have gaged their strength and the first instance of official bad faith will serve as a loud alarm telling us to mobilize. And certainly no one will object if the Russians accept in good faith.

STERLING AMENT.

WASHINGTON, D. C., October 15, 1945.

Re atomic bomb.

MILITARY AFFAIRS COMMITTEE,
House of Representatives, Washington, D. C.

GENTLEMEN: To the great problem of elimination of wars and the consequent possible world destruction by the atom bomb, I am submitting herewith what I believe to be the only practical solution. This is contained in the basic psychological means as provided in paragraphs 5 and 6 of the attached. It is my opinion that no peoples of any nation will ever vote in the majority for war. With my terms in effect it will be the man who fights, pays, and dies in a war that will decide the issue by direct mandate. His answer anywhere, at any time, will be in the majority against war. I believe that no mechanical means can be found to counter this terrific atomic force, whereas my suggested conclusions can forever harness all danger. I am not in favor of any such idea as a one-world nation, or that we surrender our national sovereignty to accomplish the objective. With my plan in effect we are still left an independent nation. I further believe that any measures short of my suggestions, by the United Nations, will fail in its objective. You may feel that my views will be hard to put in effect. Granted; but so was the Constitution. Gentlemen, here is the one and only answer and, in the name of God, do not pass it up. Thank you for your consideration.

FRANK E. VANDERHOOF.

VANDERHOOF 13-POINT PEACE PLAN TO ELIMINATE FUTURE WARS AFTER VICTORY

(This plan presented to Congress, by Hon. Wirt Courtney, from Tennessee, as it appears in the Congressional Record of July 1, 1943, House of Representatives)

- (1) An organization or association to be formed among the United Nations, and those others which will have been freed from the bondage of Germany, Japan, and Italy.
- (2) These nations, large and small, shall be permitted to set up their own form of governments, without influence or demand.
- (3) These nations shall set up a new code of international law.
- (4) Present enemy nations shall not be barred from membership in such organization or association.
- (5) Each nation in association, to be acceptable to membership must adopt or write a constitutional amendment, waiving all right by power of their government to declare war, unless attacked by forcible arms. The association to decide what constitutes forcible attack.
- (6) All power to so declare war must rest with the people of each respective nation, by popular vote.
- (7) The armament of each of these nations shall not be in excess to that which will be necessary to maintain internal order. Size of each respective army to be determined by the association or union.
- (8) An international chamber of commerce to be organized with equal representation among these United Nations, to create markets and guide in the fair distribution of raw materials and manufactured goods. The main object of such

chamber is to eliminate competition among nations as much as possible. Tariffs of each member nation to be regulated by the association.

(9) The principal of freedom of religion must be a point of adoption among these nations. This to be the constitutional right of all the peoples of these respective nations.

(10) The principal of freedom of trade, of the seas, and in the air must be adopted.

(11) Any nations not joining this association or union, by adoption of agreement as set forth in paragraphs 5, 6, and 9 shall be cut off from international trade, postal exchange, and diplomatic relations with all nations of this association. Citizens of the outlawed nation will not be permitted to enter the boundary of any of the associated nations.

(12) Each nation of these United Nations, both large and small, shall have only equal representation in this association. Territorial claims and boundary disputes to be settled by the association.

(13) A sizable international police force or army to be maintained in readiness to occupy any aggressing nonmember nation. Also to see that the laws of this association are justly maintained.

FRANK E. VANDERHOOF.

STATEMENT ON ATOMIC POWER AUTHORIZED BY EXECUTIVE COMMITTEE,
METHODIST FEDERATION FOR SOCIAL SERVICE

The most destructive weapon in the history of warfare has been used by the United States. Tens of thousands of men, women, and children have been killed in one bombing. Great cities have been destroyed. The second bomb used was reported to be far deadlier than the first. Effective counterweapons have not been developed, and perhaps never will be. The question of war or peace is now a question of life or death for entire peoples—for mankind.

Temporary American monopoly over this weapon cannot guarantee the security of America or of the peace of the world. Peacemakers cannot emphasize too strongly that the atomic bomb is no substitute for international cooperation in general, or friendship with the Soviet Union in particular. In fact, the bomb makes that cooperation and friendship more imperative than ever. The bomb's use and discovery makes even more pressing the preservation and securing of the peace. But no one nation safely can be trusted with that task. This means that no one nation should claim or maintain an exclusive monopoly over that weapon.

Supposedly, the United States has today such a monopoly. But the scientists assure us that such monopoly is short-lived at best. The New York Herald-Tribune editorializes "that Britain, Russia, France, probably Canada, and some others could now produce atomic bombs in a reasonably short time if driven to the attempt." We are further told that, in order to win the race with the Germans to make the bomb, four processes were tried, three of which worked. Some other nation or nations might develop one of these processes or another one even more effective. The basic principles involved are already open knowledge. And as the Herald-Tribune again points out, it is futile to hope "that the genie can ever now be thrust back into the bottle."

How could the United States possibly gain by clinging to her certainly temporary monopoly? This could only serve to strengthen and spread hostilities, suspicions, fears, and hatreds between nations. It might well open the door to a mad competitive struggle in the development of atomic warfare. This would start mankind on the road to destruction and doom by splitting one world, in which peace alone is safe, into a divided world of two or more hostile blocs, a grim prospect indeed.

Fortunately, there exists an alternative. The alternative is that, under proper safeguards, the atomic bomb and its manufacturing processes be transferred to and controlled by the United Nations Organization and its Security Council. The President and the Government of the United States should make known a will to effect such a transfer and to effect it speedily. This would serve to clear the international atmosphere of ominously growing suspicions and fear. It would make clear to the world that our Nation has abandoned forever the fatal pattern of chauvinistic nationalism and isolationism. It would prove the sincerity of our professed aim to look, not to our isolated armed might alone, but to the new international organization, for the maintenance of world security. Thus can the atomic bomb be used to strengthen, not shatter, the precious fabric of international cooperation as begun through the developing United Nations Organization.

Now, not tomorrow, is the time to act—now, before the competitive armaments race has begun in full fury, now that the United Nations Organization and its Security Council have been set up in response to the overwhelming demand of the peoples that the catastrophe of recurring war be ended through sincere international cooperation and solid world organization.

* * * * *

Meanwhile, we should give consideration to the constructive possibilities of atomic power. Possibly the doors are opening to a new atomic age. President Truman has described the splitting of the atom as "the harnessing of the basic power of the universe." Monopolistic control over such power for the ends of private profit is as basically sacrilegious as would be similar monopoly for similar purposes over the air and stars. This vast new power must not get into the hands of vested monopoly interests or cartels to be used for private profit. It must, rather, be used and controlled of, by, and for the people as a whole. Such constructive democratic use of atomic power demands public or social ownership and control. It is in the hands of the awakened people to insist that such be our own Nation's policy.

X

ATOMIC ENERGY

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

FIRST SESSION

PURSUANT TO

S. Res. 179

A RESOLUTION CREATING A SPECIAL COMMITTEE
TO INVESTIGATE PROBLEMS RELATING TO
THE DEVELOPMENT, USE, AND CON-
TROL OF ATOMIC ENERGY

PART 1

NOVEMBER 27, 28, 29 AND 30, 1945

DECEMBER 3, 1945

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III

ATOMIC ENERGY

TUESDAY, NOVEMBER 27, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to call, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Johnson, Connally, Byrd, Tydings, Vandenberg, Austin, Millikin, Hickenlooper, and Hart.

Also present: Edward U. Condon, scientific adviser, and James R. Newman, special assistant to the special committee.

The CHAIRMAN. The committee will come to order.

The Special Committee on Atomic Energy of the United States Senate is beginning this morning its public hearings on the entire question of the atomic bomb and atomic energy. Senate Resolution 179, by which the committee was created, stated that it shall be the duty of the committee "to make a full, complete, and continuing study and investigation with respect to problems relating to the development, use, and control of atomic energy."

(S. Res. 179 is as follows:)

Resolved, That a special committee on atomic energy to be composed of eleven Members of the Senate appointed by the President pro tempore of the Senate, of whom one shall be designated as chairman by the President pro tempore, is authorized and directed to make a full, complete, and continuing study and investigation with respect to problems relating to the development, use, and control of atomic energy. All bills and resolutions introduced in the Senate, and all bills and resolutions from the House of Representatives proposing legislation relating to the development, use, and control of atomic energy shall be referred to the special committee. The special committee is authorized to report to the Senate at the earliest practicable date by bill or otherwise with recommendations upon any matters covered by this resolution. The existence of this committee shall terminate at the end of the Seventy-ninth Congress.

For the purposes of this resolution the committee, or any duly authorized subcommittee thereof, is authorized to hold such hearings, to sit and act at such times and places during the sessions, recesses, and adjourned periods of the Senate in the Seventy-ninth Congress, to employ such experts, and such clerical, stenographic, and other assistants, to require by subpoena or otherwise the attendance of such witnesses and the production of such correspondence, books, papers, and documents, to administer such oaths, to take such testimony, and to make such expenditures, as it deems advisable. The cost of stenographic services to report such hearings shall not be in excess of 25 cents per hundred words. The expenses of the committee, which shall not exceed \$25,000, shall be paid from the contingent fund of the Senate upon vouchers approved by the chairman.

The CHAIRMAN. These hearings are going to be full, complete, and extensive. We want all the pertinent facts submitted to the committee so that our decisions may be based upon all the evidence which we can secure.

1

The release of atomic energy is certain to affect every phase of our life. Like the discovery of steam and of electricity, this may well hold the promise of tremendous benefits to mankind. It is essential that we exercise the best judgment of which we are capable in order to insure that atomic energy becomes a blessing to mankind and not a scourge.

All of us, I am sure, are anxious that the atomic bomb may never be used again in warfare. All of us want atomic energy used for peaceful purposes, to make life better and fuller.

We are conscious of the fact that no time is to be lost in dealing with this problem and I confidently hope that our hearings and deliberations will proceed expeditiously. However, we members of the committee feel impelled to bring out the relevant facts in the democratic manner. When those facts have been developed, then, and not until then, we will turn to specific legislation. We must have the basic data of scientific, industrial, economic, and social significance relating to the development of atomic energy, so that in weighing any proposed bill for its control and in making recommendations we will be in the position to contribute to the safety and welfare of our own country and the peace of the world.

The first witness before the committee, I believe, is Dr. Alexander Sachs, an early figure in this matter.

Dr. Sachs, will you identify yourself?

STATEMENT OF DR. ALEXANDER SACHS

Dr. SACHS. I am by profession, gentlemen, a practical economist, economic adviser, and consultant. I was previously economist and vice president of the Lehman Corp., of which I am still a director and a special economic adviser in my new capacity. Throughout the decade prior to the war I was associated with them.

I have also been interested in problems of national welfare and related problems, and from the very beginning of the great depression I had taken a much greater concern over its nature and development than other people were doing, and came to be known or nicknamed as the "Economic Jeremiah."

In the course of that, I had gone to Europe, and from the great crisis of 1931 my advice was sought by leading figures.

I was particularly a special adviser in an informal capacity to Lord Reading and Lord Lothian, who were concerned with the impact of the world depression on England.

I came back from that trip with a sense of foreboding as to the evolution of that great depression and a sense that its nature, as the collapse of the postwar reconstruction, was bound to affect us and was bound to undermine the political order of the world. I had so distinctly felt that that it became communicated in 1932 to Mr. Roosevelt, and so I began an association in which I continued through the years as an informal adviser without any special label. I tried to live up to a concept that he had formulated in connection with his reorganization message of January 1937 about certain assistants, that these should be men in whom the President has personal confidence and whose character and attitude are such that they would not attempt to exercise power on their own account. They should be

possessed of high confidence, physical vitality, and a passion for anonymity. I tried to live up to the last one, a passion of anonymity, and I have not myself participated in any self-reverentialness, feeling that my job was to be a person who was on tap and not to be one who was in the news or in any way trying to influence the course of events beyond that of trying to point out their implications and their consequences.

It was from the very beginning of 1933 that I sensed that the economic crisis was going to have political consequences. I had in 1932 written what I had passed on to the President-elect. The statesmen of the world continued to be overtaken by a sort of high-tension paralysis, like the trivial oscillations of the trench war battle fronts up to America's entrance in the great war, only to find that the imperious and menacing march of events swept aside the half-willed and half-thought schemes, and even attacked improvised defenses that were resorted to too late, as in the case of Germany to save Germany for democracy.

The outstanding feature of this great depression is that the economic concept developed since the Reformation and the great society developed since the fall of the Roman Empire have come to be threatened not by the destructive impact of external or natural forces, but by a disintegration from within because of an incipient failure of will and political wisdom.

Thus imbued in 1933, in connection with the National Recovery Act where I had been called in in my capacity as an economist, I had suggested that the best use for public-works money was to apply it to the reconditioning of the Navy and to the improvement of national defense.

Gen. Hugh Johnson, who was at the time an assistant in an economic capacity to Mr. Baruch, and who had gotten to know me from echoes heard of what he thought were always correct forecasts, had called me in; and I had urged upon him the inclusion of these provisions.

Senator AUSTIN. What year was that?

Dr. SACHS. That was 1933, in the legislation of April and May.

Hugh Johnson was a little bit too humorous about it in thinking that I had put anything over, but the fact was that it was a very patent argument with the President that the advent of Hitler to power boded ill for all democracies, and that it was necessary that we take time by the forelock.

Hugh Johnson in the Blue Eagle, pages 197-198, credits me with having suggested that this provision about the availability of funds for naval construction be written into the NRA bill.

I have always been of the view that the real warmongering is done by the pacifists combined with a defeatism, and that one who is concerned about the protection of national interests without aggressive aids is the real practical pursuer of peace.

Later on—and I had been in the habit of reporting to the President regarding the progress of international developments—in 1936 he called me in to help in working out a solution on the problem of public utilities and power. I had proposed the idea of a power pool, and even then we discussed that in the event of danger we would want to have a mechanism for the coordination of private and public power.

The distinguished figures representing the public were Mr. Owen D. Young and Mr. Lamont, and I had been another one that was selected alongside those representing the public-utility interests and the governmental authorities concerned with power.

After Munich I had begun to send the President a series of memoranda, and it was at the turn of the year, in January 1939, that I had sent in a very long study on the international situation. In the preface to it, in the foreword, I described that memorandum and its predecessors. I had been discussing these things with him in 1936, and also in 1937 prior to the "quarantine" speech.

My role was, if you will, to be a reasonator for ideas that he had and also as a humble submitter of ideas. In this preface I wrote:

The orientation toward the crisis that has been developed in prior reports and needs to be borne in mind continually is that we are already in what Thomas Hobbes, who lived through the British civil war 300 years ago, justly called "war time-tract" and "war-weather": "For war consisteth not in battle only but in a tract of time wherein the will to contend by battle is sufficiently known * * *. For as the nature of foul weather lieth not in a shower of rain but in an inclination thereto of many days together; so the nature of war consisteth not in actual fighting but in the known disposition thereto during all the time there is no assurance to the contrary."

The thesis then was that the aggressor powers, the Nazis and the Fascists and their other allies—since Japan had already started this in 1931—were passing from the state of "white" war and limited war to totalitarian war.

On March 10, 1939, when I was asked by St. John's College to deliver a talk on the world situation, I prepared certain notes, a copy of which I sent the President. Those were "Notes on Imminent World War in Prospective Accrued Errors and Cultural Crisis of the Inter-war Decades." That was a memorandum dated March 10, 1939, and the opening sentence was:

This interwar generation has been living on the edge of a smoldering volcano; and the predominant attitudes among both what is called "Right" and what is called "Left" have been variants of escapism, very much like peasants situated on the edge of a volcano who go on cultivating the slopes in the hope that the eruptions will not take place in their lifetime.

Then I reviewed the errors of the interwar period, and said:

The present period is too late for that reversal of error which prevents the consequences of error. The real "Munich" took place in 1936, in connection with the Rhineland. Then was the last opportunity missed for preventing that cumulative German aggression that was bound to culminate in a new and more terrible war by Germany. But what can and must be done for our salvation and safety is self-clarification and self-reorientation towards the onrushing dangers.

Then in the concluding sentence—and you must pardon the length—I thought it was my business to try to think these out, not try to be popular, I said:

There is still time for western civilization, and especially for the exceptionally and fortunately situated United States, to use the time drafts that can still be made on the Bank of History for the preparedness that has and will become more and more urgent and inevitable for all members of western civilization as a result of the past errors committed and in the course of the prospective unfolding aggressions of Nazi Germany.

That was in March, and the address was delivered in April before St. John's College on war imminence and the cumulative crisis of the interwar period.

It was in the following month, on April 15, 1939, that there was published in the *Physical Review* a note by Dr. Leo Szilard entitled "Instantaneous Emission of Fast Neutrons in the Interaction of Slow Neutrons with Uranium."

In keeping with the custom in scientific research, the date of its original sending was included, dated March 16, 1939; so it coincides with the time when Hitler seized Prague and by seizing Prague became the controller of the crossways of the continent.

The background of that was that at the turn of the year 1937 certain experiments had been concluded in Germany, and they were made available and made known. Dr. Niels Bohr of Denmark came to this country and spoke to his colleagues. Scientists are an international community. I think the word "international" is not as precise as it ought to be; it really is "transnational," across the boundaries of nations. They function in terms of common ideas because, after all, our heritage of common moral ideas and intellectual ideas dates for our world from the Reformation or the Renaissance, and it is a crystallization of the very Christian ideas and the pursuit of science irrespective of national boundaries, but as a human activity. These scientists depend upon the free flow of knowledge, the free flow of ideas. They had learned that there were completed in Germany experiments by Drs. Hahn and Strassmann regarding the fission of uranium.

What was done in this country represented a distinct advance because of the work of Dr. Szilard and the independent confirmatory work of another scientist, Dr. Fermi, a Nobel Prize man in physics of Italian descent who, under the conditions of fascism, found it inadvisable to return to Italy. The Nazi contamination had advanced so far that it became difficult for those who did not conform to the tribalistic notions of their sect.

The confirmatory work of Dr. Szilard and Dr. Fermi amounted to the suggestion that a chain reaction could be established in the process of atomic fission, and that chain reaction had implications for the type of energy for the kind of power that would be telescoped and concentrated in the process of disintegration.

Because I had been imbued with those ideas upon the nature of the world crisis, I was concerned with what was happening to the victims of nazism and fascism, and I tried in my own small way to be helpful during the period when the scientists had to leave.

I gave you at first some highlights of the "book of genesis" of my concern, and that is, if you will, the "book of exodus," the exodus of scientists who came to this country as a haven.

Prior to that, Dr. Szilard had worked in England at Oxford and Cambridge, at Oxford with F. A. Lindemann, who afterward became Lord Cherwell and played toward Mr. Churchill a role analogous to the one, in respect to this project, that I played toward Mr. Roosevelt.

In this phase of the exodus, the scientists were concerned not only with the progression of a technical problem, but with its political and moral implications.

There was another great physicist, who was a friend of Dr. Szilard and part of that group, Professor Wigner, of Princeton. There were a great many of them in Princeton, which became one of the great

centers. There was Professor Wigner, Professor of Theoretical Physics, and then there was Professor Einstein, whose theoretical work antedated the First World War, whose practical confirmation in the astronomical tests interestingly enough came just in the closing phase of World War I, as Prof. A. S. Eddington, of Cambridge, shows in his book on "Space, Time and Gravitation"—he was the head of that expedition.

Einstein, Wigner and Szilard discussed the problem; and I want to impress upon you gentlemen that, if I may refer to the Gospel of St. John—I happen to regard these testaments as equally significant in relation to basic ideas—"in the beginning was the Word." In the beginning was a moral idea and a political concern on the part of the physical scientists and this social scientist whom they brought in. They brought me in because they had heard that I was in a position to talk to the President and talk to him in terms of broad and fundamental concepts; and the ideas was, how can this be brought to the attention of the President?

The Germans were organized to carry on experimentation without limit. The Nazis were not at all concerned about money expenditures. Ironically, despite all the beblinkered concern on the part of experts in my own field, economics, as to the terrible problem of reparations, the fact was Germany was spending on armament in any and every year, once it got going, more than was involved in the total amount of its remittances on reparations. Money was no object. They had these institutions. Many of the scientists were themselves refugees from work that they had been doing at these same institutions, the Kaiser Wilhelm Institutes of Physics and Chemistry.

The idea was that if they should be able to discover a concentrated power that could be used as an explosive, then the real safety of the United States and the rest of civilization would be gravely imperiled, because bear in mind that the essence of this period of foul weather internationally, to use Thomas Hobbes' expression of this wartime weather, was that the Nazis were rushing and not permitting the time for the organization of defense.

Therefore, these scientists, these physical scientists and myself, who was brought into the picture in the summer of 1939—and I had been introduced to Dr. Szilard by Mr. Stober, who was an economist; but I had known in a general way what was taking place because I had long been interested in theoretical physics and had followed publications in a general way—then felt that it was important to bring these matters to the attention of the President. We felt that it was essential that an opinion should be written by the one man whom the world recognized as the preeminent scientist of our day, and not only the preeminent scientist but, as the Senator this morning remarked, one of the greatest humanitarians, because he had left nazism before expulsion orders were given to him. He had anticipated the trend of events. He did have political foresight, and did see what it implied.

Dr. Einstein wrote a letter regarding this, dated August 2, 1939. I had also asked Dr. Szilard to write a memorandum describing the significance of the current and evolving scientific research, and that was a memorandum of August 15, 1939.

Then I sought for an opportunity to see the President. I had been in touch with him, but I felt at the time that the mere delivery of

memoranda was insufficient. Our social system is such that any public figure—you gentlemen in your work as statesmen, and the administrators in Government—are punch-drunk with printer's ink. You have to read so much that I felt there was no point to transmit material which would be passed on to someone else. This was a matter that the Commander in Chief and the head of the Nation must know. I could only do it if I could see him for a long stretch and read the material so it came in by way of the ear, and not as a soft mascara on the eye.

Then, of course, with the outbreak of the war it was not possible for the President. He had the problem of the existing neutrality legislation, as you recall, and only when that was solved did I accept an appointment, because it meant that then I could see him at leisure and read the material. I brought over the material to him, and met with him on October 11, 1939. I wrote the letter in anticipation of my seeing him so that I would be able to read it, and the opening sentence was:

With the approaching fulfillment of your plans in connection with revision of the Neutrality Act, I trust that you may now be able to accord me the opportunity to present a communication from Dr. Albert Einstein to you, and other relevant material bearing on experimental work by physicists with far-reaching significance for national defense.

Briefly, the experimentation that has been going on for half a dozen years on atomic disintegration has culminated this year (a) in the discovery by Dr. Leo Szilard and Professor Fermi that the element uranium could be split by neutrons and (b) in the opening up of the probability of chain reactions—that is that in this nuclear process uranium itself may emit neutrons. This new development in physics holds out the following prospects:

1. The creation of a new source of energy which might be utilized for purposes of power production—

naturally featuring first peacetime production.

2. The liberation from such chain reaction of new radio-active elements, so that tons rather than grams of radium could be made available in the medical field.

3. The construction, as an eventual probability, of bombs of hitherto unenvisaged potency and scope. As Dr. Einstein observes, in the letter which I will leave with you, "a single bomb of this type carried by boat and exploded in a port might well destroy the whole port, together with some of the surrounding territory."

In connection, then, with the practical importance of this work—for power, healing, and national defense purposes—it needs to be borne in mind that our supplies of uranium are limited and poor in quality as compared with the large sources of excellent uranium in the Belgian Congo and, next in line, Canada and former Czechoslovakia.

I also informed him that we had learned that in the wake of successful experiments by Drs. Hahn and Strassmann, one of whom afterward also joined the exodus, that the Germans, upon capturing Czechoslovakia, the seizing of Prague, had embargoed the export of uranium from Czechoslovakia.

I also mentioned the people who had been at work on this and who had been consulted:

Mindful of the implications of all this for democracy and civilization in the historic struggle against the totalitarianism that has exploited the inventions of the free human spirit, Dr. Szilard, in consultation with Prof. E. P. Wigner, head of the physics department at Princeton, and Prof. E. Teller of George Washington University, sought to aid this work in the United States through the formation of an association for scientific collaboration, to intensify the cooperation of physicists in the democratic countries—such as Professor Joliot

in Paris, Professor Lindemann of Oxford, and Dr. Dirac of Cambridge—and to withhold publication of the progress in the work on chain reactions.

The CHAIRMAN. Doctor, what was the date of the embargo on uranium?

Dr. SACHS. Right in April, right after the seizure of Prague on March 15, 1939.

Bear in mind that this world community was already functioning and included Professor Joliot, married to a daughter of Madam Curie; Professor Lindemann of Oxford, who afterward became Lord Cherwell and played this corresponding role toward Winston Churchill

As the international crisis developed this summer, these refugee scholars and the rest of us in consultation with them unanimously agreed that it was their duty as well as desire, to apprise you at the earliest opportunity of their work and to enlist your cooperation. * * *

In the light of the foregoing, I desire to be able to convey in person, in behalf of these refugee scholars, a sense of their eagerness to serve the Nation that has afforded them hospitality, and to present Dr. Einstein's letter, together with a memorandum which Dr. Szilard prepared after some discussion with me and copies of some of the articles that have appeared in scientific journals. In addition, I would request in their behalf a conference with you in order to lay down the lines of policy with respect to the Belgian source of supply and to arrange for a continuous liaison with the administration and the Army and Navy Departments, as well as to solve the immediate problems of necessary materials and funds.

There is one more document that is pertinent. One of the things that I brought together and submitted to the President, in addition to the scientific material, was, of course, this review of mine of the whole world situation on the imminence of war and the nature of this war, which is really a 30-year war, from 1914 on, for a world dominated by Germany with aggravations, of which there was one brief interlude, a brief armistice.

From 1931 on there was a resumption of war first in Japan in the seizure of Manchuria, and then came the succession of wars, the Italian war against Abyssinia, the interventionism by the Axis powers in Spain, the war against Austria, and finally the seizure of Czechoslovakia.

In 1936 there were lectures delivered on the history of science, reviewing the progress in sciences for the preceding approximately 40 years. The book was published by Cambridge University Press after Munich. It was published in 1938. Due to the work that I had done in England and my relationship to figures who consulted me—in addition to Lord Reading and Lord Lothian, there was Sir Josiah Stamp, a great economist, who had gotten in touch with me—I used to get these publications, as my interests included scientific work.

This book published in 1938 contained two lectures on the history of recent developments in physics, and the development of the theory of atomic structure by Lord Rutherford, whose work initiated the technical side of the physical research begun about the turn of the century.

Some of the greatest work of Lord Rutherford was done right nearby when he was professor of physics at McGill University, and it was for this work that he got the Nobel prize.

There were these two lectures prepared by Lord Rutherford, which after his death, were revised by an assistant of his, and then

there was a separate lecture, in addition, on *Forty Years of Atomic Theory*, by F. W. Aston of Cambridge, who died only a few years ago. You may have seen the notice.

F. W. Aston, reviewing the work that had been done in 1936 and describing what was being done in England and elsewhere, ended up his lecture as follows, and I showed it to the President with a view to high-lighting the fact that, like all things, there is an ambivalence in it, there are two poles of good and evil. The concluding paragraph is as follows:

There are those about us who say that such research should be stopped by law, alleging that man's destructive powers are already large enough. So, no doubt, the more elderly and ape-like of our prehistoric ancestors objected to the innovation of cooked food and pointed out the grave dangers attending the use of the newly discovered agency, fire. Personally, I think there is no doubt that subatomic energy is available all around us, and that one day man will release and control its almost infinite power. We cannot prevent him from doing so and can only hope that he will not use it exclusively in blowing up his next-door neighbor.

The President remarked, "Alex, what you are after is to see that the Nazis don't blow us up."

I said, "Precisely," and he then called in General Watson, lovable "Pa" Watson, another one of that period who has gone from us, and he said, "This requires action."

General Watson then went out with me, and the informal group was established.

Senator VANDENBERG. What was the date of this?

Dr. SACHS. October 11, 1939, sir.

He selected, with the approval of the President, one man representing the Army concerned with science, and one representing the Navy; Colonel Adamson for the Army and Commander—since Admiral—Hoover for the Navy.

Holding that as an expert I ought not to be injecting political views, I have throughout my work remained an associate regardless of party and other affiliations. As I have the honor to know ex-President Hoover, I was very pleased to find a namesake of his concerned with these scientific problems, as President Hoover during his incumbency as Secretary of Commerce did a great deal for the advancement of science and scientific research.

As the central figure, the President named a Government individual who was concerned with problems of science, the Director of the Bureau of Standards, Dr. Lyman Briggs, who rendered very great work during the critical period.

I got in touch with Dr. Briggs that very night, before having to go again to the White House to have some words with the President to report progress, because the potentialities of this were very much in the mind of the President, and he had communicated, "Don't let Alex go without seeing me again."

I saw him later that night, and the idea was to hold a meeting. A meeting was scheduled after this October 11 conference at the White House; a meeting was scheduled for October 21.

I reported to Professor Wigner, who throughout this period occupied a pivotal role because he is highly esteemed and was perceptive on what you might call the political problems. I reported to him in a letter of October 17 and I sought throughout the interval to broaden the group of scientists who were to attend that conference

Senator VANDENBERG. How about the Einstein letter you referred to?

Dr. SACHS. The Einstein letter of August 2, from which I quoted in part in my own letter, was left with the President, along with my letter.

The CHAIRMAN. Have you a copy of it?

Dr. SACHS. That is part of a record which I will leave with you gentlemen, which was a report I prepared immediately after the announcement about the use of the atomic bomb in August, which I prepared for the White House, the Department of Commerce—Mr. Wallace as the successor in charge of the Department that had such an important role—the Bureau of Standards, and the War Department.

The CHAIRMAN. Does that contain your letter?

Dr. SACHS. It contains all the documents, sir. It contains Einstein's letter, and it contains other memoranda.

I had throughout this period sought to be a historian, because the President said to me, "Pa Watson is going to be too busy to be a historian; you had better do that."

I made contemporaneous reviews, and would submit them as galvanizers of action.

I have a copy of Einstein's letter, a duplicate, which has his signature, and I will leave that copy with you.

Senator VANDENBERG. Could you state in a sentence or two the import of Einstein's letter?

Dr. SACHS. Yes, sir. [Reading:]

Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendation.

He then describes the new phenomenon, and describes that the sources of supply are outside the United States; that the United States has only very poor ores of uranium in moderate quantities, and that there is some good ore in Canada and the former Czechoslovakia. As to that, he reports:

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under Secretary of State, von Weizsaecker, is attached to the Kaiser Wilhelm Institute in Berlin, where some of the American work on uranium is now being repeated.

In other words, there was political interest being taken in the work. So Dr. Einstein said that one of the ways in which the administration could be helpful was to entrust this task to a person—

* * * who has your confidence and who could perhaps serve in an unofficial capacity. His task might comprise the following:

(a) To approach Government departments, keep them informed of the further development, and put forward recommendations for Government action, giving particular attention to the problem of securing a supply of uranium ore for the United States;

(b) To speed up the experimental work, which is at present being carried on within the limits of the budgets of university laboratories, by providing funds, if such funds be required, through his contacts with private persons who are

willing to make contributions for this cause, and perhaps also by obtaining the cooperation of industrial laboratories which have the necessary equipment.

These scientists, as you see, gentlemen, were no doctrinaires, but indicated only a practical perceptiveness—using whatever means were available so that the Government and the Nation had a supply and had funds for going ahead with this thing.

The next meeting that was held was on October 21 in Washington under the chairmanship of Dr. Briggs of the Bureau of Standards, and there was a survey made of the whole situation. Many scientists were there, scientists who were not as much concerned as these refugee scientists, because, as I tried to explain, gentlemen, they just were not only interested in advancing science; they were interested in the imperiled position of the United States and civilization. They were imbued with a concern in the Quaker sense of the word, devoted interest and responsibility.

Many other scientists said: "This is very remote; we have got to wait and see; there are other lines of progress rather than the chain reaction that may be more attractive," and the discussion wandered all over the attractive side issues.

The job on the part of one who occupied this intermediary and catalytic role in behalf of the President, was to ask these gentlemen of science and Government officials, including the Army and Navy, to indulge—and I remember using a phrase by the Irish poet Yeats, echoing Coleridge—in a "willing suspension of disbelief."

The issue was too important to wait, and the important thing was to be helpful because if there was something to it there was danger of our being blown up. We had to take time by the forelock, and we had to be ahead.

One great advantage that we had was that these refugees, these scientists, themselves responded to that very spirit of freedom that brought the Pilgrim fathers over here, a freedom of speech in religion, if you will, free science and free thought, and were saturated by the idea that that motive which the regimented scientist would not have would itself lead them to make advances much faster.

In the wake of that conference, a subcommittee was appointed, notwithstanding these expressions of doubt. The subcommittee was presided over by Dr. Briggs, and on behalf of Keith F. Adamson, lieutenant colonel, United States Army, and Gilbert C. Hoover, commander, United States Navy, a report was written to the President on November 1, 1939, on the stationery of the National Bureau of Standards of the Department of Commerce, which reviewed the situation technically and culminated with this observation:

3. The energy released by the splitting of a mass of uranium atoms would develop a great amount of heat. If the chain reaction could be controlled so as to proceed gradually, it might conceivably be used as a continuous source of power in submarines—

I would not have wanted to limit it to this form, but a continuous source of power was the fundamental idea—

thus avoiding the use of large storage batteries for underwater power.

4. If the reaction turned out to be explosive in character it would provide a possible source of bombs with a destructiveness vastly greater than anything now known.

The military and naval applications suggested in paragraphs 3 and 4—

in this case he was expressing the not-quite-suspended disbelief of the representatives of the services. Voicing their greater skepticism, Dr. Briggs said that the military and naval applications—

must at present be regarded only as possibilities because it has not yet been demonstrated that a chain reaction in a mass of uranium is possible. Nevertheless—

and in this respect those representatives were willing to go ahead—

in view of the fundamental importance of these uranium reactions and their potential military value, we believe that adequate support for a thorough investigation of the subject should be provided.

There had been a previous adverse report that I had known about, which was given by a technical adviser of one of the services in the summer, and it was because of that adverse report—they didn't see any reason for being interested, although they wanted to be kept informed—that I was brought in to go directly to the Commander in Chief.

So they concluded:

We believe that this investigation is worthy of direct financial support by the Government.

But, alas, we had no money.

The Lea bill now before Congress, if enacted, would provide for carrying out important investigations of this kind in cooperation with the universities.

We recommend the enlargement of the committee to provide for the support and coordination of these investigations in different universities. We suggest the following be invited:

President Karl Compton, Massachusetts Institute of Technology.

Dr. Alexander Sachs, 1 William Street, New York—

that was my address at Lehman Bros., who were very kind to let me devote time, and did not ask me to tell them what it was about. Mr. Robert Lehman is particularly to be thanked for this, and a man who afterward became an adviser of the War Production Board, and later Deputy Chairman, Mr. Arthur Bunker, who was then executive vice president of the Lehman Corp.

The people who were asked to be added were Prof. Karl Compton, myself, Prof. Albert Einstein—I am reading this in order; I belong very much at the foot of any such list—Prof. Albert Einstein, of the Institute for Advanced Study, and Dean George B. Pegram, Columbia University.

As a sequel to the major finding and recommendation, the committee proposed that initial support take the form of:

(a) Supplying for immediate and experimental work four metric tons of pure-grade graphite, and

(b) If later justified, supplying 50 tons of uranium oxide.

Later on there were all kinds of difficulties about getting the supply, to which I referred, and in the following year there was another refugee, an industrial engineer by the name of Pregel, who made available very valuable supplies to Columbia University for the experiments of Dr. Szilard and Professor Fermi, for which he was thanked by Dean Pegram.

The first phase was to coordinate the group of physical scientists for the purpose of presenting the idea to the President. The second phase was the securing of action by the Government, and that was climaxed by a report, which was a go-ahead signal, that Dr. Briggs wrote on November 1, 1939.

If you bear in mind how narrow has been the time, how correct was the concept of the memorandum from which I read of mine of March 10, 1939, that the job was "time borrowing, the issuance of drafts on the Bank of History," if the work had not been thought through before the advent of the war, if the President had not taken action immediately after, if the report of the Bureau of Standards and its technical head had not come forth on November 1—the bomb came toward the end of the war; it abbreviated the war, but it came in 1945—you will realize that the time borrowing was very essential, and the organization and the finding of proper medium was the great task of the year 1939 and the year 1940.

While I was an adviser of the President, also, on problems of strategy, I was also a special consultant to General Donovan, of the Office of Strategic Services, and had written the first report on the work that was being done outside on problems of totalitarian economics and war economics, as well as strategy, before the organization of the Office of Coordinator of Information, which afterward became the Office of Strategic Services.

Through these connections I was able to keep in touch, and I was kept in touch on the basis of great confidence, with the White House on what was going on, so I knew what was happening, even to the very last. I discussed the problem of the form of the use of the bomb with the President early in November 1944, when I submitted a memorandum on the final phase of the European war. That memorandum contained a forecast that the war would end in April or May, and that there would be no lasting stand, that the whole German system would collapse.

Though I have kept in touch, my official role as the representative of the President continued up to the time when, as you will see, I submitted to him the idea that it must be given over to an organization in charge of all scientific development, and suggested Dr. Bush, of whose keen interest and ready aid I had learned in the course of the difficult months of 1940.

Many of the pivotal figures are not now alive; the President is dead; General Watson, who rendered very great service, is dead. I remember that to military and naval men who said, "Well, this is still so remote; what is this thing; let's wait and see," "Pa" Watson would answer, "But the Boss wants it, boys." That was the one theme song of "Pa" Watson.

He is dead, and the secretary who used to call me up and pass on my messages is dead.

These documents which fortunately were written, represent the only available record of the flock of events, apart from scraps; and the scraps that are available in the files are insufficient to give a correct picture. One gets a picture by reading some of the things that have been published, but there was a linear progression.

Like all things, it was full of set-backs, difficulties, and perceptiveness and willingness, doubts, and hesitations, and it required continuous prodding. Such work as I was able to do, I was able to perform because everyone knew I was not concerned about anything but the progress of the work, and had made myself anonymous.

If I may again quote the New Testament, there is a verse in 1st Peter, "Be ready always to give answer to anyone that asketh of you

the reason of the hope that is within you," and yet with meekness and fear I felt that I had to go on with this work, that I had this vision and it must go on; and so I sacrificed my time and concentrated on that. Later on, as a matter of fact, when the war broke out I resigned from my administrative post and became a private economic adviser so as to be able to devote myself to war work to a very large extent.

In the summer of 1941 I had given to the Navy a plan that was worked out with the aid of a great engineer, radiosonic buoys for the establishment of the Atlantic security lane for the lend-lease shipments. This was afterward adopted by the Navy through the technical work by Professor Huntsacker of M. I. T.

I want to convey this impression, that in the beginning there was a political concept and a moral concern, and that it was necessary to provide proper vehicles for action and also to get acceleration of action.

The third stage was the coordination phase of the university researches with limited governmental aid and pressure—these were words that I used at that time—as I was saying, limited governmental aid and pressure by Einstein and the writer for a new framework and an accelerated tempo for the project.

While a number of the university representatives were encouraged by the governmental interest, the fundamental tenor and the tempo of the work remained, on the whole, continuous with the past—that is, they were regarded as mere laboratory researches.

The time of this phase was approximately coincidental with what was called at that time the "phony" war. This was the time of the war which embraced the period between the fall of Poland and the Nazi invasion of the Lowlands.

You can well believe that the President during this period was pressed by, and preoccupied with, numerous internal and international problems.

Our liaison officer for the project, General Watson, orally conveyed to the President the general tenor of Dr. Briggs' report. While he had done that, he thought, when he transmitted it to the writer on February 8, 1940, that a more pointed conclusion was necessary. He added that he had asked for a special recommendation from Dr. Briggs.

Meanwhile, some progress was made in the coordination of the university researches by the coordinating committee mentioned in the concluding point of Dr. Briggs' report. The appointment of Dean Pegrum served to focalize activities in Columbia on this project, and frequent conferences were held thereby with the speaker and Doctors Pegrum, Fermi, and Szilard. This group used to meet often at the Columbia University Faculty Club.

In mid-November, this group projected an octet of experimental projects in the hope that the subsidiary questions could be cleared within a period of 6 months.

Based on notes that were made at the time, I find that the nature and scope of these subsidiary problems and the recommended personnel, all of them from nearby educational institutions, were as follows—I will not read that, but it included the leading figures in this country, people working on these problems.

However, I will say that the most important of the men who were brought in was Prof. Harold C. Urey, who won the Nobel Prize for his work on heavy water, and who later on became very important.

At the same time, the Columbia project became the recipient of governmental aid in the form of limited funds intended for the purchase of materials, as is borne out by the reply that Dr. Briggs made on February 20, 1940, to General Watson's note of February 8, 1940.

On the other hand, Dr. Einstein and myself were dissatisfied with the scope and the pace of the work and its progress. The writer conferred with Dr. Einstein at Princeton in February. I went out to see him there and there developed an inquiry as to the importance of the work that was being carried on at the time in Paris, work that had been described in a contemporaneous issue of Science.

We felt that it was very important that this free trade in ideas—to use Justice Holmes' words, one of his expressions given in one of his great and discerning decisions—that this exchange of ideas should be carried on because these things that were being reported served as links and as stimuli to future work.

I had asked him, Dr. Einstein, about the work of the French, and he reported about that, and he said that he thought that the work at Columbia was more important.

As I say, I evoked from him the statement that the work being done at Columbia was more important. He further said that conditions should be created for its extension and acceleration.

Accordingly, the writer sent, on February 15, 1940, to General Watson a plea for larger aid and an intimation that presently Dr. Einstein would give a favorable evaluation of the work which had been completed at Columbia:

(The letter referred to is as follows:)

FEBRUARY 15, 1940.

Gen. EDWIN M. WATSON,
Secretary to the President,
The White House, Washington, D. C.

DEAR GENERAL WATSON: Thank you very much for your letter of the 8th and the accompanying report of Dr. Briggs to the President, both of which will be treated as confidential. Had the recommendations from the second part of point 5 through points 6 and 8 been placed ahead of the more technical points 1-4, the practical meaning of the letter would have been clearer and more forceful—namely, that in the opinion of Dr. Briggs and his colleagues it was distinctly worth while to go ahead. Due to too academic a presentation, I feel that that practical point was lost.

As the last issue of Science contained a quotation from Science Letters bearing on work in Paris, and as, since our meeting, there has been even more searching and significant work in this country, I shall take the occasion to submit within the next month an up-to-date appraisal of the situation which, according to Dr. Einstein in a recent conversation, holds forth even greater promise than we had thought.

With kind regards and appreciation,
Yours sincerely,

ALEXANDER SACHS.

Dr. SACHS. Ensuing conferences which I had with Dr. Einstein prompted the suggestion that he prepare another review of the situation for submission to the President. I had felt that Dr. Einstein's authority was such that, combined with his insight and concern, it could affect the tempo of the work which then, to use a musical term, too slow, troppo lento.

His review, which was dated March 7, was written as a letter to me. I will read the opening and closing paragraphs of this letter dated March 7, 1940. It was addressed to me at my office at the Lehman Corp.

In view of our common concern in the bearings of certain experimental work in problems connected with national defense, I wish to draw your attention to the development which has taken place since the conference that was arranged through your good offices in October last year between scientists engaged in this work and governmental representatives.

He also reported that he had learned of the further work that was going on in Germany since the outbreak of the war, the work on uranium.

He pointed out that this work was being intensified in Germany. I shall quote a portion here:

I have now learned the research there is being carried out in great secrecy and that it has been extended to another of the Kaiser Wilhelm Institutes, the Institute of Physics.

However, when it comes to secrets—even under the totalitarian system, secrets come out. Under our freer system, things also come out. They come out even while we are taking terrific measures, and very rightly, they still come out. I refer specifically to the Minerals Yearbook of 1943.

On page 828, that book contains something which was very significant. In a very technical statement about uranium, it spoke about uranium production in 1943—

Senator TYDINGS. Was that our book, or was it a German book?

Dr. SACHS. It was our book, the Minerals Yearbook for 1943, on page 828.

At the very time that newspapers and editors were not even to breathe the word "atom," the Minerals Yearbook of 1943, page 828, said, with reference to uranium:

Uranium production in 1943 was greatly stimulated by a Government program having materials priority over all other mineral procurements, but most of the facts were buried in War Department secrecy.

Then, it goes on to say:

Most of the 1943 uranium supply was used by physics laboratories for research on uranium isotopes as a source of energy.

These technical books went everywhere, they were available, by the ordinary routine, to the technicians, who would not have to read between the lines.

Our secrets leaked out. However, the same thing applied in the hermetically sealed German system. It is inherent in the situation.

The only way in which secrets do not get out is if no one knows anything about them. Once it is known, it is out. The only reason they got no secrets from me was that no one knew that I had anything to do with it. The newspapers, which are always eager in trying to get stories, got nothing from me because they did not know I had anything to do with it, so they did not seek me out and they did not get the kind of denial that would mean an affirmation.

As I said, Dr. Einstein wrote me on March 7, 1940. He said that in view of our common concern in the matter, he wanted to make a report on the developments, what the developments were, since the outbreak of the war. He stated that research on uranium had intensified in Germany.

Since the outbreak of the war, interest in uranium has intensified in Germany. I have now learned that research there is being carried out in great secrecy and that it has been extended to another of the Kaiser Wilhelm institutes, the Institute of Physics. The latter has been taken over by the Government and a group of physicists, under the leadership of C. F. von Weizsaecker, who is now working there on uranium in collaboration with the Institute of Chemistry. The former director was sent away on a leave of absence apparently for the duration of the war.

Should you think it advisable to relay this information to the President, please consider yourself free to do so. Will you be kind enough to let me know if you are taking any action in this direction?

I shall skip the next paragraph. Then he wrote:

I have discussed with Professor Wigner of Princeton University and Dr. Szilard the situation in the light of the information that is available. Dr. Szilard will let you have a memorandum informing you of the progress made since October last year so that you will be able to take such action as you think in the circumstances advisable. You will see that the line he has pursued is different and apparently more promising than the line pursued by M. Joliot in France about whose work you may have seen reports in the papers.

And I have, throughout, followed the policy not only of having an expert on tap but of going to other people's experts to see what they were doing. When it came to scientific work, I was going to leave that to the scientists, I did not presume to act as a scientist. These memoranda written by Dr. Einstein, Dr. Szilard and the others, I did not presume, when I forwarded them, to act as a synthesizer for them.

I passed on Dr. Einstein's review of the situation to the President on March 15, 1940, asking for an opportunity to confer with him on the latest phases of the experimental work. That letter I have here.

(The letter referred to was entered in the record of the committee and appears below:)

MARCH 15, 1940.

The PRESIDENT,
The White House, Washington, D. C.

DEAR MR. PRESIDENT: As a sequel to the communication which I had the honor to submit to you on October 12, Prof. Albert Einstein sent me another regarding the latest developments touching on the significance of research on uranium for problems of national defense. In that letter he suggests that I convey to you the information that has reached me that since the outbreak of the war, research at the Berlin Institute of Physics, which has been taken over by the Government, was placed under the leadership of C. F. von Weizsaecker, son of the German Secretary of State.

In the realization that these further views of Dr. Einstein have a definite bearing on the favorable report submitted to you by Dr. Briggs as chairman of the committee which conferred with experimental scientists concerned and myself, I am enclosing his communication for your kind perusal. May I also ask whether and when it would be convenient for you to confer on certain practical issues brought to a focus by the very progress of the experimental work, as indicated in the concluding paragraph of Dr. Einstein's letter?

In view of your original designation of General Watson in this matter, I am transmitting it through his good offices.

Yours sincerely,

ALEXANDER SACHS.

Dr. SACHS. The reply of General Watson on March 27, 1940, was to the effect that the governmental committee was awaiting "a report of the investigations being conducted at Columbia University" and hence "the matter should rest in abeyance."

I did not feel that I could rest.

Senator TYDINGS. In abeyance?

Dr. SACHS. Yes. However, the sense of foreboding about Nazi aggression that had been voiced before the outbreak of the war—as

I disclosed previously—impelled the writer to relate the expectations of new invasions in the wake of spring to the instant project.

At the beginning of April, opportunity was afforded the speaker in the course of a visit to the White House to unfold views on the probable course of German aggression as encompassing in this war—as distinguished from the last war—the elimination of neutrals so as to secure complete control of the coast from Norway to France.

It had this bearing on the uranium project: It was suggested to require diplomatic arrangement for the shipment of uranium supplies in Belgium to the United States, instead of shipment on the eve of invasion to France, to avoid their probable capture by the Germans in their military onrush through France.

Taking the project as a whole, it was urged that instead of delimited aid in the form of specific material purchases or reimbursements for expenditures by universities, a fund be made available from governmental sources or by persuading foundations to allocate a fund in order that research could be planned on an adequate scale and on a long-term basis.

You see, I had also another thought in mind in making that provision or assertion that the late spring months were not too early for the planning of the enlargement of the research personnel.

This was because around April and May the scientists were being booked up for the next year's work in the universities, and if we did not take them then, we were not going to have them later on. So, our job was this, to divert academic talent from teaching to research, public research. Otherwise, the right kind of people, the people we wanted, would have completed their negotiations with faculties for the next academic year.

The tenor of these considerations and recommendations was embodied in an aide-memoire which was prepared in Washington and left at the White House. That was another memorandum that was left with the President to review the situation.

The fourth phase was the phase which I have called in this report, written immediately after the events, in the role which the President assigned to me, among other things, as one of the originators—what I mean was that I had had assigned to me, among other things, the job of acting as the contemporaneous historian—"efforts by the originators of the project to gain the adherence of the governmental and advisory group to organizational changes needed to attune the research to the urgencies of unfolding World War events."

The representations made to the President at the turn of the month, by me at the turn of the month, that is, in March and early April, as just summarized, led him within a few days to revert to and act upon the preceding correspondence that had been pitched in the same key.

Accordingly, on April 5, 1940, he acknowledged what had been conveyed to him by Dr. Einstein and proposed that a new conference be held in Washington between Dr. Einstein and the speaker on the one hand, and Dr. Briggs and the special representatives of the Army and Navy on the other hand.

The closing paragraph of that letter implied that the President wanted the research continued. That is, the preliminary questions about which a few in the coordinating group still retained tints of doubt were in his mind disposed of.

To General Watson was delegated the making of arrangements for the conference, but he, the President, wanted to be advised directly of the results of that conference.

Under even date, General Watson asked the speaker for a list of scientists to be invited, inclusive of suggestions by Dr. Einstein. The inquiries made by the writer of Dr. Einstein and other members of the coordinating group led to the submission by the speaker to General Watson of the requested list.

Throughout my work I was in touch with Dr. Szilard and Dr. Wigner of Princeton and Dean Pegrarn of Columbia and, later on, also Urey.

Following the receipt on April 13 of the two letters from the White House of April 5, Dr. Einstein was written to on April 15. The letter opened up with a statement regarding the transmission to the President of Dr. Einstein's communication of March 7 to me.

It noted a contemporaneous impression that the efforts subsequent to the President's return from the Canal Zone trip—he had been on vacation—had contributed to the decision by the President—I had gotten in touch with him in the course of that trip and he had given me certain priorities so that this anonymous representative could go through and convey messages.

The message to the President so conveyed had contributed to the decision by the President "to adopt the procedure suggested" in the speaker's original communication.

Cognizant of the resistances in the group to the proposed enlargement of the organizational framework, the speaker urged Dr. Einstein to participate in person in the forthcoming conference. However, after a conference which the speaker had with Dr. Einstein at Princeton, it became clear that indisposition on account of a cold and also the great shyness and humility of that really saintly scientist would make him, Dr. Einstein, recoil from participating in large groups and would prevent his attendance.

So, he delegated me to report for him, too.

As a substitute, I had asked him to enable me to record the consensus of views in the form of a written communication to Dr. Briggs.

That communication, dated April 25, 1940, to Dr. Briggs, which Dr. Einstein signed, referred to the discussions he had had with Dr. Wigner and myself on the progress of the work of Dr. Fermi and Dr. Szilard.

The purpose of the letter was to impart a new impetus and to suggest an appropriate adjustment of the organization side of the research to the interlinked necessities of the emergent phase of the research and of the international situations.

I should like to quote from his letter, that letter.

I am convinced as to the wisdom—

The CHAIRMAN. Whose letter was that?

Dr. SACHS. This is Dr. Einstein's letter which I brought with me to Dr. Briggs.

I am convinced as to the wisdom and urgency of creating the conditions under which that and related work can be carried out with greater speed and on a larger scale than hitherto.

I was interested in a suggestion made by Dr. Sachs that the special advisory committee supply names of persons to serve as a board of trustees for a non-profit organization which, with the approval of the governmental committee,

could secure from governmental or private sources, or both, the necessary funds for carrying out the work.

Given such a framework and the necessary funds, it (the large-scale experiments and exploration of practical applications) could be carried out much faster than through a loose cooperation of university laboratories and Government departments.

You must bear in mind that this was before the fall of France and the Government executives had no money.

We were trying to take this thing out of where it was. This was the viewpoint of those who had shown an exercise of faith, of those who hoped for assistance, those scientists, as distinguished from other scientists who were more interested in what I called, in the memorandum to the President, a "bit-by-bit procedure."

Since they realized the import and pressure of international events, they wanted the thing lifted out of the somewhat monastic type of research that goes on in universities, a slow process, on a very limited scale. They wanted, we wanted, a greater scale and a much faster tempo.

Originally, the April meeting was scheduled by Dr. Briggs for April 22, and so far as nongovernmental people were concerned was to be limited to Dr. Einstein, Dean Pegram of Columbia, and myself.

Then, by telegram of April 20, the meeting was postponed to the 27th. In the interim I begged to enlarge the group and I requested that an invitation be sent to scientists and executives in universities involved in the current uranium research.

That request was granted, as appears from my letter of May 11, 1940, to the President.

(The letter referred to was entered in the record of the committee and appears below:)

MAY 11, 1940.

The PRESIDENT,

The White House, Washington, D. C.

DEAR MR. PRESIDENT: In furtherance of your kind letter to me of April 5, the conference suggested by you was arranged and held under Dr. Briggs' chairmanship on April 27 between the governmental and nongovernmental groups concerned with the bearing of uranium experiments on national defense. With the conclusion of the first experiment, which was conducted at Columbia University by Drs. Szilard and Fermi, with governmental aid, the whole project is now entering upon a new stage. Assuming that the governmental committee will now, upon your inquiry, report in favor of further and larger governmental action, may I, in accordance with your own gracious expression of a desire to be advised of developments, submit the following considerations and suggestions:

1. With the invasion of Belgium by the very power which has organized the residue of its scientists for uranium work, the danger—alluded to in my original letter to you of October 11, 1939—that America may be cut off from uranium supplies of the Belgian Congo has increased. In addition, the successful completion of the above-mentioned preliminary experiment renders it practicable and advisable that the action to be taken shall be adequate and comprehensive.

2. Such action inherently involves not only larger financial support to be accorded by the Government but also the formation of an organizational framework under which the work can proceed with the flexibility required for a going enterprise. Interestingly enough, the latter practical aspect has been emphasized by Dr. Einstein in conversations with myself and was communicated by him in a letter to Dr. Briggs, of which I am enclosing a copy for your kind perusal and attention. In this communication you might find of interest the enclosed copies of two communications which I have received from Dr. Szilard, the first of which contains a synoptic statement of the implication of the work for national defense that was made orally at the above-mentioned conference of April 27, and the second an outline of the next tasks to be undertaken.

3. The resultant requirement for forming an organization for directing the work outside of governmental institutions and for assuring that work by scientists in the universities is carried out with due secrecy has to be dovetailed with the designation of persons to serve as trustees of a nonprofit organization that is to supervise the allocation of funds and to coordinate the various branches of the work.

4. These interlinked needs suggest to me that it would be desirable to bring one of your legal aides into the circle of discussion, along with General Watson, who is now serving so efficiently as a liaison for the representatives of the service departments and the Bureau of Standards.

In view of the urgency of a decision on these points, I should greatly appreciate conferring with you in the course of next week, at your convenience.

Yours sincerely,

ALEXANDER SACHS.

Dr. SACHS. That, then, is the background against which the conference was held, a background which was lit up by portentous international events. The second week of the month opened with the German invasion of Norway and Denmark on April 9; the third week witnessed counteroperations by the British, the landings in Norway on April 16 and April 18.

Since the concern for national defense and the survival of civilization motivated my mediation of the project between the scattered scientists and the President, it is understandable in the flux of erupting international forces that I should seek to transpose the laboratory questions to the larger theater of international policy and military operations.

Two contemporaneous crystallizations of that preoccupation are available. The first is a memorandum-letter prepared at my request by Dr. Szilard under date of April 22. The second is a self-addressed memorandum dated April 20, 1940, and bearing the title "Import of War Developments for and Application to National Defense of Uranium Atomic Disintegration."

Skipping the technical memorandum, I want to mention the—

The CHAIRMAN. Doctor, I am sorry, but we have to recess at 12 o'clock. So, if you will, we would like to have you bear that in mind.

Dr. SACHS. All right, sir; I will pick an appropriate place.

The memorandum-letter by Dr. Szilard aimed to describe the next phase of the research and its dual alternatives and their respective applications to national defense.

The first case deals with chain reactions in which the neutrons are slowed down so only a small fraction of uranium can be utilized.

In the second case, the neutrons are not slowed down and so the bulk of the ordinary uranium can be utilized. It is the latter case which has the greatest significance for national defense and particularly for the production of atomic bombs. The former significance would appear to lie in power production and would also present the complication that personnel handling such built and powered atomic engines would be exposed to the radiations.

The second alternative also presented a dual utility for concentrated power and concentrated explosives.

As to the second use, the concluding paragraph of that memorandum constitutes a most illuminating formulation:

A chain reaction of the second type would make it possible to bring about explosions of extraordinary intensity. If, for purposes of aggression, a bomb based on such a chain reaction were set off at sea near the coast, tidal waves brought about by the explosions might lead to the destruction of coastal cities.

The coincident memorandum of the writer was concerned with highlighting the bearing of the war developments on the organizational aspects of the uranium research, and evoking applications for naval warfare with a view to throwing into sharper relief the urgencies of providing more central direction and greater adequacy of scope and speed in the prosecution of the project.

I had previously been called in to discuss what would follow, what would be the results, if control of the Mediterranean was achieved by the aggressor.

In that connection there was an idea, a coincident idea advanced by a person who had been in the Army and who was concerned about this problem, a great friend of mine, Colonel Donovan.

Colonel Donovan and myself had independently perceived this fact, which was that the Mediterranean would be significant north-south, as distinguished from east-west. We saw that the democracies would be pushed out from the continent, that the next war would push France out as a power.

This conclusion did not require great foresight, neither did it require the memory with which I had been blessed.

The French military people engaged in the last peace conference had seen that.

Furthermore, in a book to which Clemenceau wrote the introduction—Clemenceau was a layman who had his own views about military strategy—you will remember he was the man who even wrote, "War is too serious a thing to leave it solely to the military."

Clemenceau had seen that this situation was fraught with difficulty and he expressed himself on it as a layman, with complete respect to the performance of the military—the layman having the advantage that he can synthesize the military considerations with the political considerations.

Clemenceau insisted, at the Peace Conference, "If you do not give the French the protection of the Rhineland, then the democracies will have no base of operations, no base of support."

You will remember the phrase "point d'appui," which means, you might say, jumping-off place—we agreed we would not even have a support on the continent. Therefore, the significance of the Mediterranean was going to be north-south and not east-west.

Following those discussions, I broached the problem of the supply of uranium for the United States.

I pointed out that the biggest supply of uranium was in the hands of the Belgians. I pointed out that even if they sent it to France it would not come to us, that we had to open diplomatic negotiations.

Incidentally, that industrialist I mentioned, Pregel, who at that time was in France and was a French citizen, had asked his own government to make arrangements with the Belgians and he had asked it in 1939.

That prescience on the part of these refugees, gentlemen, is not any special quality in time but rather it was because they were united by a political sensitivity with their specific expertness as scientists and technologists.

Now, the memorandum which I submitted to the President opened with a description of the meetings and the work that was being done by other scientists; by the scientists in England, men like Dirac and Dr. Charwick and Lindemann, and so on. That work would be avail-

able for collaboration with research in America. In other words, there was suggested at that time the idea of Anglo-American collaboration.

In a lecture in 1936 it was foreseen that there would be developed a new source of energy; we were aware, profoundly and humanly aware, of the dualism, the good and evil in it.

The memorandum then dealt with the tendency to reservations and understatement of the results of research and their implications, the effect of which on governmental representatives was to cause them to recoil from the very suggestions that were being pressed by Dr. Einstein and me for providing a larger and more resourceful organizational framework for adequate and faster prosecution of the task.

In the effort to overcome the tempo dampening and scale dampening that that very attitude entails, and that is the attitude of conservative hesitation, proper enough in an ordinary task but not for this kind of thing, which called for what I have described as "the willing suspension of disbelief"—the speaker submitted the following observations and considerations which in a later presentation to the President appeared to be contributive toward a resolution of the organizational difficulties.

I pointed out in effect that the action was forthcoming—I did not presume to give these as my results but as my observations from reading all these memoranda. As was my habit, I did not look at it as a scientist.

The present writer, as a nonphysicist—

this is a quotation from my memorandum—

would not of course venture an opinion alongside those cited. But as an economic historian and as a practical economist versed in the conduct of technological research, he has ventured to convey to the scientists mentioned and to the governmental authorities his hypothesis that the difficulties which loom so large now might well arise from the characteristic physical limitations of the pre-pilot plant operations that are carried on in the typical university laboratories. If the project is fraught with promise and importance for national defense, then it seems to him worth while to approximate very soon the conditions of industrial-pilot-plant operations. This might entail the building of equipment, machinery, and even the construction of adequately scaled and adequately protected physical plant.

Once we relate the uranium research to national defense, it should be regearred in type and tempo to the most advanced technological research that has been carried out by the American chemical and electrical companies.

I need hardly insert parenthetically that it was this scale of operation which was carried out with such distinction later on by General Groves. Returning to the memorandum:

What has taken place in Poland, Denmark, and Norway, and will doubtless go on through other European countries that will be invaded, is that the pacific-minded countries have not brought their national defense up to the quantity and quality required for technological warfare. When the import of the European war is assimilated by the American people and national defense is undertaken as a national enterprise, then we may be confident that we will match in war the progressiveness of our civilian technology and come to surpass it, which means surpassing the German military technology.

In the conviction then that "an adequate organizational framework is itself the precondition for the ascertainment and effectuation of the value of nuclear research for national defense," the speaker proceeded to sharpen the possible applications of that research for naval operation—

Senator RUSSELL. What was the date of that?

Dr. Sachs. April 20, 1940, before the invasion of France.

As I say, I proceeded to point out the possible applications for naval operations, on the assumption that the war would in time become global on the part of the Axis, inclusive of Japan, against the democracies, inclusive of the United States.

In that event, the applications in the dual form of telescoped power drive and magnified explosions should aid the United States to overcome "the disadvantage under which we labor due to the enormous distances between continental United States and our possessions, and between our possessions and the Japanese homeland."

This was not war-mongering; this was adjustment to the import of events as I saw them, as I followed this phenomenal development of mass effort.

If I may quote again from the Bible, from Jeremiah: "Take the wine cup of this fury at my hand and—drink it."

I could see that we would all be engulfed; that on the Continent, only Great Britain would be left; and that we would be the only continental insular power left in the universe and that then we would have to take action.

I saw that we must not let Germany go ahead with research on the kind of weapon they were working on, a weapon whose essence is the elimination of time for the defense, the elimination of that borrowed time we all needed so badly in this war.

Inasmuch as the attempt to relate the applications to strategic and logistic configurations presupposed naval data, Dr. Briggs' good offices with Admiral Bowen and Commander Hoover brought answers to questions submitted in a letter. This letter I do not have.

Now, the sequel to this was a new stage in this progress. You must bear in mind that this is not the linear progress that people have written about. You will remember that story in Alice in Wonderland, about the queen: You start with the end, you start with the sentence, and then you work back.

So it is when it comes to writing history. People might say, "We have got the bomb and we used it; therefore, it must have been present throughout."

There was no such straight line. It was a very zigzag line, and every bit of time and every urgency that was applied turned out to be indispensable. Every infinitesimal effort, even, became infinitely important in the course of the eventuation of what gave us the timely use of a weapon that did serve to shorten the war.

It did shorten the war, although it must be recognized that, strategically and otherwise, Japan had been completely beaten by naval and other action. They had been beaten by the Navy, by the air power. We must not, in our concern with these things, tend to eliminate the problem of the whole organization of our national defense. We needed those bases protected by the Navy to use for the bombing and that was the result of war operations by other war technologists.

However, it presents a new factor, a most vital factor—but I will not go into those questions. I will return to the history.

The conference of April 27, 1940, on organizational framework, the inadequacy we had then, resulted in new submissions to the President for a resolution of the difficulties.

The conference that was held on April 27 at the Bureau of Standards under Dr. Briggs' able and conciliatory chairmanship did serve to

dispel doubts that had been entertained by some members. It also marked further progress in evoking a willingness to entertain consideration of large-scale expenditures that might run up to six figures. That was fantastic alongside the cost heretofore, the thousands that were being spent and the money that was being furnished by those who were on the margin, who were spending out of their own pockets in connection with this work in corresponding amounts.

It had begun to run into six figures. Yet the majority, accustomed to the small scale of physical laboratories at the universities and the correspondingly reduced scales of the budgets of governmental scientific laboratories, did not appear ready to design a large scale and comprehensive program, and instead insisted on "bit-by-bit" procedures with ranked preferences and time deferments.

By the beginning of May the uranium research at Columbia, which was the pathfinding research, had reached the point where expansion was deemed advisable and desirable by the whole quartet of scientists concerned—that is, the direct experimenters, Drs. Fermi and Szilard and Dean George Pegram and Prof. Harold Urey.

After a number of conferences of the speaker with the Columbia group, a sort of minute was drafted as of May 10 embodying the consensus as to the successive stages. In this case, I myself did the secretarial work. I did not hesitate to be a glorified office boy.

The first point in this minute was:

The first large-scale experiment would have as its aim to demonstrate beyond any doubt whatever that a nuclear chain reaction could be maintained in a system composed of carbon and uranium. This would require about 100 tons of graphite and some 10 to 20 tons of uranium metal. It would also be necessary to design a rather elaborate mechanism to stabilize the chain reaction and to safeguard against overheating as well as the possibility of an explosion.

The second point was:

The next stage is to carry out a general survey of all nuclear constants in order to confirm the values previously obtained and to narrow down the limits of experimental error beyond observed values of the constants. This would strengthen the assurance of the group in the ultimate success of the experiment.

Then as preparatory ground for that experiment would come the advancing of structural details and the carrying out of technological tests on samples of materials which have to be used in large quantities in the ultimate experiment. This in turn would require getting bids for the manufacturing of the material in needed quality and quantity.

As to quality, the problem of refinement was throughout a very grave one; it was the industrial know-how which had to be acquired, as well as the fundamental scientific research.

In financial terms, the first stage would require expenditures of \$30,000 to \$50,000; the second stage would require from \$250,000 to upwards of \$500,000.

It was the speaker's view that in the interest of time, speed, and even of economy, the second could be prepared for while the first was going on, providing that adequate funds were made available to begin with. The proposal which had been submitted for a nonprofit organization directed by a mixed board of trustees seemed particularly suited to methodical and economical direction of the work.

The lack of resolution of the organizational difficulties led the speaker to submit an analysis of the situation and resultant recommendations in a communication to the President dated May 11, 1940, together with a note of transmittal to General Watson of even date.

The point of departure was—I am coming to the end of this section, that may serve as a terminal point.

The CHAIRMAN. Very well, Doctor.

Dr. SACHS. The point of departure was that, according to the advices given to the speaker by Dean Pegram, the graphite experiment, which had been partly financed by the Government, was a success. As the communication was coincident with the German march through Belgium, the invasion having begun on May 10, the situation adumbrated in the initial presentation of October 11, 1939, had come to pass.

I mean, the situation I had presented when I stated that we should acquire uranium supplies from Belgium had come to pass.

A problem of access of uranium supplies that would be needed on a larger and larger scale had been thrust forward.

This, in turn threw into sharper relief the need for a change of the organizational framework "under which the work would proceed with the flexibility required for a going enterprise."

The President was therefore requested to designate a legal aide to facilitate the establishment of a nonprofit body which would secure the resources for carrying on the work under conditions where the tenure of the research posts would be secure and their equipment and material be amply provided for. I have in mind here that large group of scientists that would have to be brought in at that period when they were looking for other university posts.

Along with that there should be provision for the necessary secrecy as distinguished from the normal eagerness and competitiveness in early publication of indicated results.

You must see that we had a job there. Even in getting the scientists, you had to take that into account, the fact that we were preventing them from having what is the biggest asset to the scientist—the knowledge that the results of his research will get published to all when he does an important job. He would not have that satisfaction—and you have to give them an adjustment in salaries.

This was no time to delay; if we delayed, then we would be losing the scientists.

Also, at that time—this was before the invasion of France—you would have to see to it that, so far as our publications go, the scientific magazines, such as Science, and the Physical Review, and related publications, that this work, in view of the potential value and the potential danger, was not made known to the potential enemy.

Is this a good stopping point, Mr. Chairman? I could go on. What do you say, sir?

The CHAIRMAN. Doctor, the Senate meets at 12 o'clock.

Dr. SACHS. All right, let me go on, then; this is a very short part.

The CHAIRMAN. All right.

Mr. SACHS. This is part 6 of this contemporaneous history, assembled at the end, in August. This is on the basis of what had been done with these reviews that were made, it is contemporaneous with what I have developed.

The heading is:

Resolution of the difficulties and resetting of the uranium research project into the new organization established by the President on June 15, 1940 for the direction of all scientific developments related to national defense.

The CHAIRMAN. What was the date that the small-scale stage ended and that you were to go forward on the large scale?

Dr. SACHS. Between May and June it was decided that we needed to go forward on the larger scale. The appointment of a new organization, the Office of Scientific Research and Development, came, I think on June 15, having been preceded by suggestions of such a scheme as I transmitted to General Watson.

Senator AUSTIN. This was 1940?

Dr. SACHS. This was in 1940.

In keeping with the practice of full confidence and cooperativeness with the Presidential representatives from the Government services to direct the joint committee on the uranium project, the letter to the President of May 11 was given a counterpart in the communication to Dr. Briggs of May 13, 1940. That is, I did not do anything with the President without sending a copy of it or speaking about it to Dr. Briggs, as the administrator-scientist, and to General Watson, as aide to the President.

My letter to Dr. Briggs drew attention to Dean Pegram's favorable report on the graphite experiment and inferred that the governmental committee would report favorably to the President on the project. That would be reported directly to the President and I was convinced enough and could discern that it would be certain to be recommended.

Recognizing that university research is inherently characterized by a "traditional discursive attitude and leisurely tempo," the contemporaneous facts of the invasion of Belgium threw into sharper relief the requirements of national defense. Applied to this project, those requirements were for a resourcefulness of operation and an acceleration of pace and also a secrecy that could not be had in the university projects, generally carried on with limited means and in an atmosphere of mutual interchange.

And I want to say here that the scientists, Dr. Szilard, Dr. Wigner, and Dr. Einstein, were all of the same view, that there had to be secrecy against leaks to the enemy.

In furtherance of the foregoing, another letter was written to General Watson on May 15, the second and revised version of which is included here.

[The letter referred to was entered in the committee's record and appears below:]

(Revised version)

MAY 15, 1940.

DEAR GENERAL WATSON: Confirming the intimation that I had the honor to convey in my letter to the President and in my covering note to you, I have just received a letter from Dean Pegram, of the department of physics of Columbia University, stating that the initial experiment "has now been concluded with satisfactory result," and that "the absorption cross-section of carbon was found to be encouragingly small * * * only about one-third of the upper limit previously reported in the literature." The detailed meaning of that has been set forth in the letters of Dr. Szilard of May 10 and of April 22, which I forwarded to the President; a copy of the latter was also sent to you. Please advise me before any conference on this is arranged.

In connection with an independent matter having to do with economic and fiscal policies for effectuating national reconstruction and defense, I should appreciate your expressing to the President my readiness to submit certain social-minded economic ideas that had interested him in 1933 and 1934, as to incentive devices for evoking large-scale plant investment for national defense and the training and reconditioning of the requisite skilled labor. To the original proposals drafted in 1932, there was added in early 1933—when submitted for the National Recovery Act—a provision authorizing public works' expenditures

for national defense, in view of the altered international situation. The ideas and proposals in connection with the original FHA plan submitted in 1933 were later expanded in the second FEHA plan that, at the President's behest, was worked out for Governor Eccles' advisors. In keeping with the pattern of these earlier plans, the role of Government can be adjusted to specific requirements.

For the instant purpose, the organizational instrumentality proposed is the establishment of a Scientific Council of National Defense, composed of executives, engineers, and economists, acting in behalf of the Government, who should be invested with administrative powers for the testing and execution of technical projects of utility for national defense.

Yours sincerely,

ALEXANDER SACHS.

Gen. EDWIN M. WATSON,
*Secretary to the President,
The White House, Washington, D. C.*

Dr. SACHS. There was a telegram in between that letter and the revised version of it.

The letter starts out with a reference to a letter from Dean Pegram, of Columbia University, which I do not have. The substance of that letter from Dean Pegram as given to General Watson was as follows: "The initial experiment has now been concluded with satisfactory result; the absorption cross-section of carbon was found to be encouragingly small, only about one-third of the upper limit previously reported in the literature."

The main communication of the speaker contains the first adumbration of a plan similar to that later developed by the President for the direction of the scientific work related to national defense. The new suggestion was made in the setting of proposals which the speaker was evolving for submission to the President with respect to amortization and other incentive-tax devices for national defense plant construction.

It was my belief that industry had to be regulated and integrated for national defense and I had been asked to submit some suggestions and I made many suggestions in my professional capacity as an economist with reference to these problems, besides my interest in this uranium research.

For instance, in connection with the economic aspects of national defense, I make allusion here to the suggestion contributed by me under the National Recovery Act in 1933, for the inclusion in that Act of a provision authorizing public expenditures for national defense and naval construction.

In respect to the specific problem of an organizational framework that would carry forward uranium research on a bigger scale and at a faster tempo, the new recommendation of the speaker was as follows, against the background that the Government was then thinking of going to the Congress with a request for bigger appropriations.

For the instant purpose, the organizational instrumentality proposed is the establishment of a Scientific Council of National Defense, composed of executives, engineers, and economists, acting in behalf of the Government, who should be invested with administrative powers for the testing and execution of technical projects of utility for national defense.

In acknowledging that letter, General Watson on May 16 added an observation regarding the broader suggestion for a mixed executive and administrative group for scientific phases of national defense.

The CHAIRMAN. Was that group formed?

Dr. SACHS. That group was formed on June 15; there was an intervening communication and I had received an authorization after an O. K. and an encouraging word from the President to represent the Government in negotiations with the Belgian company representatives here for the acquisition of uranium.

The CHAIRMAN. Doctor, there has just been a quorum call from the Senate and I think we will have to stop at this point:

Dr. SACHS. May I read the last stage and that will complete the whole story?

The culmination of the foregoing phases of the uranium project came on the day following the German Army's entry into Paris. On June 15 the President established a new committee for the correlation of the scientific efforts of the country concerned with the problems of national defense and placed that committee under the chairmanship of Dr. Vannevar Bush, president of the Carnegie Institution of Washington, whose name I have mentioned in the course of my discussion here. This committee included representatives of the Army and Navy and distinguished scientists and, initially, was to be attached to the Council of National Defense, in keeping with the suggestions I had made.

Accordingly, the President advised Dr. Briggs on June 15 that "since the problem on which you are engaged is part of this larger picture," Dr. Bush was requested by him to take over the uranium project and to reconstitute the committee.

Now, I make my summary. Thus was found a larger framework in accordance with the tenor of the speaker's recommendations. Dr. Bush's committee after our entry into the war became the Office of Scientific Research and Development. Associated with him and Dr. James B. Conant, of Harvard, was the General Policy Committee, which included the then Vice President, Henry A. Wallace; Secretary of War Stimson; Gen. George C. Marshall; and Army and Navy representatives. The other group of the Army came in 1942.

The uranium project as initially presented by Dr. Einstein and the speaker in October 1939, having by the Spring of the next year been reported on favorably by the testing and coordinating committee that the President had appointed under Dr. Briggs' chairmanship, was thus launched on a permanent and progressive career in the wake of our decision after the fall of France to embark on expanding defense.

From then on it became invested with the importance, the resources, and the secrecy available to the Government of the United States in defense and later in war for the translation of an idea into a reality and into an instrument of national policy in war and peace.

The CHAIRMAN. Thank you very much, Doctor.

The committee will adjourn until 10 o'clock tomorrow morning.

(Whereupon, at 12:05 p. m., the committee adjourned until 10 a. m., Wednesday, November 28, 1945.)

ATOMIC ENERGY

WEDNESDAY, NOVEMBER 28, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to notice, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Johnson, Connally, Byrd, Tydings, Vandenberg, Austin, Millikin, and Hickenlooper.

Also present: Edward U. Condon, scientific adviser, and James R. Newman, special assistant to the special committee.

The CHAIRMAN. We have with us today Major General Groves, who took such a prominent and leading part in this project.

We are pleased to have you with us, General. Will you go right ahead.

STATEMENT OF MAJ. GEN. L. R. GROVES, UNITED STATES ARMY

General GROVES. I have a short opening statement which I would like to read to the committee.

It is essential, in the highest national interest, that further development in the field of atomic energy be pursued under controls which will preclude the utilization of atomic energy in a way which would imperil the national safety or endanger world peace. Future activity in this field is so important to the national welfare, and potentially to the enrichment of our living, that control should be exercised by a special commission independent of any existing Government agency with the sole duty of supervising and controlling the development of atomic energy. The commission should have complete authority over all activities in the field, subject only to the approval of Congress and the President. The commission should be composed of persons of recognized ability whose actions would be unquestionably in the public interest. Broad discretionary powers and adequate funds are essential to its success.

The War Department will always have a vital interest in the use of atomic energy for military purposes. In the field of practical administration and operation, the Army can furnish invaluable assistance. Civilian and military personnel who have acquired knowledge and experience on the project should continue to serve to the extent that their services are useful. The commission should be in complete control of policy and should exercise general direction and supervision of all activities.

Because of the current uncertainty, we are daily losing key people whose services should be retained. Until that uncertainty is resolved by the establishment of a national policy, we are not in a position to offer acceptable commitments to these key people. Prolonged delay will result in appreciable loss of the present efficiency of the vast combination of plants, scientific talent, and engineering skill.

We must recognize the clear distinction between domestic control and international control. The two can and should logically be separated. Domestic control is necessary no matter what international policy may be eventually worked out for the United States and the world. It is necessary to protect America's tremendous investment in atomic research and development and to insure that this development will go steadily forward.

I would like to discuss for a few minutes what happened when these bombs were dropped over Japan. I don't know how much repetition there is in this, but I do not believe there is very much.

The atomic bomb mission which went overseas, headed by Major General Farrell, made no attempt at Nagasaki and Hiroshima to secure or estimate exact casualties. This was not possible because the mission did not survey the cities until over a month after the dropping of the bombs.

The best over-all estimates—and these come from the Japanese as they were given to General Farrell—of the dead and missing at Hiroshima are somewhere between 70,000 and 120,000; injured, between 75,000 and 200,000.

At Nagasaki, the dead and missing were between 40,000 and 45,000, and the injured about 40,000.

The figures at Nagasaki are much better than they are at Hiroshima because the authorities were able to act after Nagasaki because it hit one section of the city, the industrial section, and did not destroy all of the city and military governments. At Hiroshima there were a number of military targets, including army divisional headquarters, an army ordnance depot, an army transport base, an army clothing depot, all the public utilities, an oil storage depot, various textile and rayon plants, and Japanese Army headquarters, the commander of which was charged with the defense of that section of Japan against American attack.

Practically everything at Hiroshima for a radius of about a mile and a quarter from the point of detonation was burned as well as blasted. Up to a radius of 2 miles from the point of detonation everything was blasted, with some damage from burning. Between a radius of 2 and 3 miles, everything was about half destroyed. Beyond a radius of 3 miles, damage was fairly slight, with roof damage up to 5 miles. Glass was broken up to a radius of 12 miles.

There were about 20 masonry and steel structures left standing in the central portion of the city. However, the interiors of all buildings were gutted and all windows were out. Few bridges were destroyed; most were left intact except for handrails and sidewalks.

In the pier area—Hiroshima was a great military port—individual warehouses were collapsed. Intervening hills protected some nearby areas from the blast. Automobiles had roofs caved in, shelters were caved, and street cars were derailed and burned. About 4 miles away a fire was started in a forest on the mountainsides.

There were approximately 20,000 army personnel in Hiroshima at the time of the bombing, of which 80 percent were casualties. The Army headquarters, which I spoke about, had 9,000 men in the headquarters; of those, 7,000 were casualties.

At Nagasaki the blow was struck in a largely industrial area, which left a large part of the residential area more or less standing. The effects of the explosion in the industrial area were probably more spectacular and startling than Hiroshima; for example, the complete destruction of the huge steel works by blast and fire, and the destruction of the torpedo works by blast alone. Within a radius of 2,000 feet from the point of detonation, heavy industrial buildings, gas storage tanks, and many reinforced concrete structures were destroyed. The steel frames in all buildings in all cases were pushed away from the point of detonation. For a radius of 8,000 feet, Japanese workers' homes were completely demolished. Up to a radius of 2 miles, workers' homes had collapsed; roofs and walls were smashed, but were left partly standing except in isolated cases where exceptional shielding was given by local topography. Up to a radius of 3 miles there was some roof damage to tiles of heavy type. Glass and plaster damage was evident up to much greater distances.

Up to 2,000 feet, 9-inch concrete walls were destroyed. Up to a radius of 4,000 feet, brick smokestacks with 8-inch walls were displaced, cracked, and overturned.

The northern ordnance plant, at a distance of 4,000 feet from the point of detonation, had corrugated iron stripped from walls and roofs, window sash pushed out and framework overturned and destroyed. These were of light-steel-frame construction.

Fire damage was heavy throughout the area. The length of the burning area was 3 miles, with a 6,000-foot width in the northern part of the city.

The Japanese listed no destruction to shipping in the harbor, which was a considerable distance away, except minor damage to superstructures, which included broken glass. There were about 100 ships and small boats in the harbor, of which about a third were 100 tons in size.

Senator AUSTIN. May I ask a question at this time, Mr. Chairman?

The CHAIRMAN. Of course, Senator.

Senator AUSTIN. Have you any record of the examination of these two areas made since the time that you are now testifying about that would indicate whether there is a residue there of radioactivity in those areas?

General GROVES. Yes, sir; and there is none. That is a very positive "none."

I would like to read a statement from an eyewitness, which goes into that phase of it.

The CHAIRMAN. General, was that because of the way that the bomb was exploded?

General GROVES. Yes. The bomb was exploded at considerable height, and for that reason there were no after-effects from radiation. There were some radiation effects at the time of the explosion; they were instantaneous. No one suffered who was not exposed at that moment, and the casualties, as far as we can determine, resulting from that were relatively small.

The CHAIRMAN. If it is a permissible question, at Alamogordo, where you exploded from the top of a steel column, there was some radioactivity, was there not?

General GROVES. At Alamogordo we exploded it at a height of 100 feet on top of a tower, and there was residual radioactivity on the ground right below the point of explosion. That was of such a nature that you could walk through it, you could spend hours in there, but I would not have wanted to sit down and make my home in that area.

The CHAIRMAN. Would you want to own some of those cows, General, that they say changed their color?

General GROVES. They changed their color, but an examination of the animals shows they were not injured in any way other than having temporary gray hairs. They were streaked with gray.

This account was written at our request by a Jesuit Father, who was on a mission to Japan. He had formerly been in Tokyo, and his school was moved from Tokyo to Hiroshima.

As you know, the Jesuit Fathers, for a number of years—and I should say centuries—have been some of our most accurate reporters of world events. He prepared this at our request. I imagine he would have prepared it anyway and sent it back to the headquarters of the society.

He is a German named Father Siemes. This is his eyewitness account:

Thousands of wounded who died later could doubtless have been rescued had they received proper treatment and care, but rescue work in a catastrophe of this magnitude had not been envisaged. Since the whole city had been knocked out at a blow, everything prepared for emergency work was lost, and no preparation had been made for rescue work in the outlying districts.

Many of the wounded also died because they had been weakened by undernourishment, and consequently lacked the strength to recover. Those who had their normal strength and who received good care slowly healed the burns which had been occasioned by the bomb.

It was also noised about that the ruins of the city emitted deadly rays and that many workers who went there to aid in the clearing died, and that the central district would be uninhabitable for some time to come. I have my doubts as to whether such talk is true, and myself and others who worked in the ruined areas for some hours shortly after the explosion suffered no such ill effects.

He and a number of his fellow priests went from this outlying novitiate where they were living down into the center of the city to rescue their Father Superior who had been injured. I think they were in the ruins for about 12 hours, and from that time on they devoted most of their attention in assisting in the alleviation of the suffering, and certainly were exposed to anything anyone would be exposed to.

Senator RUSSELL. That was immediately after the explosion?

General GROVES. Within a few hours they got the word. It took about 12 hours going in and out of the city.

There has been something said of relief workers who were injured in the relief work. Those relief workers were in the city before the bomb went off, and they were just like any other inhabitants. They were in there because the Japanese had decided to evacuate all unnecessary population from Hiroshima. I think they felt that the city had been spared from bombing up to then. They did not know why, but they expected it to be bombed. They did not know it was being reserved, as it were, for this.

Senator MILLIKIN. May I ask, General, was Hiroshima on the list of cities to be bombed that were scattered over Japan?

General GROVES. No, sir; it was not on that list. That list was put out by General LeMay, and did not include Hiroshima. I don't recall whether it included any other cities that we were interested in or not. This is again from Father Siemes' account, and is his concluding paragraph.

Senator AUSTIN. May I ask a question before you pass forward?

General GROVES. Yes, sir.

Senator AUSTIN. There was one phrase in your testimony that causes this question, and that was "as soon as he heard about it," or words to that effect. Is it true that this priest did not know of the explosion until someone told him?

General GROVES. Oh, no, sir. He was, as I recall, about 4 to 5 miles from the explosion—or maybe 3—well into the suburbs. He was standing in front of the window when this bomb went off, apparently just looking out and seeing what a beautiful day it was. It was good weather, and there had been an air-raid alert, because of these three planes that had come over, but the Japanese had decided the three planes were photographic planes, and had apparently recalled the alert.

He was standing there looking out the window when the bomb went off and he saw this terrific light effect, and was scratched around his face and hands, I suppose by flying pieces of glass.

He did not realize at the time—for he thought it went off right over his head, and to him it was just a single bomb—he did not realize what had happened to the city until the refugees started streaming by. He did not know even then, and couldn't imagine that his Father Superior who was so far removed from him could possibly have been injured.

This is the final conclusion by Father Siemes:

We have discussed among ourselves the effects of the use of the bomb. Some consider it in the same category as poison gas and were against its use on the civilian population. Others were of the view that in total war as carried on in Japan there was no difference between civilians and soldiers, and that the bomb itself was an effective force tending to end the bloodshed, warning Japan to surrender, and thousands to avoid total destruction.

It seems logical to me that he who supports total war in principle cannot complain of a war against civilians. The crux of the matter is whether total war in its present form is justifiable even when it serves a just purpose. Does it not have material and spiritual evil as its consequences which far exceed whatever good might result? When will our moralists give us a clear answer to this question?

Senator RUSSELL. Before we get away from the question Senator Austin asked, do you intend to touch any further on the radioactivity?

General GROVES. I would be glad to right now.

Senator RUSSELL. I suppose the War Department has conducted an independent investigation other than that statement submitted by the priest?

General GROVES. Oh, yes, sir.

Senator RUSSELL. The first reports coming out of Japan were naturally highly colored and stated, as you have just related, that there were thousands of people who sickened and died several days after the explosion, and went so far as to say it killed all the fish in the rivers and created havoc generally.

What did the commission find?

General GROVES. I would like to explain first what the mission consisted of.

I have forgotten now whether it was after the Nagasaki bomb or after the Hiroshima bomb that I realized that this war was not going to last very much longer. I had always thought such would be the case once we dropped one. So I assembled in this country a special group to go over to investigate what had happened in Hiroshima and Nagasaki. Some of the group came from the Marianas where General Farrell was, and the whole group went over under his personal guidance. We sent essential medical scientists of the highest repute in the United States, headed primarily by Col. Stafford Warren, who is, in normal times, one of the leading authorities, a professor at the University of Rochester.

We had the full support of General MacArthur's headquarters over there and assistance in going into these cities once we were landed in Japan.

They made very careful studies. They talked to the Japanese doctors and the military, all of whom had order and who faithfully carried out those orders to cooperate in giving us all possible information.

We are still studying those facts and figures, and I think I can make some positive statements. First, there was no radioactivity damage done to any human being excepting at the time that the bomb actually went off, and that is an instantaneous damage.

The CHAIRMAN. General, you don't make any point of congratulation on that result, the fact that that didn't happen, do you? If there was radioactivity, there wouldn't be anything morally wrong with that?

General GROVES. No; we hoped to avoid that, and we did avoid that; but I think that is something that if it was a choice between radioactivity on a few Japanese or even a number of thousands of Japanese or a case of saving 10 times as many American lives, I would go the American way on that question without any hesitation.

The CHAIRMAN. It seemed to me that the War Department had made a great deal of the fact and sought to emphasize it time after time, that there was no harm from radioactivity.

Of course, if you are simply telling the fact, that is one thing, but its very reiteration seemed to me to indicate that there was some feeling on the part of the War Department that there was something morally wrong if it had. I just wanted to get your view on that.

General GROVES. There would be no feeling, as I say, on my part, on anything that would have shortened this war by a single day.

Senator RUSSELL. My question was not intended to indicate that I thought there was anything morally wrong if the radioactivity had been very disastrous; but thousands of people all over this country are living in tremendous fear of this atomic energy and its use. I thought it would be well to develop just how far the effect of the radioactivity would go.

General GROVES. I would like to go into that, if it is agreeable to you gentlemen, now.

As I say, our facts disclosed that nothing happened of that character excepting at the time the bomb went off, and that the number of casualties from that were relatively small. Nobody knows what the casualties were or how they were made up; but all the investigations by men who were in there to investigate and get the facts, not

to come out with an answer, indicated very clearly that that was the case.

Now, at the time the bomb went off, a person who was within a certain range could be affected by radioactivity; but in the normal case, he would already have been killed by the effects of the explosion or by the tremendous heat, and that is the real thing to think of. If he was right on top of the bomb, he could be killed in a dozen ways, all of them equally fatal; and as he removes himself from that exact point, certain of these possibilities are removed.

It really would take an accident for a man, the average person, within the range of the bomb to be killed by radioactive effects.

Senator MILLIKIN. Mr. Chairman, may I ask a question, please?

The CHAIRMAN. Yes, Senator.

Senator MILLIKIN. General, is there any medical antidote to excessive radiation?

General GROVES. I am not a doctor, but I will answer it anyway. The radioactive casualty can be of several classes. He can have enough so that he will be killed instantly. He can have a smaller amount which will cause him to die rather soon, and as I understand it from the doctors, without undue suffering. In fact, they say it is a very pleasant way to die. Then, we get down below that to the man who is injured slightly, and he may take some time to be healed, but he can be healed.

Senator MILLIKIN. Does that come about through treatment or through time?

General GROVES. Through time. Radioactive effects are like X-rays. They depend upon the intensity and the time. Anyone who is working with such materials, who accidentally becomes overexposed, just takes a vacation away from the material and in due course of time he is perfectly all right again.

Senator MILLIKIN. Let me ask you, would the effect be different had the bomb exploded in the ground?

General GROVES. If the bomb had exploded on or near the ground, that is, within a hundred feet or so, the effect would have been the same as at New Mexico, I believe; there you would have had lasting effects for a considerable period of months. You would have had a considerable number of radioactive casualties, and I think that you would have had an area which should have been banned from traffic.

The first mission given to our organization that went over there was to determine that the cities of Hiroshima and Nagasaki were 100 percent safe for American troops, and to know absolutely that that was a fact so that the men themselves would know that everything was all right.

Senator MILLIKIN. General, can you tell me the largest size regular bomb that was used in the Pacific area at the time of Hiroshima and Nagasaki?

General GROVES. No; I really do not know, Senator.

Senator MILLIKIN. Can you give us a reference point, some sort of bomb that was in use, and tell us how many of those bombs it would have taken to produce the same result in those cities?

General GROVES. I am sorry, I cannot tell you exactly. I believe that at that time they were using against Japan a bomb which must have had about 1,000 pounds of explosives in it; against Okinawa,

possibly up to 10,000 or 15,000 pounds of explosives. I may be in error on these figures, but I can tell you that taking the heaviest type of bomb they had that a rail of a thousand planes would not have been as effective as this one bomb in actual damage done to the cities—no comparison.

Senator MILLIKIN. One thousand bombs of the type they were using would not have produced a similar effect?

General GROVES. That is correct. At Tokyo, which had been bombed repeatedly, and I don't know how many times or how many bombs were dropped there, there were a great many burned-out sections, but it also had a great many usable sections. The casualties at Tokyo I understand are greater than they were at Hiroshima or probably as great as in both of these bombings, but the effect was not the same.

Senator MILLIKIN. Are the cities comparable, so that you could draw a comparison?

General GROVES. In physical damage, I would say that it would take maybe as many as 2,000 planes to equal the effect of 1 of the bombs; but in the effect on the people, there is a much greater effect. I think the Japanese officer who was assigned to aid General Farrell at Hiroshima presented that thought in the best possible way. He stated that when it comes to the fire bombing of Tokyo and the high-explosive bombing, there was something you could do about it—that the bomb fell and you took your chances; a small number of people were killed with each bomb, and you could get out and save some of your property. In general, it was something that you could stand up against. But he said when it came to the Hiroshima bomb it was unendurable, and I think that is the real statement; that it is an unendurable bomb to anyone, and particularly to someone who did not know it was coming. How much the surprise element had to do with our success I don't know, but I am a great believer in military surprise, as is everyone; and this was the greatest surprise since the Trojan horse, and it ended a war just as suddenly.

Senator MILLIKIN. May I ask you, what was the percentage of loss on our plane flights in that area?

General GROVES. I do not know, Senator. Due to the cooperation of various services, such as the Navy Special Rescue Service, and the supreme care that was exercised, I think that our loss rates were getting better all the time. After all, these planes were flying a tremendous distance, and just in the normal time of flight they were bound to have accidents. How many men were lost there, I do not know.

Senator MILLIKIN. Passing the question of time in shortening the war, I was trying to determine the lives that we saved just in point of the air missions that would be required to produce the same amount of damage.

General GROVES. In that, I don't know that you could get a real figure, but I think we could get that from the War Department for the record if you would like to have it. I think that the real saving in life came in regard to the attack on the beaches. The Japanese, from all that we can find out, had no intention of quitting this war even if we had bombed by normal means and destroyed every city in Japan. The people on the beaches of Kyushu, in the caves there, were perfectly prepared and expected to stand there and die—men, women, and children—and take as many Americans with them as they could.

Senator MILLIKIN. Your point is that the psychological effect created by this bomb served to pull them out of the war, whereas the same amount of damage, the same number of casualties produced in other ways might not have pulled them out of the war?

General GROVES. That is absolutely correct.

Officers I have talked to, who have toured Japan under the conditions as they are now, state that this bomb created a fear throughout all of Japan that was just indescribable, and that that was the first real propaganda that they could understand; maybe they had gotten a lot of leaflets, but this was something they could understand, and it went all over the Japanese press, and they knew that it was the end. Of course, it was a tremendous point for the Japanese Government and the ruling classes to lean on as a face saver to get out of the war.

Senator MILLIKIN. Thank you very much.

The CHAIRMAN. You and I have talked about Churchill's estimate of what he thinks was saved this country and England.

Do you agree with his estimate, and will you state it for the record?

General GROVES. As I recall, it was 1,000,000 Americans and 250,000 British. I don't know what the basis of his estimate is. I think probably that it is a little high.

All that I can say definitely is that probably, if you figure on the number of divisions that had been announced as making that landing, and think of the number that were on Okinawa and that this was the homeland, you can estimate quite properly that the casualties that would have been suffered—and I am speaking of the serious casualties, not the ones that are just for a day or two and not the ones who are disabled for life due to illness of various kinds—could well have numbered into the hundreds of thousands, possibly up to Churchill's figures, and certainly enough so that everyone who had a boy over in that theater, or expected to have one, was dreading the day of that landing on Japan. I don't think that that dread was unjustified at all.

Certainly, the military authorities in their plans and in their estimate of the situation never felt that the landing on Japan would be a push-over in any sense of the word. They felt that they were going to fight to the last cave.

Senator VANDENBERG. What was the Hiroshima date, General?

General GROVES. August 5.

Senator VANDENBERG. And what was the date of the test in New Mexico?

General GROVES. July 16.

Senator VANDENBERG. So that as soon as this bomb had been developed to your satisfaction as a success, there was no delay in its use in the war itself?

General GROVES. There was no delay. I would be glad to tell you of the delays that we had from the time that we could have done it. The whole bomb depended on when we could get the material. The mission that I gave to the scientific laboratory at Los Alamos, N. Mex., under Dr. Oppenheimer, was that I wanted a test of that bomb as soon after we got sufficient material to them for the test and it could be processed and put into the bomb. My recollection is that they were 3 days late. In other words, they had a few things that they had not solved ahead of time. That mission had been given

to them over 2 years before. I felt it was a master performance on their part.

Part of the bomb for Japan was sent over there, as you know on the *Indianapolis*, and part of it followed by air. The bomb was ready to be dropped, or could have been ready to be dropped on the 31st of July. It had to be assembled overseas in part. We had to wait for weather, so that it was really from the 16th of July until the 31st, and in that time we had to assemble enough material and ship it.

Our production of material was going up on a very sharp curve, and we had enough for the first time. The delay in the use of this bomb was 5 days, and that was due to weather.

Senator VANDENBERG. Up to July 16, you had not been prepared to proceed?

General GROVES. Oh, no, sir. We did not have enough. We couldn't. In other words, we could have fired our first bomb on July 16, and the second on July 31 in the Marianas. If we had had a second test in this country, which we would not have had under any circumstances, that could have saved the time of travel from the United States over there of about a week. So that the second test could have been on July 24.

Senator VANDENBERG. So that completely dissipates the stories that were general in this country, that there was a long and substantial delay in the use of the bomb for international political reasons?

General GROVES. Those stories are completely without basis in fact.

Senator HICKENLOOPER. General, coming out of the Los Alamos test were the stories of the effect of the flash and the light on the eyes of the observers at great distances.

Did the priest who wrote this report make any statement as to any effect on his eyes at that comparatively close distance?

General GROVES. He did mention that eye effect and talked about a girl who was much closer than he was, and how she was blinded temporarily from the flash just as you are if you happen to look at a welder on a street-car track as you drive down the road. You are temporarily blinded, but your eyes soon recover, and you are all right.

We have had no results that I know of that indicated any real eye effect. There would possibly be some, but if they were minor, just a few, I would not know it. There were certainly not any great number or I would have known it.

Senator HICKENLOOPER. It seems to me I recall from reading some of the stories that have appeared in articles and in the newspapers that the observers at Los Alamos were unable to view the first flash even through darkened glasses.

General GROVES. That is correct. I think the best example of that were the observers who, I believe, were 27 miles away. Those were the observers who had worked with it and were not necessary to the test, and they had a vantage point out there. They were provided with the equivalent of welders' helmets with the glass that is in them, and they could view the explosion through those.

The ones who were looking directly at it at the time of the explosion, which were approximately 90 percent, were just sort of temporarily blinded just as you are when a flashlight bulb goes off, just that same feeling, and the result was that they could follow right along and see what happened. Some of the men in their excitement,

having had 3 years to get ready for it, at the last minute forgot those welders' helmets and stumbled out of the cars where they were sitting, and did not have the helmets in front of their eyes. They were distinctly blinded for maybe 2 or 3 seconds, and in that time they lost the view of what they had been waiting over 3 years to see.

Senator HICKENLOOPER. How far away were they?

General GROVES. About 27 miles, as I recall. It may have been 20, but I think 27.

I was at 10 miles and looked at it as soon as I could turn around after it went off. I looked at it through dark glasses. That was probably a fraction of a second, or maybe a little bit more. At that time I could look at it, and it was perfectly all right through a piece of smoked glass.

Senator RUSSELL. What equipment did you give the crew of the plane that carried the bomb?

General GROVES. They had special glasses of the polaroid variety that they could twist to change from almost full light down to no light at all, and they were supposed to be screwed down to the complete no-light basis.

Senator HICKENLOOPER. It seems curious that this priest could be 4 or 5 miles away from the center of this explosion without anticipating it and suffer no particular ill effects from his eyes.

General GROVES. I think the answer to that is that when we saw the thing go off in New Mexico, although we had figured out and told ourselves that we were going to have this tremendous light and should watch our eyes and all of that, we did not really believe it; it was so far beyond the human experience, seeing this tremendous light in the sky, that it just gave you a strength of light many times that of daylight, so we over-emphasized that effect and thought it was more dangerous than it was. In the same way, it was so overpowering that I was not particularly interested in the blast or the noise effects of this explosion. In other words, most of us lost the keenness of observation that we should have had for such a thing because we were so dumbfounded by this light effect, although we had expected it and said, "That is what is going to happen."

Senator MILLIKIN. Can you tell us of the heat reactions, if any, felt by the observers in New Mexico?

General GROVES. The only heat reaction that I recall was just a sort of warm glow. Some people claimed they felt it on the backs of their necks. We were all lying on the ground faced away from the explosion, and they claimed they felt some; but I did not feel any.

Of course, for a considerable distance around all the vegetation was seared off. There wasn't any left.

Senator MILLIKIN. What is the heat generated at the moment of explosion?

General GROVES. I would prefer not to answer that in open hearings, sir.

Senator MILLIKIN. Let me ask you one more question.

In your opinion, had Japan lost the war strategically at the time of the bomb?

General GROVES. I think Japan lost the war—and of course I am not speaking for the War Department here—at the Battle of Midway, but they didn't know it and would not admit it, and their people did

not know it. It took something to knock them out of the war. They were still fighting, and they had no expectation of quitting even if they had lost the war.

The CHAIRMAN. General, it occurs to me that some foreign agent might spread this radioactive material around a city, and you would not know it was being spread because you could not see it, and it might kill a whole population.

General GROVES. You would know it, because everybody who used X-ray film would know it was all fogged, and you would have almost immediate warning because they are using X-ray film constantly. Every person with a camera would find it out as soon as he tried to develop a picture. The photographic film would tell you immediately.

The CHAIRMAN. Suppose some enemy were to drop an atomic bomb or atomic rocket on you. Would there be any danger of radioactivity?

General GROVES. If they dropped one on a city and exploded it close to the ground, there would be radioactivity there that would have an effect.

The CHAIRMAN. Do those rockets that the Germans used over London explode near the ground?

General GROVES. I don't know just where, but some exploded, I believe, on landing. I don't know where most of those exploded, but I believe the world knows today that the way to get maximum explosive effects is to get up in the air, depending on the size of the explosion. For that reason, if they want explosive effect, they will certainly set it off up in the air.

If we had set that bomb at Hiroshima off when it hit the ground, the damage would not have been nearly so great. It was designed to be set off so as to give us the maximum possible explosive force.

The CHAIRMAN. I think those rockets that went over London exploded on contact. If they were loaded with atomic material and it spread out, there would have been considerable danger then from radioactivity?

General GROVES. There would have been considerable danger, but the total damage done to London would have been much less than if the rockets had been exploded in the air; so the real fear would have been in the case of a fuse that did not work and did not go off when it should have up in the air, but then would have been a much less favorable result from the explosion. I say "less favorable" from the standpoint of the enemy dropping it.

The CHAIRMAN. General, relating the bomb to approximately the same size that was sent over Hiroshima, suppose one dropped upon Washington. Could you estimate the amount of damage and relate it to Washington?

General GROVES. Related to Washington, if that bomb had been dropped, say, in the center of the Pentagon, there wouldn't be any Pentagon left.

The CHAIRMAN. That is a big result.

General GROVES. That would have far-reaching consequences.

If it were dropped in what would probably be the goal of any enemy dropping it in Washington, so that it hit on the Federal triangle and destroyed the offices of the Government, it would have destroyed an area maybe 2 miles in diameter so there wouldn't be much left there.

Of these big Federal buildings that are well built, many would have their walls standing. All of the limestone and marble on the facing would have been blown off. There is not much question of that, but the concrete and steel structure might still be standing.

All interior partitions would be gone; all the windows and window frames would be gone, and in general you would have a number of buildings standing just as you see them in the picture of Hiroshima, everything flat in between, and maybe 2 feet deep in rubble of all varieties, with these walls standing there but absolutely unusable.

The normal house that most Washingtonians live in would be completely destroyed in that area. It wouldn't be findable.

The area of real damage, where there wouldn't be much left, would have extended from the Capitol to the National Cathedral at Massachusetts and Wisconsin, or something of that general order.

It would have gone over across the river into the Pentagon area, and have blown out all the windows and window frames of the Pentagon, and probably blown out most of the interior partitions. It would not have destroyed the Pentagon, but it would probably have done a tremendous amount of damage.

Senator VANDENBERG. It wouldn't have wiped out our deficits, would it?

General GROVES. I think it would have taken the Treasury out, excepting the lower vaults; but, in general, there just wouldn't be anything left.

You would have found all of your headquarters in municipal government would be gone. At Hiroshima, as a rule there were about 400 firemen in the town, or 450, and about 25 were left fit for duty immediately after the explosion. That is typical of what happens to all your municipal affairs.

In the United States, it would have taken probably about 30 minutes to start organizing relief, and every man that could walk would be helping someone else. The Japanese did not handle it that way, and that built up their casualty lists.

The better disciplined our people are—that is, the fact that they know such a thing might come now automatically gives them a defense against it—and anything that is in the nature of an organized body gives still more power to resist and to lighten the losses that occur in such a catastrophe.

Senator VANDENBERG. General, if you had to start from zero today, with nothing except your experience and knowledge, how long would it take you to produce a bomb?

General GROVES. You mean with the same full authority I have had in the past?

Senator VANDENBERG. Yes.

Senator CONNALLY. Do you mean with the installations?

Senator VANDENBERG. No; I mean all installations are out; he has got to start at zero.

General GROVES. But knowing what we do today?

Senator VANDENBERG. That is right.

General GROVES. I would say if we had complete authority and freedom from interference by suggestions from lots of people, we could do it in probably 2 years' time as compared to the almost 3 that it took us.

If we had that interference I think it might take anywhere from 5 to 10 years, because it is so easy to say, "We have got a better process; you should build the better process and get more efficiency, or you can do it faster," or something else, and by the time you get through settling those matters, the time has gone.

Senator VANDENBERG. Would you be willing to state what our total investment in atomic energy is up to this time?

General GROVES. I would be willing to state, but unfortunately I do not know the figure. I should say, offhand, the figure of \$2,000,000,000 that was given in August was very close. I think by this time it is probably about, I should say, a little over \$2,000,000,000, maybe \$2,100,000,000, something of that order. I would be very glad to supply that figure.

Senator VANDENBERG. Would you state the total employment in the United States on this enterprise?

General GROVES. The maximum direct employment either by us or our contractors who were working directly for us was 120,000 peak.

There were, in addition to that, all the suppliers of goods who were furnishing on a unit-cost basis. These are not included in that; it might make up a total of 200,000 people, maybe 225,000.

With respect to the operational forces, operating our establishment, the peak of those was somewhere in the order of about 55,000—between 50,000 and 55,000.

Senator VANDENBERG. Now, in dealing with the problem we have to consider, among other things, that we have some Federal cities on our hands, have we not?

General GROVES. Yes, sir.

Senator VANDENBERG. Will you state for the record what they are and, very briefly, what has been done there?

General GROVES. At Oak Ridge, Tenn., we have a town, or a city I think would be a better way to put it, which had a maximum population of 78,000. We have discontinued certain work down there, trying to economize where we can, remembering that money is now controlling where time was before. So that I should say that it would compare in size with the normal city, residential city of, maybe, approximately 50,000. That is 100 percent a Government city.

Senator VANDENBERG. That is the city you built right up from the ground?

General GROVES. Yes; right up from the ground in every way, including every facility considered to make up a city—amusements, stores, and everything else.

Senator VANDENBERG. And the Federal Government owns the whole thing?

General GROVES. The whole thing is owned by the Federal Government; yes.

Senator VANDENBERG. What else?

General GROVES. Hanford, Wash., at Hanford Engineering Works, at what was the site of Richland, Wash., a small town.

There we have a city which is designed to house, I believe, about 5,000 workers and their families. Just what the total population is, I cannot say. I imagine it would be about 15,000 to 18,000. The houses there are different from the ones which you saw in Tennessee. They are probably of better construction but they were also cheaper to build because of the locality.

Senator VANDENBERG. Now, is that a Federal city?

General GROVES. That is a Federal city, the same way, on Government property, everything owned by the Government.

At Los Alamos, N. Mex., the town there is more like the normal military reservation. It has housing for married people and it has quarters for bachelors and the unmarried. It has a large military population, mostly enlisted men who were young scientists who came into the Army and whom we picked out by reason of their records and brought into the work. They were people without whom we could not have done this job. We had a total of about 3,500 of these men out there at Los Alamos.

Our problem there is much more serious than at the other two places. We can house the people we need at the other points but we cannot house them at Los Alamos, the people we should have there right today.

They were brought in there during the war but they will not come in time of peace without some provision for their families and we are faced now with what we are going to do with that establishment.

Due to the uncertainty we are losing the people; we are faced with a very desperate situation.

That laboratory was designed to develop the bomb, all the theory connected with the bomb, the designing and the engineering of it, and to take the pieces that were made elsewhere, as well as some that were made right there, and assemble them into the final bomb; to do some of the final processing of the material as it came from these two plants.

Generally, that laboratory was to develop all the technical details that went into our operations overseas. They furnished the men who were our technical detachment overseas, which was a combination, like everything else in this project, of the American people, made up of Army officers, enlisted men, Navy officers, and civilians, both scientific and highly skilled mechanics of a type that is far beyond what you would normally refer to as a skilled mechanic.

Senator VANDENBERG. Now, is it your contention, General, that in the adequate continuity of developing atomic energy, it is going to be necessary to maintain all these enormous installations?

General GROVES. It is going to be necessary from the standpoint of—but before I answer that, I would like to add that, in addition to those things that you have generally been made aware of, we have certain laboratories that are Government-owned. We have one in Tennessee, which you went into that afternoon. That is a very important laboratory. We have one near Chicago, in the outlying districts of Chicago.

The CHAIRMAN. That is the Argonne?

General GROVES. The Argonne; that, also, is a Government laboratory, although it has been operated for us by the University of Chicago.

Then, we have these various laboratories in universities where, while they are university laboratories, we have been supporting them. We will have to continue to support them if we are going to stay in the lead in this field, because the universities cannot afford to support them, in the first place. In the second place, the universities will

not wish to work on certain problems we are vitally interested in, because they are not of particularly scientific interest as a whole.

The CHAIRMAN. Is that not the reason, General, that you have lost some of your personnel?

General GROVES. Oh, yes.

The CHAIRMAN. Some of these scientists who have done a wartime job of making an explosive will want to get back to something that they consider a little more constructive, will they not?

General GROVES. They wish to get back to the type of life which they chose as young men. They chose to be academic scientists because they like the life. When a man chooses his profession considering all the financial rewards and considering how hard he is going to have to work, and considering the surroundings, and he chooses an academic profession, he would like, in the main, to get back to it. They still feel that the academic profession is more attractive.

The CHAIRMAN. General, going back—

Senator VANDENBERG. Excuse me. Can we have an answer to the question, General?

General GROVES. Did I dodge it? I am sorry.

Senator VANDENBERG. No; you wanted a little more prefix to it. You remember what my question is?

General GROVES. Yes. I would like to amplify a little the situation I am faced with at Los Alamos.

There we are trying to establish this scientific laboratory which will be of a highly secret order. It will have there the heart of the weapon and everything else, as it has in the past.

In order to have scientists of the caliber we are getting—we are getting good men there despite all the handicaps that we have in getting men—we are not getting some of them, we are losing some we would like to keep, but we are getting good men and we hope that we will have an operating laboratory.

To get those men, we are having to encourage them to come and we are encouraging them in two ways.

The first way is that, in addition to working directly on this weapon for us, they are going to be given the equipment and they are going to be given the time to engage in certain fundamental research that they would be doing if they were back in their home universities. That is part, as far as I am concerned, of their salary. We are merely giving them that much time to do the work that will enable them to keep on doing our job with the fullest of interest.

These men have very active minds, they border on the genius type and unless we do that, we just cannot keep these men, we cannot keep them doing it willingly and with pleasure and, I think, with efficiency. In other words, we cannot keep them working toward one goal all the time without ever taking their noses off that particular grindstone. They should have that opportunity of doing their own work, and we are going to furnish that.

We are also going to furnish them with housing that will enable them to have their families there and to have the proper housing for the supporting cast, which is enormous.

These scientists will need the technicians; they will need the technicians to do the wiring for them, so that they can devote their time to

what they are being paid for, which is scientific endeavor and not the rigging up of their own experimental equipment. This is the custom in most university laboratories. You see these very high-grade men having to spend time worrying about wiring up things that they could buy if the budget permitted them to buy.

Now, what we have to keep operating, in my opinion, at the present time is this:

We have to keep operating everything from the standpoint of having a sufficient supply of bombs on hand until somebody makes up his mind as to what is to be the future of this work.

If we shut down a plant, there is no telling what the cost of that shutdown will be. It is possible it can be restored in 6 months' time, that the cost there would be five million or ten million dollars.

How long it will take us to get the personnel back even in time of war is a question. We, of course, have our lists of everybody who worked or is working for us and, naturally, we would send out and call them and get them back.

But we do not know about the equipment. We have never shut down a plant like this. We are shutting down certain sections in our plant in Tennessee and we are shutting down the sections that we feel aid the least and the shutting down of which would enable the greatest saving in money.

In other words, if we can save 35 percent of our money, maybe we will only lose 10 percent in production.

However, when it comes to shutting down the remaining works at Tennessee or the Hanford Engineering Works, we are making a decision that cannot be easily corrected—in fact, a decision which may not be possible of correction. I do not know whether certain of these buildings and equipment could be shut down without having to replace certain parts. I know that we would have to replace certain parts; just how many, nobody knows and nobody will know until we shut down and try to start again.

It is not like some other weapons, like a gun which we can cosmoline and put away and say that we can always clean it up in 30 days and we would have that gun in shape. We cannot do that.

We cannot shut down the Los Alamos laboratory and ever assemble a laboratory like it again, except in time of war. We cannot stop our work at the Clinton laboratories and start up again because we would have lost the personnel—there is not much in equipment there.

With regard to the work at the Argonne, we would lose the momentum we now have and it would cost a tremendous lot of money if we had to get that momentum back.

Senator VANDENBERG. How are you operating? Are you still operating under war appropriations?

General GROVES. We are still operating under war appropriations and those appropriations, of course, run out next July 1.

Senator VANDENBERG. Have you made a budget estimate for the next fiscal year?

General GROVES. No, sir; I have not, because I had hoped that that would be done by some other agency.

We are preparing now, in view of the fact that legislation has not been passed, we are starting in now to get together a general idea of what it will cost.

I cannot possibly give you any figures today, because we are still trying to decide what is going to be done on the major decisions, the ones that will affect us for 5 and 10 years. We cannot do that until we have somebody who will make up his mind about it.

Senator VANDENBERG. So, if I understand you, speaking generally, you would anticipate not only the desirability but the basic necessity of substantially maintaining your present establishment in peacetime?

General GROVES. Yes, sir; as it now stands. That is, with the reduction we have already made in Tennessee and with a distinct saving in personnel as time goes on, because we are getting savings. Naturally, we are watching and seeing where we could do with less personnel. As we learn more about the process we are able to do that and as the time factor becomes of less importance, we are also able to do a great deal more.

For instance, we no longer have to rush materials through; we can take our time about it and it does not cost us anything to have material in process, whereas before it was costing us days of war.

Now it merely means we can get it any time; but the pressure of time is gone.

Senator VANDENBERG. Speaking generally, is this going to be a billion dollars a year, half a billion, or do you have some figure in mind?

General GROVES. I would hate to speak because you might remember the figures [laughter] but I should say that it will be less than a half billion.

Senator HICKENLOOPER. I was just wondering, General, with regard to this matter of safety. How long would it be safe for a fellow to walk around with a radioactive dime in his pocket?

General GROVES. I don't know, Senator.

Senator HICKENLOOPER. Do you think it would be safe?

General GROVES. I wouldn't carry it. [Laughter.]

Senator MILLIKIN. General, am I correct in interpreting your remarks to the effect that you favor the maintenance of the essential parts of your set-up until Congress decides upon its policy?

General GROVES. Yes, sir.

Senator MILLIKIN. You are not advocating a permanent maintenance?

General GROVES. No, sir; I am not advocating its permanent maintenance; the permanent maintenance of the essentials of our present organization.

I am advocating it until such time as Congress passes some legislation. I am advocating it beyond that point to the time when the body that is given the responsibility over this thing has a chance to really understand what problems it is going to be faced with.

Senator VANDENBERG. Regardless of what kind of action Congress takes, is it your view that it is necessary to maintain it? If I understand you, if we are to maintain our momentum in the field of atomic energy, regardless of what Congress does, you say it is going to be necessary substantially to maintain an institution approximately of the present magnitude?

General GROVES. No; I think that it is possible that that can be cut considerably in magnitude, within a period of, say, 2 years.

In other words, our first problem is to get adequate supplies on hand and then we will be in a position where we can say that now we can start cutting down on that establishment.

Senator AUSTIN. May I ask a question?

The CHAIRMAN. Certainly, Senator.

Senator AUSTIN. In your view, does it make any difference, with respect to this minimum amount of facilities, whether the ultimate control of this production is in the hands, you might say, of an institute that is operating as a private enterprise, with its own horde of trustees that are self-perpetuating and thus released from Government; or whether it is to be continued to be operated by Government through some agency set up for that purpose and always under the control of the Government?

Whichever role we should decide to take, whether public ownership or private ownership, there is a minimum below which we cannot afford to drop, in your view. Is that right?

General GROVES. That is correct; but I cannot imagine the Government failing to continue to have a controlling voice in this problem because it involves the whole existence of the Government and of the people that make up that Government.

Senator CONNALLY. General, at that point, I assume that your theory is that it is no more necessary to keep an Army and Navy than it is to keep other essential war or aggressive agencies and weapons in a distant part of our national defense. Would you not say that it is just like maintaining—spending hundreds of millions of dollars—maintaining the Army and the Navy?

I assume that your idea is that so long as this thing has all its potentialities it is pretty well demonstrated to be in the interest of the Government to maintain these plants and control this instrumentality until some new policy is adopted; is that right?

General GROVES. I think that this is an integral part of our national defense.

Senator CONNALLY. That is right.

General GROVES. And it is not only an integral part but it is absolutely essential to our avoiding national suicide.

To me it is not a substitute for the Army and Navy, but it is certainly part of the integrated force—I hope a well-balanced force—of whatever is needed to protect the interests of the United States.

Senator CONNALLY. I would like to ask you this question. Furthermore, would it not be wholly impracticable to turn this over to any private corporation? Do you not think that the Government itself ought to keep the whole of it?

General GROVES. I feel that this is so important that it must be retained under complete governmental control and that private industry should have no rights whatsoever with respect to this, excepting those rights that can be given without interfering with the welfare of the United States.

Senator CONNALLY. Thank you.

Senator TYDINGS. Have you any estimation offhand as to the number of employees that you think would be required to operate permanently the establishment that you describe, beginning 2 years from today?

General GROVES. I should say offhand that it would get down below 35,000.

Senator TYDINGS. For all these plants?

General GROVES. For everything.

Senator TYDINGS. How many do you have now, roughly?

General GROVES. Roughly, we have now, I believe, about 45,000.

Senator TYDINGS. So all you see in the picture is the possible reduction of about 10,000 employees when you reach the 2-year level which you have described?

General GROVES. Yes; but I also see a great reduction in the subsidiary employees who are furnishing materials of one kind or another, so that the impact on the country will be less.

Senator TYDINGS. Are they Government employees or private?

General GROVES. You mean on furnishing those materials?

Senator TYDINGS. Yes.

General GROVES. Private.

Senator TYDINGS. So that the governmental picture as of today is 45,000; and you see it 2 years ahead from now as being about 35,000?

General GROVES. The governmental picture is a lot more than that at the present time. I was speaking of operating only. We are still trying to finish certain things which are almost finished so that we will have a well-planned process.

Senator TYDINGS. What I am trying to get at is: What is the over-all governmental picture—governmental employees as of today and what you think it will be in 2 years?

General GROVES. I should say the over-all governmental employee situation is that we will cut it almost in half within 2 years. It is about 70,000.

Senator TYDINGS. And you think that 2 years from now, if the plan you have in mind is carried out, it will be 35,000?

General GROVES. I think under 35,000. As I said to Senator Vandenberg, I hate to submit my successors to something that will be worrisome in the future.

Senator VANDENBERG. Well, is this figure you are making a figure that would include the operation of the Federal cities?

General GROVES. Yes, sir.

Senator VANDENBERG. And it includes the necessary employees for that purpose?

General GROVES. Yes, sir.

Senator TYDINGS. May I ask you one other question? The expense of operating that plant today, the over-all governmental expense of operation today on the 70,000-employee basis, plus the cost of acquiring materials, and so forth, the operating of all the plants you now have, how will that figure compare with your figure for 2 years from now? Will it be the same cost, will it be half, one-third, or two-thirds, in your opinion, of what it is today?

General GROVES. I think it will go down to probably half or two-thirds.

Senator TYDINGS. You mean it will go down two-thirds?

General GROVES. No, sir; it will be, at the end of that time, between 50 and 60 percent of what it is today.

Senator VANDENBERG. That is, without inflation? [Laughter.]

General GROVES. Of course, if you are going to raise all the civilian salaries we had better make it all military, so that the pay rates won't go up. [Laughter.]

Senator VANDENBERG. General, I would like to ask you one more question—if I may, Mr. Chairman?

The CHAIRMAN. Yes, sir.

Senator VANDENBERG. Assuming an international decision to outlaw the use of atomic energy for military purposes, in your opinion could the world be successfully policed in respect to that objective?

General GROVES. I don't know. It all depends on what the attitude of governments is. I don't think it could be policed as of today unless the United States is ready, on the drop of a hat, to start an offensive, aggressive war against somebody who has taken the first step toward preventing the inspection that will be necessary.

I don't think—you are really getting me out of my field—but personally speaking, as an individual—I don't believe that the people of the United States would ever be willing to enter on an aggressive war to destroy another nation because some agent of the United States Government said that he was not allowed to go and look at a certain city because they said, for example, that the roads were bad or they had an epidemic of smallpox in that area.

Now, that is what we are faced with. We have got to have inspectors who can go everywhere, who can go into every man's house—not quite into every man's house but, in general, nose into everyone's business throughout the world.

Now, we can do a lot and be reasonably certain that things are going on as they should be by other means, maybe, by watching certain trade movements and the like. But it is impossible, unless you have complete and free access to every nation in the world, a willing access of the type that we give any foreign national in traveling in this country in general. It will be necessary also to have that access include every one of our industrial plants. It will be necessary for them to poke into all the rooms where we are developing a new piece of commercial equipment and it will be necessary to have the shrewdest and sharpest people to do that job.

It is awfully hard to think of anyone who is of that caliber who could ever forget his national loyalty. I certainly would not be willing to recommend any man that I thought was capable to be one of these international inspectors who would forget for one minute that he was a United States citizen with all the loyalty that means.

Now, of course, I have been educated and brought up on the United States' first principle.

The CHAIRMAN. Just a minute, General. That implies that the inspector you would recommend, if he found in the making of a joint inspection in this country that, we will say, in the laboratories of one of our big corporations that there were some secret works going on—is it your thought that you would reprimand that man if he reported to an international inspection service what was going on in that laboratory?

General GROVES. You mean—no; I would not reprimand him. I just say that if I were that inspector I would always be thinking about the United States, as well as the international organization.

The CHAIRMAN. You would also think about the obligations that the United States undertook, to open up to an inspection service, under a solemn agreement that they would? You would reprimand this United States inspector who was a member of an inspection panel of, we will say, six members who joined in a report, we will say, to the United Nations Organization that there was some secret atomic-energy work going on, we will say, in Princeton, N. J.?

General GROVES. No; but I would hope not to have anything to do with it, Senator, myself, personally.

If there were secret work going on in the laboratory of one of our big commercial organizations and that secret work involved, say, a new design of an automobile that was being kept secret for trade purposes, I would hate to be a party to encouraging some foreign commercial spy in getting information about that. It is so hard to draw the line as to what is atomic energy and what is something else.

The CHAIRMAN. We are talking about atomic energy, weapons of war, and not automobiles.

General GROVES. But, to me, it means this: As I say, any inspection service has got to be free to go into every crook and nook and cranny of the United States, to be certain that any work being done is not work on atomic energy.

That means that we are all going to have them; if they decide that I am working on atomic energy and they say that I must have some notes at home, it means that they can come up and search my house.

That is the degree to which you have got to go if you are going to depend on that service. That is so because when the scientists developed this thing, the theories on which this was done, practically all of them, were based on theoretical blackboard work and you would have to be able to inspect those blackboards.

I think you have got, maybe, to change the world from feeling loyalty to nations. We had a civil war in this country and it was based on loyalties, and you do not drive those loyalties out of a man's head overnight. You cannot just say that everybody in this country now is going to owe allegiance to some international organization.

Now, we may do it. We may come to it. It may be the solution. But, at the same time, we have to have the feeling—we may be misguided in that feeling—but we have to feel that the other nations of the world will come into this with just the same desires as we have.

Senator VANDENBERG. Now, assuming that we do try to discriminate between the development of atomic energy for war purposes as distinguished from peaceful purposes and suppose we allow a general world-wide development of atomic energy for peace purposes, is it possible to develop atomic energy for peace purposes and stick to that with complete fidelity—

General GROVES. No, sir.

Senator VANDENBERG. And yet be just as ready, the day after tomorrow, to turn it into a war weapon?

General GROVES. We can. The real secret of this development does not lie in the work that was done at Los Alamos, which was the development of the bomb itself; it was in the preparation of the material, that was the hard job.

Now, I am not taking away anything from Los Alamos. They did a magnificent job but it is something that if we had to do over again—supposing I was an outsider and was in some other country and I was told to duplicate that job. My real worry would not be the work at Los Alamos, but the work that led to the development and to the successful operation of the separation plants.

There was involved not only the development. We had to learn how to operate and that took us a long, long time.

We were on the brink of failure; in fact, we were over the edge on the failure side many times and for long periods of time.

It is that that is the real thing which I would like to see kept. Now, in other words, that means that you cannot separate the peace and the war. They are just so closely interlinked that you just cannot separate them.

While you may say that we can use it for peace and if we start out for war we will do something, I say that you have got to be prepared to go into an aggressive war at the drop of a hat, at somebody's say so, and without even waiting to assemble Congress in special session because it would take too long. We would have to change from peace to war pretty fast and get to making enough bombs before they could put our bomb-making capacity out of business.

Senator HICKENLOOPER. In other words, there is no difference between the material and its use for peace and industry and public health and fields of that kind and its use as a weapon? The same material is used for both purposes?

General GROVES. It is the same. It is in a different form, as you know. I think I have shown you all those various steps in these processes, where they take the material and change it from one salt to another and do that all the time and that does not take very long with modern chemistry.

Those things can be studied and they are being studied and these processes can be discerned, they can be learned from very small amounts of the material. It can be done by sneaking out some of the material and they can develop all of our processes and be all ready to go when the time came.

Senator TYDINGS. Right along that same line, suppose that the leading nations started on the production of atomic energy for peacetime purposes and that they had plants which produced it and it was beginning to be utilized to run ships or automobiles or electrical plants or whatever it might be.

They would then have plants that were making the elements that go into a bomb. I imagine that it would not be a very difficult procedure, after assembling all the elements, to build the apparatus that would make the bombs. As I understand it, the problem is to get the elements.

General GROVES. That is right.

Senator TYDINGS. So, if we do have an atomic-energy-operated world, all the inspections will be pretty much dissipated—the value, rather—because once the development of atomic energy is assured to different nations and the means for producing it is set up, it is a very short step from there, both in time and in mechanics and intellect and everything else that enters into it to change that into making a bomb with it?

General GROVES. That is correct. If that came to pass and I had anything to say about the inspections, I would want an inspector of my own in every plant that this material was being used in for the production of energy and I would also want somebody in there watching that man to make certain that he was still my man.

Senator TYDINGS. You would still want another man watching him?

Senator VANDENBERG. In view of all these complications, have you thought this thing through as to a recommendation?

General GROVES. You mean, as to what to do?

Senator VANDENBERG. Yes.

General GROVES. I feel that the step proposed by the President, as announced in the agreement or announcement signed by himself and Mr. Attlee and Mr. King was the correct step to take.

In other words, we have now got a weapon which can destroy an enemy very suddenly and punish him to the point where it would be a long, hard pull if he is going to win out. I don't believe, necessarily, that we will have a push-button war in which somebody will press a line of buttons and then the war will be over. But I do think that whoever is hit by what comes from that line of buttons is going to be at a terrific disadvantage. He is going to have the equivalent of 5 or 10 Bull Runs on the first day of the war.

Senator TYDINGS. With three Pearl Harbors thrown in.

General GROVES. I was not mentioning Pearl Harbors.

Senator VANDENBERG. That is around the corner down there [indicating corridor]. [Laughter.]

General GROVES. That is what is going to happen. I think that the discipline of the people is going to tell whether they quit like various nations quit in this war or whether they are going to go on fighting no matter how dark that day looks to them.

The CHAIRMAN. In that event, maybe there will not be enough people left to compose a coroner's jury if we had that kind of devastation.

General GROVES. I think the thing we are faced with is that this can be a terrific blow in the early stages of a war. It is a terrible temptation to anyone who wishes to start a war, as Japan did with us. It could give them a tremendous advantage in the way of a sudden surprise attack which would come without all the diplomatic palaver that went on in this case.

For example, using Japan as an instance, they would have come in 1935, or something like that time, when supposedly everything was lovely between us, but they would have made up their minds that we were an obstacle to a Greater Asia and therefore they were going to put us out of business.

Senator TYDINGS. General, coming back to this question of inspection, I take it from your remarks that inspection might be feasible and beneficial in the early development of this energy and before atomic energy gets into what might be called civilian use.

I take it that after that point was reached and atomic energy was being used on a wide scale, let us assume, it seems to me that the value of the inspection decreases correspondingly as civilian use of the atomic energy increases, because it would be so widespread, so much of it here, there, and every place. Is that correct?

General GROVES. I would say that perhaps the value would not decrease but the possibility of doing it would become just hopeless.

Senator TYDINGS. Yes.

Senator BYRD. General, the answer you gave to Senator Tydings' question was that you said it was hopeless. I presume you have been doing considerable thinking on the feasibility of inspection?

General GROVES. Yes, sir; I have.

Senator BYRD. Have you called upon the officers for a report on that subject?

General GROVES. Not for a report, but I have discussed it individually with a great many of them.

The CHAIRMAN. It is my information that a great many of them, officers and generals, will discuss that phase and we hope that we will have the best of their thinking on that proposition within a short time. I just wondered as to how deeply the War Department had considered the subject.

General GROVES. We have discussed the subject. On all such matters we have discussed them very closely with a number of scientists. As you know, we have a great many hundreds and even thousands of them and we do not discuss everything with all of them. After all, we still have work to do and so have they.

However, we try to get a cross section of their views and opinions as to how just such a thing can be operated. We also try to get their opinions on a great many other things—when we get into something that involves science as a whole we try to get the views of their representatives.

There is one thing I would like to take this opportunity to correct and that is this: I do not feel that there is any real difference between the War Department and the scientists.

I say that because the War Department does not want to put the scientists in a strait-jacket, they want every possible advance in the country scientifically, as well as in all other fields of knowledge.

The scientists, on the other hand, do not wish to disclose things that should not be disclosed to foreign governments.

I think that that is really their standpoint on that. I had hoped today to be able to read to you an extract from a letter written by one scientist to another of which he sent us a copy.

The CHAIRMAN. Before you go into that, General, I would like to go back to your estimate of 2 years that you made in answer to Senator Vandenberg's question.

Assuming that we were starting from scratch with what we now know about it today and suppose that we wanted to get into production, I want to ask you this.

Have you taken into account the following factors:

First, on the assumption that the safety of operating personnel is to be disregarded, would that period of time be considerably shortened? It would, would it not?

General GROVES. I think, if safety of operating personnel is to be disregarded, it may be.

I would also like to add that when I said 2 years I assumed that we knew what had happened but that we did not have the experimental work done and that we had to repeat that. In other words, that we threw away our notebooks, as it were. If we did not do that, that time, maybe, would be shortened. Well, it would still remain almost 2 years, but it would be a lot easier.

The CHAIRMAN. I would like to go into that because that seems to me to be a very pertinent subject for further inquiry.

I think one of the things you have to determine is the possibility of other nations getting going on this project.

That leads me into another subject I want to inquire into, namely, if certain countries were to announce, tomorrow, that they had it, I wonder if it would change your views any.

Now, you have the assumption that if safety of personnel were disregarded entirely it would cut down the period somewhat?

General GROVES. It would cut it down in this country, if we could do that.

The CHAIRMAN. In other words, if we built those buildings without any regard for safety factors or if we just took an empty factory building, any empty factory building, or put up a great big shed or a great big tent just to cover you from the weather and without any regard to the cities you built around this project which took, of course, a good deal of time, you could then really bring it down to the basic factor of building some complicated machinery, could you not?

General GROVES. No; because you would have a cleanliness affair. Now, if you take the work that you saw at Tennessee, the two big plants, there were no unusual safety factors built into those plants. They were built that way because they had to be in order to start operating.

The CHAIRMAN. But we developed four processes in 3 years, did we not?

General GROVES. Yes, sir.

The CHAIRMAN. Now, assuming that we took the best process and proceeded from scratch on that—that is, when I say “scratch,” I mean with the knowledge of how to go about it—without regard to safety and using flimsy buildings without building any city and using one process that will work, that has been found to work before, does that change your 2-year estimate?

General GROVES. Yes; if we built one, the 2 years would probably become 3 years because you could not accomplish what we did if you built one process. It might become 4 years.

The CHAIRMAN. But today you know the best process, do you not?

General GROVES. Yes, I know.

The CHAIRMAN. Knowing the best process and concentrating on that, would it shorten the time?

General GROVES. No, sir; it would increase the time.

The CHAIRMAN. In other words, you have got to use all four processes?

General GROVES. Not all four, but it would increase the time because of the whole over-all picture. I am taking it from the time we started until we have a bomb that would work. I would rather not explain the details of that in an open hearing.

Senator HICKENLOOPER. General, if we disregarded the safety factor of the personnel, would not the morale of the personnel have something to do with the efficiency?

General GROVES. I do not think—knowing what I do know of American citizens—I do not think that we could operate this thing, even with the most highly disciplined troops, without regard to safety.

Senator BYRD. You have had no operating accidents?

General GROVES. We had no operating accidents throughout this project that were directly attributable to the unusual nature of the material that was a fatal accident. We had one after the bomb was exploded. We then had one which we should not have had; there was no reason for having it.

It was like all accidents, industrial or home accidents. If you do not turn on the light when you go down to the cellar, you are going to start having accidents; that is something that's too bad, but that is the way most industrial accidents happen.

Senator HICKENLOOPER. But even in the case—General, let us assume, in order that we may have an extreme assumption—let us assume that we had slave labor or impressed labor of one sort or another. Would not the morale factor of the impressed labor, knowing that their safety was not being taken into consideration, reduce their efficiency almost to the point of zero?

General GROVES. I would say that the best example of that is to read what the American prisoners did in that machine shop in the Japanese prison camp. There the Japs found out that impressed labor ceases to be of value when it is for anything but plain physical labor, like shoveling dirt. Where you get into highly complicated technical processes, where one man can turn a valve and turn it back again and nobody can tell that he did it unless he has a terrific amount of equipment such as we have for registration, it is just too bad.

Senator HICKENLOOPER. And you cannot stand for sabotage in this business.

General GROVES. That is right. Sabotage is a very serious problem. We have had some cases where a man made a mistake and that mistake was extremely costly. I think it would be very difficult to operate without the highest morale on the part of the workers and without the highest degree of intelligence and capacity.

Senator TYDINGS. Going back to the question of inspection again because, after all, sooner or later we have got to determine what to do to protect ourselves and the world, I take it that you are looking ahead 15 or 20 years, to what we might say would be the normal evolution of atomic energy.

With that viewpoint, according to your statement as I understand it, you consider that as of doubtful final value; and that your opinion is that some approach to it, similar to President Truman's statement, is the best thing we have been able to conceive for the future protection of our own country and of the world?

General GROVES. I think so. That will lead to inspection of a certain type. That approach, in my opinion, leads toward the opening of international frontiers and a free interchange of people and essential ideas.

With that free interchange I think that it is impossible for a dictator to exist, except in a very small place, like a city. For example, you may have a city dictator but he cannot become a national dictator with a capacity of waging war and drawing the whole world into it.

To me the important thing is the opening up of all nations to freedom of travel and that, you might say, would be an inspection service, but you would not say that if we had inspection we would be safe.

You would be expanding that. You would have not only scientists, but you would have engineers, you would have nationals of all types traveling back and forth and spreading the doctrine of how the rest of the world lives.

I think that would do more toward obviating wars than anything else because then a man would say, "Why should I starve over here when I can go to another country and be treated decently?" The better men would tend to migrate and the thought of war would be less and less in their minds.

Senator TYDINGS. So that the real hope cannot be pinned too strongly on inspection alone?

General GROVES. No, sir.

Senator TYDING. Inspection simply implements a plan for the control of atomic energy?

General GROVES. I believe depending on inspection alone would be like depending on having most of these bombs alone and saying, "Here, we have got 10 times as many bombs as anyone else has, so we are absolutely safe." We are not absolutely safe. It may have a very strong influencing effect.

I think, in the same way, an inspection service would be a great influence and, as far as we are concerned in our own country, would be quite effective, but I do feel that we cannot depend on it unless we are willing to have every house subject to inspection without warning or without warrant.

Senator MILLIKIN. May I ask a question?

The CHAIRMAN. Yes.

Senator MILLIKIN. General, assuming that there is inspection and assuming that it is reciprocal and assuming that to make it efficient involves a large number of inspectors who would be privileged to go through all our industrial processes and laboratories and that the same privilege would exist in all other countries, what would be the effect on the private enterprise economy of the world?

General GROVES. I don't think there would be anything private anymore because if, for instance, you have got a new type of automobile brake, you would have to explain it to every other nation.

You might say that that possibility might not be included; but as soon as they can pry around and they start finding out things it will be so.

I think the history of the General Motors proving ground, for example, showed that. They had, they found out, to bar the public to keep their competitors from finding out what they were doing.

Senator HICKENLOOPER. As soon as somebody locks a door to an inspector, that places the building immediately under suspicion?

General GROVES. Yes. If I were running that inspection service, I would want to know what was going on in that building.

Senator HICKENLOOPER. Whether it was work on industrial power or atomic power, the inspection would have to be held to find out?

General GROVES. Oh, yes. It may be something that somebody is making; for instance a better microphone. I would say: "I wonder how it fits into this bomb. I want to use it. Maybe they are making a special type of fusing for that bomb."

Senator HICKENLOOPER. May I ask another question?

The CHAIRMAN. Yes.

Senator HICKENLOOPER. General Groves, I would like to ask you, is there any encouragement at this time—

Senator VANDENBERG. I don't think so.

Senator HICKENLOOPER [continuing]. For the development of a reasonably adequate defense against the atomic bomb within the reasonably near future?

General GROVES. I know of none. I think the only defense is to stop the carrying vehicle before it can launch the bomb.

The CHAIRMAN. How about its being planted by sabotage around our cities?

General GROVES. As to its being planted by sabotage, I think that that means that you have to know enough about what is going on if you want to have complete protection.

There again you have got to have a corps of inspectors that will go into every room, you might say, of everybody's house and see if they have got the ingredients for the bomb.

Senator HICKENLOOPER. My point is this: There is no encouraging answer when it comes to defense now to detect a bomb in the air and explode it, for instance, or destroy it before it reaches its target once it is launched?

General GROVES. No way. I see no hope of that and none in the future. You must figure, in this instance, that you have got to stop them 100 percent. It is not sufficient to stop half of them. You have got to stop them all and no one, I think, has yet been ever able to devise a perfect defense line.

Senator HICKENLOOPER. You can detect it with radar, the approach of it if it is coming, just as a metal object; but there is no way of detonating them or reaching them?

General GROVES. You could detonate them with high-powered artillery, but some of them would get through. As you know, the attack by the German buzz bombs—a great many of those were shot down but some of them got through; not enough of them to do enough damage when they got through, so they could stand that. But these bombs, you have to stop them.

Senator VANDENBERG. I would say your answer is, "There is no encouragement—period."

General GROVES. There is no encouragement—period.

The CHAIRMAN. Assuming that 40 of these were planted around 40 of our centers of population and were detonated in some mechanical way, of what value would 10,000 of these bombs be to us, distributed around the country ready to launch at an aggressor?

General GROVES. I would say the value would be that although we had suffered a loss through the damage of 40 such bombs—

The CHAIRMAN. Which might mean 40,000,000 people?

General GROVES. Which might mean 40,000,000 people; but the rest of the people would still win the war.

The CHAIRMAN. How would they know where to launch the 10,000 we had?

General GROVES. It is a little hard for me to conceive of someone just exploding such bombs without at least letting us know who it was.

The CHAIRMAN. Well, let us assume that country A takes over country B, a small country. This small country, for all you can find out, these 40 bombs come from this small country. On that suspicion, are you going to launch the 10,000 bombs at country A?

General GROVES. If I were running the Government I certainly would not hesitate very long on that, because you are faced then with the need of an instant decision which would mean the life or death of the United States and you could not sit down and have a jury trial to determine whether that country did it or not.

The CHAIRMAN. But they might be innocent.

General GROVES. Well, if they are innocent—

Senator RUSSELL. They are out of luck.

The CHAIRMAN. In other words, it is too bad for us or too bad for them, the innocent country?

General GROVES. Yes, sir. But it is just like anything else. If you are driving an automobile across the street and a child runs across

the street and you instinctively turn the wheel and run into another car and kill somebody in that car, it is too bad for that person in the other car.

The CHAIRMAN. I don't think any system of morality I know of would work.

General GROVES. In other words, I feel that it is very difficult when you take a hypothetical question, to know just what all the background is going to be. That is what would determine it, the background. I cannot imagine not knowing who was responsible. I personally feel that if that was done the nation responsible would tell us.

The CHAIRMAN. If we had an inspection force, the feasibility of such an event as I have described would be, you might say, considerably lessened, would it not?

General GROVES. Considerably lessened; yes, sir.

The CHAIRMAN. From that point of view inspection would be zero plus, some factor, anyway?

General GROVES. Yes, sir. That is what I said to Senator Tydings. I hope I made it clear that I do not oppose inspection because I feel that the steps the President is taking will lead eventually to some type of inspection. But I would say that you cannot make inspection 100 percent perfect.

The CHAIRMAN. Don't you think that it would be easier for us to act before other nations got it?

General GROVES. I am very much in favor of rapid action on this and that has been the policy of the War Department straight through, that everything should be done to get this thing settled and on the way as soon as possible.

The CHAIRMAN. Rapid international action as well as domestic?

General GROVES. Oh, yes, sir.

The CHAIRMAN. One more question, General, and then we have got to adjourn.

This stuff we are making now, as you know, has a peacetime use for experimentation, making it serve a use for good instead of for destruction?

General GROVES. Yes; we hope it has. We think it has. We do not know yet, but we think that we will find the way through that problem.

There is no question in my mind that it is going to come.

The CHAIRMAN. So, to consider our production day by day as simply for bomb-making purposes is to throw it a little out of focus, is it not?

General GROVES. Yes, sir; although we do not know yet. In the end, I think that the atomic bomb will be considered as a byproduct of the atomic age.

The CHAIRMAN. Thank you, General Groves.

We will adjourn until 10 o'clock tomorrow morning.

(Whereupon, at 12:05 p. m., the committee adjourned until 10 a. m., Thursday, November 29, 1945.)

ATOMIC ENERGY

THURSDAY, NOVEMBER 29, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Johnson, Connally, Byrd, Tydings, Vandenberg, Austin, Millikin, Hickenlooper, and Hart.

Also present: Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. General, I believe you had finished your formal statement.

General GROVES. Yes, sir.

The CHAIRMAN. Are there any questions which you want to ask, Senator Hart?

Senator HART. No; I was not here during all of his testimony.

The CHAIRMAN. Of course; you had to attend a meeting of the finance subcommittee.

Senator Hickenlooper?

Senator HICKENLOOPER. I would like to ask the general a question or two, if he cares to give an opinion on this matter. If this is a matter that you feel you prefer not to answer, it will be perfectly all right. If you can, I would like to have it answered.

Assuming our present state of advancement in the atomic science, assuming that we kept on within reasonable degrees of scientific progress vigorously advanced, what in your opinion would be our opportunity of keeping reasonably ahead of any other nation for a period of time?

In other words, could other nations catch up to us in spite of all the time and scientific effort that we might put into this thing, based on our accomplishment?

STATEMENT OF MAJ. GEN. L. R. GROVES—Resumed

General GROVES. Other nations can catch up to us on fundamental science within a reasonably short period. They can catch up with us eventually on our present state of technological advance, engineering, and operation, assuming that we remain stationary.

The CHAIRMAN. Pardon me; I did not get that last answer.

General GROVES. I will be glad to repeat it. On the basic fundamental scientific knowledge, other nations can catch up with us with-

in a comparatively short period, say 2 years, and that assumes that other nations will make a really serious effort. They cannot do it by just sitting there with a handful of men and spending a few dollars. They have to spend a lot of money and put their best people on it. There has to be a lot of people, and they have to be supported. They cannot take the time to build their own apparatus. They will have to have it made by mechanics instead of professors.

On the development of that basic information into the information that is necessary to produce a bomb, including the separation of the material, the making of plutonium, and the development of the bomb, they can catch up to where we are at the present time within a period of years.

I testified before the House committee, in response to a direct question on that point, that one nation could catch up and produce a bomb, if they did it in complete secrecy, probably within from 15 to 20 years—more likely the latter. If they did it without secrecy and with a great deal of help from the United States and from England and Switzerland—and I say Switzerland because she is a manufacturer of precision machinery—it could be done in 5 to 7 years, probably seven.

Now, that would be catching up with us to where we stand today.

Senator HICKENLOOPER. Assuming that we go forward from where we are today on advanced research and intensive research into this fission field and the whole field of atomic energy, is it reasonable to assume that we could keep several steps ahead for a long period of time, ahead of the accomplishment of any other nation, if we devoted time to it?

General GROVES. I believe that we can keep ahead of any other nation in the world for all time to come, provided that the rules are the same for the two nations.

Senator HICKENLOOPER. That does not mean, of course, that they cannot build a bomb that would blow up?

General GROVES. That is right, and it also means this: When I say that the rules are the same, if we have secrecy and they have secrecy, we will be ahead. If we have free and open distribution of every bit of knowledge we have, and they have secrecy, they eventually are going ahead because they will finally find out something that we don't know and we won't find it out.

Senator HICKENLOOPER. I have one other question, if you would care to comment.

Do you consider the development of the atomic bomb or the atomic fission in this country, eventually resulting in the making of the bomb, to be entirely a question of scientific calculation plus mechanical development, or are there some other elements that went into that besides those scientific and mechanical things?

General GROVES. There were the scientific developments and there were the decisions as to which route to take to get those developments. Those decisions are probably not so important now as they were at that time, because people know that we were successful.

Then there is the other factor, and that is the operation. These plants do not operate themselves. It took many months before we could make one of our processes work in operation. You could take one element of it and it would work. That was the electromagnetic plant, but it did not work satisfactorily as a complete process until the

best management and the best advisers we could get on the problem had worked and worked at that problem for many months.

Senator HICKENLOOPER. Is it a fact that it requires an unusually high degree of fidelity in personnel as well as scientific and mechanical development?

General GROVES. It requires all the qualities that any employer wants in his personnel up to the utmost. It requires skill, ingenuity, faithfulness, and carefulness that is hard to equal elsewhere in the world.

Senator HICKENLOOPER. Thank you.

The CHAIRMAN. General, you say that they can catch up on fundamental science involved within a comparatively short period. I believe you said that period was 2 years. It has been my understanding that the fundamental science has been encompassed in the Smyth Report.¹

General GROVES. No; I don't believe that is correct, sir. The Smyth Report gives the fundamental science that was known or could be easily deduced. It did not give all the fundamental science.

There is always the question of what is fundamental. Here you have something that stretches over a tremendous field, and the question is: What is fundamental?

It is just like the framework or the bone structure of the body. What is the fundamental framework?

The CHAIRMAN. But the Smyth Report received world-wide distribution, did it not?

General GROVES. Yes, sir.

The CHAIRMAN. That would be my conception of fundamental principle.

General GROVES. If that is your conception of fundamental, if that is the definition you apply to fundamental, then it is already known and was known back in 1939.

The CHAIRMAN. In other words, the problem now is to take the theoretical principles which are known and put them into application?

General GROVES. Yes.

The CHAIRMAN. That is, we have the "know-how" of doing that.

Now, do you think it would take 2 years for them to get to the point where they would start to develop the "know-how"?

General GROVES. I believe it would take them 2 years to get to the point where it would be feasible to get into the actual development of plants, start that phase of it, and to me that is the fundamental knowledge.

The CHAIRMAN. You have two other estimates. You say that if we gave help it would take them 5 to 7 years. What do you mean by giving help, which would reduce it from the estimate of 15 to 20 years?

General GROVES. I mean this: We would give them various engineering developments, how to make certain things, how certain machinery was made, the exact design and exact specifications, the metallurgical processes, as well as the analyses—everything that a man has to know in order to do the job.

¹ A General Account of the Development of Methods of Using Atomic Energy for Military Purposes Under the Auspices of the United States Government, 1940-45, by H. D. Smyth, chairman of the Department of Physics of Princeton University and consultant to Manhattan District, U. S. Corps of Engineers; published by the U. S. Government Printing Office, August 1945.

The CHAIRMAN. Well, it seems to me if we gave that, they would be able to go ahead and do it in a very much shorter time.

General GROVES. No; the only way they could do that would be to have us send over American labor to do the job for them.

The CHAIRMAN. This 15 to 20 years, 5 to 7 years, and 2 years—just so that we will have the record straight—are estimates by you?

General GROVES. Yes, sir.

The CHAIRMAN. That estimate would seem to me to encompass a pretty detailed knowledge about the industrial manufacturing, engineering, and scientific fields in the various nations to which you applied the estimate. What I am getting at, General, is that it is a guess, isn't it?

General GROVES. Yes, sir, it is a guess.

The CHAIRMAN. A pure guess?

General GROVES. It is my guess, based on my knowledge of what it took us, and I certainly had the opportunity to have a better basis for the guess as to what it took us than any other individual.

With respect to other nations, some of them we know something about; others have had a wall around them and it has not been possible to know what is necessary in order to make the guess. But we do know, we have looked into the problem, we have consulted and I have personally discussed the problem in its various phases with everyone with whom I could come in contact who had any basis of knowledge.

The CHAIRMAN. I have some more questions on that, because I think this is a very important point.

As to the countries on which you have not had such full information, the guess would be worth a good deal less than it would in others, would it not?

General GROVES. I think that follows naturally.

The CHAIRMAN. Of course, you know that the scientists who worked on this have a different estimate of the factors involved?

General GROVES. I know that some of them do, and I know that some do not. I believe that the answer to that really falls within how closely they were acquainted with the industrial problems with which we were faced in this country as opposed to how much of their time was devoted to the purely scientific phases.

I would also like to point out that when you say my guess may be in error—which I admit fully, naturally—it may be in error in the other direction. It may be that instead of this being 20 years it should be 40 to 50. A good many people who know and have been in some of these countries tell me they don't think they could ever build it, because they could never get, under their present system, men with courage enough to go in and make the mistakes that are necessary to produce such a thing as this.

The CHAIRMAN. I presume you would agree that no country of any size is holding back on this problem, and, for purposes of prestige and purposes of equalization, if you please, they are not sparing any efforts from here on. You don't think they will go about this lackadaisically, do you?

General GROVES. I have no information which would lead me to believe that they are pursuing it with the vigor that the United States pursued it, or anything approaching that vigor. They are still ap-

proaching it from the standpoint, you might say, of the attitude that was taken in Germany from 1939 until the end of the war. It has not reached, as far as I know, the point where anyone has started really to do anything. They are still talking and still working in their laboratories; they are still collecting scientists; they are not putting behind those scientists, or over them, or in front of them, the management and the engineering and the drive that are going to accomplish anything in a hurry. They are going to build up their stocks of fundamental knowledge, their basic science, and the things that build onto that science, so that later they will save some time; but they are not yet, as far as I know, making the determined effort that is necessary in this work to make it a success in a short time.

The CHAIRMAN. Haven't I read something in the papers about England starting a plant?

General GROVES. You have read a good deal of discussion, and it depends on which paper you read; but as far as I can tell and as far as I know, and I think my information is accurate, England has not yet made any step comparable to what we did.

The CHAIRMAN. You stated that we could keep several steps ahead, and I think we ought to make it clear for the record.

As Senator Hickenlooper said, they don't have to go ahead of where we are now to make it somewhat uncomfortable.

General GROVES. I am glad you brought that up, because I meant to comment on that, and that is that in this affair it certainly will not do us any good to be a few steps ahead if they are right up behind us and they have enough; so it is not sufficient just to say, "Well, we can always be ahead of them."

The CHAIRMAN. When you say, "Keep a few steps ahead," I presume you mean a bigger explosive and a bigger detonation?

General GROVES. Yes, one that may be cheaper and may be in greater quantity, particularly cheaper in production.

The CHAIRMAN. Of course, cost has never been a factor in the making of warfare. Isn't that true?

General GROVES. I think costs sometimes have a good deal to do with it. Our country has so much economic power, they have to decide what we will do with that power. In our case, during this last war, despite all of the economic power of the United States there had to be a military decision made by the President on the advice of his military advisers that the effort that would go into this project should be devoted to that rather than to something else. No country is rich enough to embark on such a project as this without realizing that it affects its economic structure.

The CHAIRMAN. Of course that theory does not hold water. There was Hitler. I remember that Mr. Miller, who was the financial attaché at the Embassy, made a speech in this country before the war that there wouldn't be any war because Hitler could not afford it.

The Kaiser was supposed not to have been able to afford it, either.

I don't follow your theory that cost or money has anything to do with the making of war.

General GROVES. Money does not as such, but the economic power does; and when I speak of that, I speak of the factories, the raw materials, and the labor.

The CHAIRMAN. Wherever they are found in abundance, plus a determination to proceed, you have a situation on your hands in which

there are unknown factors, of course, but nevertheless you can come to the conclusion they are going through as far as they can.

General GROVES. I have no doubt but that they will go through if they decide that they want to, and then it is just a question of how soon they can. I also understand that most of these nations state that they are unable even to subsist without money from the United States, so it is a little difficult for me to see how they can embark on something of this scale so blithely.

I think they have to consider how they are going to handle this, how much they are going to reduce the rations of their people, and possibly how much money they are going to have to borrow from the United States to build these plants with which to attack us.

Senator HICKENLOOPER. Have you finished, Mr. Chairman?

The CHAIRMAN. For the present, yes.

Senator HICKENLOOPER. May I ask the General a question?

Let's assume that some other nation or other nations, no particular nation, could build pilot models and experimental models in which they could produce small quantities of this fissionable material.

Does it necessarily follow that because they can produce these small models in fairly sizable laboratories, for instance, that they can thereafter easily go on and build quantity production models with any great speed?

General GROVES. Not unless they are a lot smarter than we were.

Senator HICKENLOOPER. In other words, there is a difference between the experimental models that produce very small quantities and the quantity production plants that produce this material in sufficient quantities to be usable as an explosive?

General GROVES. There is a great difference, and I think you saw at Clinton the preliminary pilot model for the Hanford Engineering Works.

Senator HICKENLOOPER. Yes.

General GROVES. Now, the difficulties in the problems that we were faced with there in the Hanford Engineering Works are just not comparable. They merely sort of gave us a little guide as to what might be done.

Senator HICKENLOOPER. In other words, when you built the pilot model you certainly did not know how to advance to production?

General GROVES. It was like having a headline to a newspaper story that was going to run three columns and you had the headline only.

Senator HICKENLOOPER. Reverting to the question of our keeping ahead of other nations, I assume that if they reached a point of production of this material that we have reached today they would be producing bombs that could blow our cities to pieces.

If we went forward from today, on the basis of knowledge that we have, it is reasonable to assume that the main advantage we might get from the scientific development would be, perhaps, an exploration of the field of new and different materials that would be fissionable and possibly, although it may be remote, the discovery of some more adequate defense against the atomic bomb. Is there experimentation and development along those lines?

General GROVES. I think that at the present time we have merely scratched the surface of knowledge, and we are in the same position

as some other sciences were a few hundred years ago. For example, in the lifetime of all of us we have seen the tremendous advances in the equipment for medical services. If you go to a doctor's office now, he has everything that is necessary to make a good guess, at least, as to what is wrong with you, whereas formerly, a hundred years ago, he did not have those facilities.

We are now in the same position in this field that medicine and medical treatments were in several hundred years ago. We don't know, but maybe we have gone a lot beyond that point. Maybe we have learned everything, but we have no reason to suspect so, because the more we work the more we learn things. We have not reached any slowing down on learning.

Senator HICKENLOOPER. It is interesting to note that we have not developed any defense, figuratively speaking, against the slingshot except to go farther away or put up a wall; but they can still throw the missile over it.

General GROVES. We can always, of course, if the world should ever get into such a horrible position, disperse. It would be a terrible thing economically to have to live in an armed camp. What we hope, at least I personally hope, will come within a reasonable length of time is a freedom which such wars; but I don't believe that freedom will come by ignoring the tremendous impact of this as a military weapon.

Senator MILLIKIN. Mr. Chairman, may I ask a question, please?

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. General, roughly how many separate items go into the making of one of these plants? Is it in the order of thousands?

General GROVES. Well, many, many thousands. I think the best answer to that, that really gives you what you want, is that at the Hanford Engineering Works, the Dupont Co. had over 10,000 sub-contractors, each of them supplying a different material and not raw materials or basic materials. They were supplying subassemblies, you might say, as if they were in the automobile business.

Senator MILLIKIN. Each one of those items involves a technique that is the result of long experience and oftentimes of exclusive "know how." Is that not true.

General GROVES. I would say not each item, but a great many of them. In fact, of the 10,000 probably 50 percent at least required special "know how." Some of them required "know how" which with all of the power and knowledge of American industry, took us more than 18 months to learn.

Senator MILLIKIN. In many cases you took advanced technology that made them advance still further.

General GROVES. Advance much further, and far beyond what they thought was practicable. I think a good answer to that, in clearing up that point, was a statement made to me by a gentleman I met some months ago who manufactured a certain type of material which is in common use, but in the normal plant you use, say, 100 pounds of it a year, which would seem a large consumption. This gentleman told me he received an order from the Hanford plant which instead of being 100 pounds per year might be said to be 10,000 pounds per year. He replied and said, "You don't need this; you are throwing away,

Government money; why do you need it," and the answer came back: "Supply that material."

Without the 10,000 pounds it would not have worked, because you cannot, in this complicated affair, use certain materials when you need a higher grade. They just will not work.

Senator MILLIKIN. Would it be correct to say that thousands of these items represent a reflection of technological skills that have been built up in this country for many, many years, in many cases for many generations back, not only as to the particular firm that is making the item but the workmen and the craft traditions that have been passed on?

General GROVES. I think the answer there would be not only thousands, but probably tens of thousands of items.

Senator MILLIKIN. Leading now to the end point toward which I am driving, anyone that wants to do the same thing has either got to duplicate that same technology in that same way, or possibly in an expedited way as much as it can be expedited, or borrow it or assemble it from around the world. Is that correct?

General GROVES. That is correct.

Senator MILLIKIN. Either way of doing it would be a difficult way of doing it, would it not?

General GROVES. Yes, sir; unless they had world support for doing it.

Senator MILLIKIN. And it would require a long, long time?

General GROVES. I believe so; yes.

Senator MILLIKIN. With a rather technical and highly skilled overall direction which in itself, you suggest, may be lacking?

General GROVES. There is nothing that is harder to get than competent management, I think, as everyone who has tried to operate knows, and not only top management, but down below in what would normally be termed the subsidiary positions.

Senator MILLIKIN. If a country that figured on making this bomb commenced to reach out and pull in scientists that specialized in atomic energy, and if they started buying specialized machinery here, there, and in other places over the world, we would find out about that in the normal course of events, would we not?

General GROVES. We would. That comes back to the point I stated, that if they went out and told the whole world, it would be 5 to 7 years; but if they tried to do it all themselves, it would probably be 20.

I think there is another point there which will clarify it. I have discussed just how a nation would proceed on such a thing. I believe the first thing they would do would be to start educating their workmen and their management so that they could operate such an affair. Now, you cannot pass on the ability and the skill of management, or of scientists, or of any other highly skilled workmen, in, say, 5 years, and then liquidate the men—because you never know what problem is going to come up. You cannot pump a man dry unless it is something that is simple, like a formula.

I believe that certain formulas, for example the one for bitters, have been kept in the family as a trade secret, and no one has achieved the knowledge of that secret. That could probably be told in half an hour, but you cannot tell the secrets and the knowledge that are necessary to operate a thing like this in half an hour or in half a cen-

tury. You have got to build up your men and build them up so that they have the capacity to do the job.

Senator TYDINGS. General, assuming that in any one of the big nations the funds were available, the material was available under reasonably conceivable conditions, and with a degree of good fortune in discovery, we will say, how long would it take any of the leading nations in your judgment to reach the point that we have reached in this country with reference to the atomic bomb?

General GROVES. Depending upon which country you take, because there is a wide variation between them—

Senator TYDINGS. I didn't want to take one particularly, for obvious reasons, but say any of the three or four leading countries.

General GROVES. It would depend on what knowledge they had and what their industry was. In a country in which people were interested in it, if they did it in complete secrecy, it is my opinion it would take from 15 to 20 years; if they did it with the help and assistance of ourselves, England, and Switzerland, they could do it some 5 to 7.

Senator TYDINGS. Your guess would be, as between those two propositions that it looks as if you have a margin of safety in some cases of, say, 12 to 15 years?

General GROVES. Yes; I think that in any case we have a period of at least 5 to 7 years in which the problems of the world can be settled to such an extent that we won't immediately start dropping these bombs on each other.

The CHAIRMAN. Senator Tydings, before you came in, the general testified that was a guess.

Senator TYDINGS. I understand.

General GROVES. There is a more complete discussion, Senator, in the record.

Senator MILLIKIN. Mr. Chairman, I would like to pursue that just a step further.

Aside from Switzerland, Sweden, Belgium, France, what other nations could help a nation?

General GROVES. England.

Senator MILLIKIN. England, I assume, is with us.

General GROVES. Those are the principal nations, and I believe that you can almost limit it to the United States, England, and Switzerland, with possibly Sweden. It is the machine industry that is necessary. Certain things could be done in Switzerland or in the United States that cannot be done easily elsewhere.

Senator MILLIKIN. France used to make a lot of small items of various kinds.

General GROVES. Yes; and Switzerland has also been a center of high-grade machine tools of special design. You find a great many of them in this country, particularly in any plant that has been in operation for a number of years and has accumulated a number of special Swiss machines.

Senator MILLIKIN. Do you think of any other countries? I think we ought to have that pretty clear on the record.

General GROVES. I don't know what was taken out of Belgium and France by the Germans. Those two countries could supply certain assistance, no doubt, and I believe they would if they were paid for the assistance.

Senator MILLIKIN. Did you say France and Germany?

General GROVES. France and Belgium. Germany, of course, could supply technicians, management, engineers, and scientists.

Senator HICKENLOOPER. Doesn't Czechoslovakia have a highly developed machine industry?

General GROVES. It has certain things.

Senator CONNALLY. Mr. Chairman, I want to ask a question.

General, it is not your fault, because you have been prodded into it by members. I think it unwise to take up each one of these countries and particularize and estimate how long it would take. It might indicate an intention to have a contest with them, or cause some unfavorable reaction.

I submit that to the chairman as worthy of consideration, at least.

The CHAIRMAN. It might be better, I think, Senator, if we generalize.

General, we have no compact with any country mentioned whereby the country has agreed not to proceed either to do it themselves or help anybody else, have we?

General GROVES. I think anything of that kind I would prefer to discuss in closed session, sir.

Senator HART. May I ask a question, Mr. Chairman?

The CHAIRMAN. Certainly.

Senator HART. Following that same subject of your estimate, you did not mention supplies of raw materials as being in the picture. Is there anything that is not already in the record that you would like to say on that point?

General GROVES. Not in an open hearing, sir; and I would like to make it clear, Mr. Chairman, particularly in view of the presence of newspaper people behind me, that the fact that I would prefer not to discuss certain things in open session does not mean there is anything there, because either affirmation or denial is something that I would prefer to avoid. The fact that I have said I prefer not to answer does not really mean I know the answer. That is important for the benefit of the press, sir.

The CHAIRMAN. We have gotten to this point, General. I think it is safe to say that we have no such agreement with Switzerland, for instance, not to engage in it or experiment. I think it is well for people to know that.

Senator MILLIKIN. I would like to say, for the benefit of Senator Connally, that I opened this subject of nations that might be in a position to contribute material for the making of the bomb without reference to any particular nation, without having as an end purpose an alinement against any nation, and it seemed to me it was very important that we know in our consideration of this problem just who is in a position to give effective help in the construction of an atomic bomb.

There was no reflection on any country; there was no insinuation or implication on my part that it might be used by or against any country.

Senator CONNALLY. My attention was attracted to the fact that you mentioned a whole lot of countries and left out some. I submit that it doesn't require a hand pointing to a sign that this is the so and so country, because by elimination anyone could determine what country you are talking about, and that is what I am objecting to.

Senator MILLIKIN. Senator, I am objecting to the proposition of smothering simple, open facts of what nations are in a position to contribute to the making of an atomic bomb.

Senator CONNALLY. We don't expect them to contribute to us to make an atomic bomb. We are going to have to make them ourselves.

Senator MILLIKIN. I think it is agreed that if anyone else makes them, we will lend the money to make them.

Senator HART. I would like to observe for Senator Connally's benefit that the questions were altogether founded on the state of industry in these various countries.

Senator CONNALLY. The state of industry in manufacturing automobiles or bombs? We are talking about bombs.

Senator HART. No; the general industry.

Senator CONNALLY. Bombs are what we are supposed to be investigating.

Senator HICKENLOOPER. I have a great deal of faith in General Groves' discretion, which I think he has proved, and I don't think General Groves would answer anything he thinks is detrimental to the public interest. Therefore, I felt perfectly free to ask him such questions as he would care to answer, and he has answered them.

Secondly, I believe that the answers elicited about these various countries are probably as well known to every other country in the world as they are to any of our people, and I could see nothing dangerous or inimical to our interests in either the questions asked General Groves or his answers given.

The CHAIRMAN. General, this weapon is not just a new weapon of war, is it?

General GROVES. I don't follow the question, Senator; I am sorry.

The CHAIRMAN. Well, there has been some statement made that this is just a new weapon of war. I know you don't agree with that.

General GROVES. Oh, I think the term usually used is that this is "just another weapon."

The CHAIRMAN. My mistake.

General GROVES. Anyone who says that, with all due respect to whoever he may be, is just ignorant of the power of this weapon; and I think the more people think about it the more they realize the importance of this and that it is not just another weapon. I think they realize that it ended the war with Japan, and sooner than it would have been ended otherwise, and that if we had been able to drop it sooner it would have ended the war just as promptly.

The CHAIRMAN. In other words, it can be a decisive weapon of war.

General GROVES. I don't know that any weapon is decisive, excepting the will of the country to continue to fight, when that is broken. But as a weapon, it is very important.

The CHAIRMAN. In view of that statement, do you not think that your former statement that you can see no desire upon the part of other nations to go ahead with this is perhaps open to some question?

General GROVES. I didn't say that I didn't see any desire, I believe. At least, that was not my intention.

I said, or wanted to say, that I did not know of any nation that was now really going after it hard, but that they were still proceeding along the lines of laboratory research on a limited scale and had not done what we had done, which was to attack this problem with real

vigor as if they really meant to get somewhere. They are still wandering around, discussing and arguing as to what is the best method.

They have given wild estimates, such as an estimate that appeared recently from a very distinguished gentleman of one foreign country, to the effect that any nation could have this bomb within 6 months.

Well, I just say that that is an absolute impossibility. It is that kind of discussion that is going on.

The CHAIRMAN. That was Professor Oliphant of England.

General GROVES. That was the press report that came over.

The CHAIRMAN. Well, he wrote an article of recent date in Nature, which is a British scientific magazine.

He is the fellow who discovered the basic tube that made radar possible, is he not?

General GROVES. I don't know much about his career at that time. He is a distinguished physicist and a man of tremendous scientific ability.

The CHAIRMAN. He did; he discovered the basic principle of the radar tube. It was his statement that you referred to.

General, I understand we killed about 500,000 people in areas in Germany, and of course pretty well wrecked her desire to fight, with the air attack.

Reverting to your testimony of yesterday that if we killed 40,000,000 people here you thought the war could still go on, do you think we would be able to wage effective war with 40 of our cities laid waste and 40,000,000 people killed?

General GROVES. I think we would wage war for quite a while on that basis if we still had the will to win, and I think anyone who travels over the United States and knows the strength of American industry and the ability of Americans feels that we would continue to fight for a long time.

I think the war years of 1861 to 1865 show that the American people do not stop fighting, no matter how hard they are pressed or what the conditions or the odds are. I don't think the Americans have changed much since that time.

The CHAIRMAN. Of course the 40 cities would contain the bulk of our industrial industry. Wouldn't that have some effect on the ability of the Nation to wage war?

General GROVES. It would have a tremendous effect, and I did not want to say yesterday that it would not make conditions very hard for us; but I did wish to make the point that we could still go on fighting and that we wouldn't necessarily quit. I don't know just particularly when we would know what we were faced with. If our people have courage we are not going to stop just because of somebody destroying a great deal of our potentialities. We would always be faced with the problem, "Is it worth while to go on?"; but England was faced with that problem and they decided to go on. It was the courage and determination of a few people in England that carried that balance over. Maybe if they had all been willing to quit they could have quit very easily.

The CHAIRMAN. General, do you want to give us some cost figures for the record on these various projects?

General GROVES. I can give you general cost figures, I think. I do not remember those figures exactly, because they are rather large. If you want to give me a little time to hunt, I will try to hunt fast.

The CHAIRMAN. Perhaps you can furnish those for the record. We would like to have those inserted in the record.

General GROVES. All right, sir.

(The following statement was subsequently submitted by General Groves and made part of the record:)

MANHATTAN ENGINEER DISTRICT GENERAL OVER-ALL COSTS

1. Diffusion plant

(a) The cost of research and construction of the diffusion plant was approximately \$545,000,000, of which about \$45,000,000 was spent on research by various plants and universities. The one major university working on research was Columbia, and the amount expended there was approximately \$11,500,000.

(b) The monthly bare costs of operating this plant under the initial conditions have been approximately \$6,000,000. These costs should increase appreciably as the plant continues in operation. (These costs do not include the cost of Government-supplied materials or the indirect costs of housing and transporting employees.)

2. Electromagnetic plant

(a) The cost of research and construction of the electromagnetic plant was approximately \$350,000,000, of which about \$33,000,000 was spent on research with various plants and universities. The one major university working on research was California, and the amount expended there was about \$14,000,000.

(b) The monthly bare costs of operating the entire plant have been approximately \$12,000,000. These costs should decrease appreciably in the future. (These costs do not include the cost of materials supplied by the Government or the indirect costs of housing and transporting employees.)

3. Metallurgical, Argonne and Clinton Laboratories, and other institutions

(a) The total expenditures on the activities at the Metallurgical and the Argonne Laboratories through June 30, 1945, were about \$17,000,000, of which about \$550,000 was spent on construction at Argonne. (These costs do not include the costs of materials furnished by the Government.)

(b) The total expenditures on the activities at the Clinton Laboratories through June 30, 1945, were about \$25,000,000, of which approximately \$12,000,000 was spent on construction. (These costs do not include the cost of materials supplied by the Government or the indirect costs of housing and transporting employees.)

(c) The total expenditures on related and closely coordinated activities at other institutions to June 30, 1945, were approximately \$4,000,000.

(d) The cost of production of metallic uranium at Iowa State College (where production of uranium ingots continued until the spring of 1945) amounted to about \$2,000,000, not including the cost of raw materials furnished by the Government.

4. Hanford engineer works

(a) The total cost of the Hanford engineer works, including housing facilities, is approximately \$350,000,000.

(b) The present operating costs are about \$3,500,000 per month. (These costs do not include the costs of certain materials furnished by the Government.)

5. Los Alamos laboratory

The total expenditures on the activities centering on Los Alamos laboratory have amounted to about \$60,000,000, of which about \$26,000,000 was spent on construction. Military pay is not included in these figures.

6. Housing

(a) Oak Ridge: Expenditures on housing facilities, including necessary roads, utilities, schools, and shops, at Oak Ridge total approximately \$110,000,000.

(b) Hanford: The total construction cost of all housing facilities at Hanford was approximately \$48,000,000.

(c) Los Alamos: The total cost of housing of all types at Los Alamos was approximately \$4,500,000.

7. Industrial accidents

(a) The cost to the project of industrial accidents to workers and their subsequent care was about \$4,441,000 up to August 31, 1945. This cost included com-

pensation benefits, medical payments by insurance companies, and that portion of plant medical operating expense assignable to industrial accidents; it is broken down as follows:

(1) Total cost in connection with construction:

- (a) Compensation benefits, \$1,577,000.
- (b) Medical payments, \$757,000.

(2) Total cost in connection with operation:

- (a) Compensation benefits, \$938,000.
- (b) Medical payments, \$1,169,000.

(b) The total accident experience of the Manhattan Engineer District is 62 percent lower than comparable experience of private industry. The National Safety Council's "Award of honor for distinguished service to safety" was presented to the Manhattan Engineer District on December 9, 1945, in recognition of the record made "in achieving and maintaining low accident rates at the Manhattan District facilities throughout the country under the urgent demands for speed in the unique processes attending the development of the atomic bomb."

The CHAIRMAN. General, what are the prospects for the development of bombs of considerably greater destructive power than those produced so far?

General GROVES. I think I can answer that one. It is a little hard to answer in open hearings, but I think it is of sufficient importance so that it should be in the open.

The CHAIRMAN. I asked the question, General, on the basis of the preliminary conference we had in which you said you thought you could answer that question.

General GROVES. I think—and I am speaking now primarily on the basis of the normal course of development, and not on any basis that there is something we know and have not disclosed or anything like that—we have built and fired three bombs. We have done this in a hurry. Our mission was to get a bomb that would go off with power. When we first started, various people talked about enormous sizes. In order to get the thing done, I stated that our goal was to have a bomb that would be the equivalent of at least a thousand tons. That was not the goal; that was the bare minimum.

Senator JOHNSON. Was that a thousand tons of TNT?

General GROVES. The equivalent; yes, sir. As announced by the President, the bombs were of the order of 20,000 tons of TNT.

Initially we all thought we could get something in the order of 10,000 tons of TNT, and I believe that I stated that the various scientists, as they started to work on this and started to wonder about how sure they were of their figures, kept putting in factors of safety, so when we came out at the end some of them even thought it would be below a thousand tons; but it actually had about 20,000, or in that order.

Senator TYDINGS. 20,000 tons equivalent?

General GROVES. Yes, sir; they are always equivalent.

Now, as to the prospects of developing bombs of considerably greater destructive power, I think they are promising; but I would also like to point out that when you go beyond this size of bomb you start to wonder where you are going to get a target that will require the full effect of this bomb. At Hiroshima we had such a target. In other words, it landed and there was space enough so that all of its destructive energy could be used. At Nagasaki we did not have that opportunity. We had a long, narrow target, and the bomb was bigger than it had to be. There was a lot of wasted energy that went off to the sides. If you remember how that river looked, the width of the

target varied. I think there were some points where there was actually no development at all.

Senator BYRD. Were the two bombs of the same power?

General GROVES. They were of the same order; yes, sir.

Senator BYRD. You would say the same amount equivalent of TNT.

General GROVES. Yes, sir. No one knows what the exact amount is. We made an attempt to determine it, but you couldn't prove it. We have not discussed, Senator, the bombs in detail, and I would prefer not to discuss them in open hearings.

Senator CONNALLY. General, does the power of the bomb increase in proportion to the size or amount of material in the bomb?

General GROVES. I don't mind answering that one here.

Senator CONNALLY. Leave it to secret session, if you like.

General GROVES. I would like to leave most of it in secret session, but there is one thing that I think should be made known, and that is what happens in an explosion anyway.

What really happens is that you develop an explosive force, and then that blows apart.

Now, the question is if you put too much material in there it doesn't all explode because it is blown apart before it has an opportunity to explode, and there is a definite limitation on just saying, "Well, you made one bomb of this size; let's put two of them together and have twice as much material and we will have twice as big a bomb."

Senator CONNALLY. If you have any hesitation, don't answer any of these questions; but there was an old theory of chemistry or physics of which I have a very hazy recollection, that you don't get any more power out of something than you put in it. Is there in these atoms a latent power that is just there that needs touching off? I am speaking industrially now, more than about this theory of ruining everything with bombs; automobiles, and everything. Do you get any more force out of the bomb than you have to put in it through all these manufacturing processes and expenditures of fuel and energy and so on? If that is a secret, don't tell it.

General GROVES. I don't know the exact answer because I have never figured out how much energy we put into it; but I think it can best be expressed by this illustration: If you dig coal you get a certain amount of heat out of that coal. Whether you used up more or less energy in digging that coal, what you would get out of it would remain the same. In other words, there is something in here which if we start to explain would be getting us into some of Einstein's theories and a few other things which I would find trouble in explaining, and I am sure you would not be able to understand my explanation. Essentially there is something that is already there which we take advantage of. We don't compress this energy and put it all in one package as it were; it is there.

Senator CONNALLY. Well, it is the old idea of the indestructibility of matter, on which I was basing my question.

General GROVES. This might be based on the theory of the equivalence of mass and energy.

Senator CONNALLY. That explains the whole thing to me, General.

Senator RUSSELL. General, the papers tell us that some of the scientists are of the opinion that if a large number of these were exploded over the world that it would reach out into the elements in the atmos-

phere, and any other elements, and start splitting atoms there which would set the entire world on fire, and instead of being a world we would just be a new star and all life on the planet would be extinguished almost automatically.

Do you have any theory on that to give us?

General GROVES. My only theory is that I don't worry about it, because if it happens it will be all over and we won't have that to worry about. We won't have to explain that one, but the theory is not concerned with getting a number of these bombs but with getting one that is big enough to do that. No one knows what that size is. It is all highly theoretical.

The CHAIRMAN. That is where this thing was 3 years ago?

General GROVES. That is correct, but 3 years ago there was an agreement among the better nuclear physicists that these theories were correct. I don't believe there is that agreement now. It is more or less the kind of thing that they will discuss as a possibility when they are just sitting around talking; theoretically they may be able to prove that such a thing is possible, but the best advice I have, and I certainly don't hold any personal views or knowledge on the subject, but the best advisers tell me that they are not a bit worried, and I, personally, am not worried. I feel it will be beyond my lifetime, and then I will let the next generation worry as to whether they are going to blow themselves up or not.

I think there are many other things that a crazy man who had power behind him, and who got enough crazy people with him who all wanted to commit suicide, could do to destroy life on this earth as well as by this means.

Senator RUSSELL. There is one other question. Yesterday you implied that you had some doubt as to the practicability of a thorough world-wide inspection or checking on the production methods or use of atomic energy. Is that due to the difficulty in exploring all the places where this energy might be developed, or just on your opinion that the people would object so strenuously to the measures that would be necessary that it would be impossible?

General GROVES. I believe it is both. In other words, if the people object too strenuously they can stop thorough inspection. This country has never been able to have thorough inspection on certain things.

Senator TYDINGS. Prohibition is a good illustration of that.

General GROVES. So are the moonshiners in certain sections of the country where you might say the people were not so solidly against the Government as they were with prohibition, but you have that problem and also it takes such an awful lot of people.

I didn't say yesterday that inspection wasn't something that should not be done. I pointed out the difficulties of it because I did not like the idea of anyone feeling that it was something that with a wave of the hand you could accomplish and have effective inspection.

I do not believe that it is safe to say that inspection gives us a 100 percent guarantee. It is just like all inspection of all kinds. It is the reason that an airplane on reconnaissance can tell you if they see something, but they can't tell you something isn't there if they don't see it. That is true of everyone who is out looking for things.

Even in the days when cavalry was of real importance in this world of ours, we had to have infantry go behind the cavalry to make certain

the cavalry had not missed some of the military information that we wanted to have. You have got to look at every foot.

In this case you have got to look much closer than is generally spoken of. You just cannot go to the big industrial plants and say, "What is going on here," and then walk out.

Senator RUSSELL. You have shown us various little gadgets where if you would hold some piece of some radioactive element you would have certain reactions. You don't think it is possible to have any machine or development expose the place where any work of this nature might be done?

General GROVES. No, I don't think that is possible at this time. You could get certain things, there is no question; but other things you could not get.

The CHAIRMAN. Those certain things would be necessary in order to make an atomic explosive, would they not?

General GROVES. No; I don't believe so, Senator. I believe that it could be fixed up. In other words, you could put shielding on certain things.

Senator RUSSELL. You don't think you could fly over in an airplane with one of these machines and tell?

General GROVES. No, sir. Just how much you can do with that no one knows. After all, we were faced with the practical problem a few years ago in trying to find out what was going on in Germany, and we had many theories presented as to how we could find that all out; some of the theories were good, but you could not do it. After all, you have got to have the men who are going to make the inspection come back. Certain things can be done by a general, broad inspection; but I believe also that there is one thing you could do to defeat broad inspection if you intended to. Certainly if you are going to conceal or try to get away with something, the first thing you would do would be to start fighting on the inspection method that was used.

Remember that all nations would probably find out what type of inspection methods were used, and then they would go out to beat those methods.

Senator RUSSELL. We have heretofore, I believe, used only uranium in developing this energy. Has any extensive research been made with other elements to determine whether or not it would be practicable to use them?

General GROVES. I think the answer to that is that our goal was to get a bomb, and we went after that goal and have done a considerable amount of research in trying to build up knowledge. We built this bomb with inadequate knowledge, particularly inadequate scientific knowledge. Every time we could guess at the answer, we guessed at it without knowing why that was the answer, and we have consistently tried to fill in those gaps in knowledge.

We are working on that today with the purpose of trying to know all that we can about fission.

There is a great deal of talk in various places about how ultimately you can split other atoms, and ones of more common material. They have talked about how fine it would be if you could split hydrogen and oxygen, and then nobody would have a monopoly on the air.

We don't know how to do that yet, and I don't think anybody even has a real glimmer of an idea. It may come in fifty or a hundred

years. I don't see it coming within a few years; if it does come, then that will be something to be faced by the people who are then responsible.

But we are not neglecting the advancement of science. We are doing everything we can to encourage it and to encourage it in our own laboratories and at our own expense.

The CHAIRMAN. General, is this material uranium radioactive in the ground?

General GROVES. Yes, it is to some extent.

The CHAIRMAN. Airplane surveys with a suitable detecting apparatus would register the presence of uranium on contact in low flight?

General GROVES. That would all depend on the shielding of the uranium on the ground. You see, when it is down in a mine or down several hundred feet, it is shielded by the earth in between. But it would also depend on the equipment.

No one that I know of has yet been able to locate uranium deposits by flying over them in low airplane flights.

If you put a piece of uranium in a room, you could probably find it if you could get up close enough. It is the same thing with some of your detecting equipment which is such that, when you hold a luminous dial in front of it, it registers, and the man who designed the equipment says, "That is a fine piece of equipment; look what it registers." Then I held my hand in front of it and it registered the same way. That is the size of it.

If you get apparatus that is too delicate then you find it goes out of order. It is one thing to have delicate apparatus in a laboratory where it can be very carefully protected from shock, and it is another to mount it in an airplane and send it through the air and really know what you are getting. You could get suspicions, but you would get a great many false suspicions.

I think eventually something may be possible on that, and certainly if I had any responsibility for inspection, it would be one of the methods of attack that I would take to try to get that knowledge. I think that eventually something can be worked out.

The CHAIRMAN. General, I have just one more question. If, perchance, by intense work it were possible to develop this process for central heating within the next 2 years, assuming that hypothesis, it would be impossible to use it until the international control problems were settled, would it not?

General GROVES. You mean to use it in the United States?

The CHAIRMAN. Yes.

General GROVES. No; I don't know of any reason.

The CHAIRMAN. You would have to put guards around it?

General GROVES. Yes, and I don't care whether it is under international control or not. I think you would want guards around it, for you have got too much money in there alone not to have guards, and real guards, too.

The CHAIRMAN. Thank you, General.

Senator CONNALLY. Mr. Chairman, I just want to say this: I think the general has made a very fine and splendid exposition of this matter and I want to congratulate him on the great work he has done in connection with the whole program and its development.

General GROVES. Thank you, sir.

The CHAIRMAN. I might say that the general has done a splendid management job in the last 3 years and has accredited himself most favorably.

Senator JOHNSON. Before the witness leaves, Mr. Chairman, I desire to say this: I concur in what the Senator from Texas has said.

But going back to the question of detection, this committee saw the finest instruments that science can devise within 12 feet of tremendous radioactivity, and the instruments were in no way affected. A dime was borrowed from the Senator from Iowa and inserted in that machine, and when it became radioactive and was placed near that machine, it went completely crazy.

Senator TYDINGS. The machine or the dime?

Senator JOHNSON. The machine. That indicates to me, at least, that it is going to be pretty hard to detect radio-activity with any kind of device, because there you had a perfect example of the difficulties of it. Just a concrete wall shut it off.

General GROVES. I think I said earlier, particularly if I knew what the rules of inspection were, that I could hide the material so that the inspectors would not find it; I think that any nation would have enough representation on that body of inspectors so that they would know.

Senator JOHNSON. That is particularly true with respect to the material when it is reduced to a chemical compound, where there is very little or no radioactivity present?

General GROVES. I think in various portions of the process it would require less shielding, but the shielding is not an impossible task; I would rather undertake the shielding than I would undertake the separation, or, particularly, undertake the detection.

Senator JOHNSON. That is all, Mr. Chairman.

The CHAIRMAN. Thank you, General.

General GROVES. Thank you, sir.

The CHAIRMAN. Professor Urey.

**STATEMENT OF DR. HAROLD C. UREY, PROFESSOR OF CHEMISTRY,
UNIVERSITY OF CHICAGO**

Dr. UREY. My name is Harold C. Urey. I am professor of chemistry at the University of Chicago. During the war I was at Columbia University in the city of New York and was director of the SAM Laboratory. SAM was code for "Special alloyed materials," which in turn was code for the laboratory doing the research on the diffusion process for the separation of the uranium isotopes and for the production of heavy water and other materials. I did not work directly on the production of the atomic bomb but on materials used in its production. Altogether I have worked about 5 years on this problem.

The CHAIRMAN. I notice, Doctor, that you would not state it, but, for the record, I believe you are a Nobel prize winner.

Dr. UREY. That is right.

The CHAIRMAN. And that award was made upon the basis of your successful experiments on heavy water?

Dr. UREY. That is right.

The CHAIRMAN. In 1932?

Dr. UREY. Yes; in the fall of 1931, reported in 1932.

The CHAIRMAN. Thank you.

Dr. UREY. The Smyth report gives a history of the whole Manhattan project from the very beginning in 1939 to August of this year. This report is very well written and does not need expansion. It states what was done and by whom and when it was done. Hence in this testimony I shall not refer specifically to the various methods used or not used in the production of the separated isotopes of uranium or for the production of heavy water or their uses. Since all production figures, costs of production, comparison of relative advantages of various methods, etc., are classified as secret, it is impossible to say more about these processes than is already published in that report.

Suffice it to say that the diffusion method was very successful for the separation of Uranium-235 and that the exchange method was very effective in concentrating heavy water but that all methods for producing this latter substance were not sufficient to produce this material in large enough quantities for large-scale use. Exact figures on production and costs would better be secured from the Carbide & Carbon Chemicals Corp. and other operating companies rather than the director of research in any case.

If the committee will secure clearance for classified information I would be glad to appear before the committee again in order to discuss technical facts which it wishes to have and which I am competent to give. Today I wish to discuss the over-all situation relative to atomic energy and the atomic bomb as I see it.

One: Facts in regard to atomic energy and the atomic bomb.

Atomic energy is stored within the nuclei of atoms and has been so stored since the beginning of the earth, solar system, or universe, perhaps. It should be referred to as nuclear energy, but popular usage has probably fixed the term atomic energy in our vocabulary. The amount of energy liberated in the fission of uranium or plutonium is pound for pound about 3,000,000 times as great as in the case of coal burned in air. An improvement in a fuel or explosive by so much as 20 percent would normally be a remarkable one. The factor of 3,000,000 is so great that the significance is not comprehended immediately. We have some conception of what 1,000 miles is but no conception of 1,000,000,000 miles. Even a large source of power after decades of development amounts to about 100,000 times the power of a horse. It will be some time yet before the people of the United States really appreciate that on December 2, 1942, a radically new source of energy for peacetime purposes was first discovered and that on July 16, 1945, a radically new explosive first appeared. This latter event changes the entire military position of the United States, as well as those of all other countries and in fact makes the defense of this country more difficult.

Senator VANDENBERG. What is the significance of the date December 2, 1942?

Dr. UREY. That was the first time that a spontaneous pile producing heat steadily without explosive characteristics was produced at the University of Chicago.

The atomic bomb which fell on Hiroshima destroyed what was reported to be 4 square miles of the city. The area of total destruction in the case of Nagasaki was reported as 10 square miles. If the third bomb of this type to be exploded was a definite improvement on the

first and second bombs we may confidently expect considerable improvements in the future.

The CHAIRMAN. Improvements, Doctor?

Dr. UREY. It depends on how you look at it. If 10,000 bombs were made and each were properly placed and if each should destroy 10 square miles, these bombs would completely destroy about the entire area of the States of Indiana and Illinois. This weapon transcends all other weapons in destructive capacity.

Scientific men have repeatedly stated that there is no defense against the atomic bomb and that there cannot be any decisive defense. Such statements come from men who have studied offensive and defensive military devices throughout the war. However, such studies are not necessary and probably are not as convincing as observations on other weapons for which defenses are known. A defense is known for machine guns, for example, armor plate; nevertheless machine guns accounted for many casualties in this war. Defenses are known against submarines, nevertheless they sank large tonnages of ships in both the Atlantic and Pacific Oceans. Defenses against airplanes are known, but they destroyed the cities of Europe. And thus we could tabulate many weapons both great and small. Similarly, we may expect countermeasures to the delivery of atomic bombs and countermeasures to the countermeasures, but in spite of this the atomic bombs will do damage in future wars commensurate with their destructive capacity.

In another way we cannot even expect as good defenses against atomic bombs as against other weapons. Forts, trenches, tank traps, armor plate, armored ships, and planes are able to absorb some punishment from the weapons used against them in warfare as it was before July 16. It is not to be expected that such defensive measures against atomic bombs can be taken except at expense so great that they could not be applied to all the vital points or to all the population of a country.

It is necessary to accept the fact that there is no decisive defense against the atomic bomb.

The atomic bomb could be smuggled into a country and used to mine our cities unless we practiced the greatest vigilance, so great in fact that our liberties would be seriously curtailed.

The bomb could probably be delivered by plane, rocket, pilotless plane, or other means. It could surely be delivered in ways that would not disclose the military power from which it came. It would be delivered from points at considerable distance from the target.

Atomic energy for peacetime purposes is possible but it is not developed to so great an extent as the atomic bomb. For peacetime uses we do not wish to secure the three million-fold effect that was attempted and secured in the bomb. Though small amounts of fuel will be required, industrial power uses will still require apparatus of the size and complexity of steam generation plants and the cost of securing power from atomic fuels will probably not be less than that for power from coal for some time. Power for special purposes such as for naval vessels, where competitive costs are not so important, will undoubtedly be the first practical application of atomic power. Many other uses as tools for research, and many techniques and devices of use throughout industry will be possible and will surely become available if ade-

quate effort is put into this side of the problem. However, I believe that the whole peacetime use of atomic power does not have comparable importance to us as a nation nor to the world as a whole as does the problem of avoiding the use of atomic bombs. I believe we could well forego the large industrial power developments of atomic energy if this would aid, as it may, the control of the atomic bomb.

Two: The course of a probable armament race and the subsequent war.

I wish to present the probable future course and development of atomic bombs, assuming that no prohibition of the manufacture of such bombs on an international scale is introduced and also assuming that a war does not break out during the course of the development.

In the first stage of this development we shall have bombs but no one else will have them. This is the present situation. We feel safe and secure, but the people of other countries do not. We know that we have no intention of attacking other countries, but they probably cannot be expected to take us at our own evaluation. If the situation were reversed we would be very much alarmed and with good reasons. Others undoubtedly are alarmed now and believe they are alarmed with good reason, too.

In the second stage we shall have a fair-sized stock pile of bombs and other countries will begin to get a few bombs. Ours will be the best unless the scientists and engineers of other countries discover and develop some better ideas that we may have overlooked. In this stage we may have sufficient bombs to destroy the cities of any probable enemy and they will not be able to retaliate. I cannot help but wonder whether we shall be as harmless at that time. Surely other countries will hardly think so.

In the third stage both we and other countries will have sufficient bombs to destroy each other's cities—and by and by all will have about equally effective bombs.

As this situation develops tensions will increase slowly at first and finally beyond anything we have ever seen, or experienced. In a few years we will begin moving our families far from big cities and industrial plants if we can afford to do so. Finally, every ripple on the international scene will make us wonder whether the atomic bombs may not arrive before morning. Testifying before a Senate committee is an unusual experience for me but it will be much more exciting when this building becomes an important and probably target for atomic bombs in that future war. Of course a scientific laboratory would be an important target, also. But probably the most important targets will be those that result in the killing of the greatest number of people.

The CHAIRMAN. You aren't inferring that if they landed one here we are the most important people?

Dr. UREY. Well, the scientific and governmental leadership of a country is very important indeed, and perhaps my estimate is not quite right. This, I think, will be one of the important targets in a future war.

We might start such a war, or another country might attack us. In either case the country attacked would probably have concealed the launching sites for its atomic bombs and hence would be able to retaliate and destroy the enemy's cities. So with all cities destroyed

on both sides we start a war with ordinary weapons and finish it in that way. Of course an enormous supply of material would have to be accumulated before the war, for with industry crippled it could not support the war while it was being fought. Unless great care were taken we would have lost our governmental, industrial, and scientific leaders. But I could go on with this for a long time and that would be unnecessary since none of us know just what course such a war would take. However, any course that it took would be disastrous for victor and vanquished.

But we have the atomic bomb and hence hold a trump card. How should we play the hand? Where can we interrupt this fatal chain of events most effectively for our own selfish advantage and perhaps to the advantage of every other country? The obvious answer is at the end of the first stage when we have lots of bombs and others do not, if we can judge exactly when that will be. We can blow the enemy's cities off the earth and take possession of the earth, occupy it with our armies, and begin the job of running the world according to our own ideas. This is a large order and one that I should like to avoid. In fact, I would stumble into it only by mistake or be forced into it only by overwhelming necessity.

My choice of time to do something about this threatening series of events is now or preferably 3 months ago, if it were only still possible. Atomic bombs must not be made by any country and they must not be stored any place in the world if we are to have any feeling of security in this or any other country on this all-too-small planet. We are making bombs and storing them and are thus a threat to other countries and are guilty of beginning the atomic armament race. If continued it will lead to dire disaster.

Three: The problem of control.

Can we control the atomic bomb by agreement between sovereign states? Japan armed herself and fortified islands of the Pacific in violation of her promises. Germany did similar things. The whole course of the League of Nations, which was a series of agreements between sovereign states, showed how ineffective such methods of control are. I would not trust the word of any foreign power if it stated that it would not make atomic bombs and I most emphatically would not expect any foreign power to trust this country. I believe that we would live up to our agreement, but I would not expect that others would believe it. And as time moves on, circumstances and people change and a time will come when abrogation of treaties will occur or treaties will be ignored or even used to deceive other peoples. I do not believe that this type of control is feasible for political and historical reasons.

Could we turn the bombs over to the United Nations Organization for safekeeping or use in emergencies? I would suppose that other countries might insist on some atomic bomb plants and their extensive accessory plants being located in other countries than the U. S. A. Also they would probably suggest that bombs be stored in other countries than ours. Also the big powers would insist on equal numbers of bombs in each of their countries or on some 5-5-3 formula. Or perhaps bombs could be stored in central Africa. In this case we would all become afraid of central Africa. I believe that there would be no satisfactory place to store bombs.

Also bombs would not be useful in an emergency. I cannot see how bombs could have been able to have solved the Spanish, Ethiopian, Manchurian, Czechoslovakian, and other troubles with which this war was begun. Further, we now have a supply of bombs. How could they be used in the Indonesian difficulty or the Chinese civil war? These bombs could have been used to destroy Madrid or Rome or Tokyo, but no one would have given such orders when the difficulty started. Only when the lines are drawn and the war ready to start could the atomic bombs be used and then an atomic-bomb war would come. Perhaps not so suddenly as otherwise but it would come nevertheless.

I believe that we should attempt to establish a control over atomic energy under the United Nations Organization which would be so effective that no person or group of persons in any nation could manufacture atomic bombs without detection and without being brought to trial and punishment. This means a sacrifice of some of the national sovereignty of this and other countries. I would rather submit to this, with police officers armed with sidearms able to arrest me for violating a law not to make atomic bombs, than to be threatened along with an entire city with destruction by atomic bombs from United Nations Organization planes for a similar violation. Also, I believe either of these would be better than an atomic bomb war. Of course the control must cover all countries of the world.

I believe that it would be technically feasible to determine whether a country as large as the United States were making atomic bombs, providing that inspectors could ask any questions and receive answers to them, could visit any scientist or engineer and see his work, inspect any plant or facility that they desired. It would be necessary to watch the movements of scientists and engineers, mines, ores, special materials and types of apparatus, and the appearance of any new developments. The existence of the Manhattan project and its general purpose were probably known by thousands of scientists in this country, and the extent of the operations and state of advancement would have been known had they been allowed to receive answers to questions. An inspector might have asked where any of dozens of prominent scientists were; and if he were told and then visited any of these, he would soon have learned what was being done and the approximate state of the work. Of course, any refusal of the privilege to visit or inspect personnel or facilities would be a suspicious act and also lead to disclosure. Covering up activities on such a broad scale would be very difficult.

In considering the problem of control there are two assumptions that might be made: First, that there would be no peacetime large-scale power plants; and second, that peacetime power plants would be permitted on a large scale.

Senator VANDENBERG. You mean power plants with atomic energy?

Dr. UREY. That is right. In order to secure power for industrial purposes from atomic energy, it is necessary to have very large scale plants. If these large-scale plants were all in existence, as they might be some 10, 20, or 25 years in the future, they would contain considerable amounts of fissionable material that could be used for bombs. It would then only be necessary to withdraw the material from these plants and manufacture this material into bombs.

This would be comparatively easy and would be much more easily concealed than if such plants did not exist.

If we have no large peacetime plants of this kind, and if it were necessary then to do a development job on somewhat the scale of the Manhattan project, I think the whole development would become quite obvious to any inspectors in the country; and I say that because the development of the Manhattan project was quite obvious to all our scientific friends not working on the project during the past few years.

The CHAIRMAN. Doctor, do you know of any invention in history, or any improvement in science, that was ever suppressed in peacetime use?

Dr. UREY. No; all weapons have been developed by other countries in time. The only case in which such things are not done is in the case of very backward countries. I don't think we need to worry very much about China and India getting atomic bomb plants; not for some years, anyway. But in the case of industrialized countries, I think that it is not possible for us to say how long it will be before they could produce them.

Great progress can be made in a relatively short time in a country that has an extensive system of technical education.

Senator JOHNSON. Reducing your "relatively short time" to years, how many years, Dr. Urey?

Dr. UREY. My guess is that it will take 5 or 10 years for other industrial countries to secure atomic bomb plants. It depends somewhat upon which country, and it depends upon the effort that is put forward.

When the bomb exploded, the most important fact was known. From that point on, any foreign country could move with confidence, and this is a great advantage; whereas we had to feel our way along on this problem, set up many alternative methods for doing this work, follow many lines of research, many of which were discarded. The foreign country at the present time would be able to set up its production sites, its bomb-production laboratory, and establish with confidence such laboratories as we had at Columbia, Chicago, California, and Los Alamos; and this would be a very great advantage.

Of course, my opinion as to how long it would be is a guess on my part, but I think that we should not think of a longer time than about 5 years. It may be longer, but I think it would be best to be pessimistic, or optimistic, depending on which way you regard the low side at the time.

Senator CONNALLY. Let me ask you one question.

You were talking awhile ago about the situation where we would not have any peacetime industrial use for the bomb at all and had none of those factors.

If we didn't, wouldn't it require, for the manufacture of bombs, such a large plant and equipment that it would be easily detected by these inspectors if there were somebody trying to bootleg the bomb?

Dr. UREY. I don't know whether you went to Oak Ridge or not.

Senator CONNALLY. No; I didn't.

Dr. UREY. The plants that are located at Oak Ridge, particularly the diffusion plant, are the largest chemical plants I ever looked at. It would be difficult to build that plant in pieces; it must be built as one unit. In order to build such a plant we need railroads, many roads,

a large accumulation of people, and above all, we need concentrations of scientific men and engineers. Probably the scarcest commodity that is involved in producing these big plants is the scientific and engineering talent, and so the whole development becomes a very big thing which would be quite difficult to conceal.

Senator CONNALLY. That is what I was getting at; that of course if we had the industrial development it would be a simpler process for them to abstract materials and go off somewhere and make the bomb. But if we did not have the industrial development, you could not hide a plant that was making the bombs, could you, from an intelligent inspector?

Dr. UREY. I don't believe so.

Senator TYDINGS. Doctor, would I be diverting you if I asked some questions on what you previously brought out, or would you prefer that I wait until the end?

Dr. UREY. It makes no difference to me.

Senator TYDINGS. Assuming that other countries had learned to make the atomic bomb, using the Jules Verne imagination, would this circumstance be possible: Let us assume that any enemy country with atomic energy in its possession desired to stage a Pearl Harbor raid again in 15 years. Let us assume that they came to the city of Washington and hired three garages in three different places in the city and operated trucking lines, say, to Leesburg, Va., Baltimore, Md., and Richmond, Va., and operated these trucking lines for 6 months; and that on Pearl Harbor day of the future these trucks were driven back from their runs and in each of them was an atomic bomb that had been gotten in surreptitiously from a ship on the coast, or what not, and these trucks were put in three different garages in the city of Washington, and with time devices were exploded simultaneously during the night and killed the President, the Vice President, and Members of the Congress, the Cabinet, the Joint Chiefs of Staff, and similar other persons.

That is a very farfetched illustration, but that is not without the realm of possibility, is it?

Dr. UREY. I should say it would be quite possible.

Senator TYDINGS. Just as Pearl Harbor astounded our imagination when it happened, it could be done; there our fleet was caught flat-footed, so to speak. That would be the logical Pearl Harbor of the future under existing conditions, wouldn't it?

Dr. UREY. I should think so. I would say that exactly what you outlined would be wasteful. It would not be necessary to have atomic bombs in each one of these trucks. Three or four would be quite sufficient.

Moreover they could probably be brought in in pieces, piece by piece, and assembled at strategic points, and then as you say, set off with an alarm clock.

Senator TYDINGS. Then we would have no President, Vice President, or anybody in charge temporarily under our constitutional form of government, and if, simultaneously with that, other attacks were made at other places, from carriers at sea, or whatnot, we would have a demoralization far beyond any comprehension of which we are now capable.

Dr. UREY. The people of all the other cities of the United States would be very anxious to get out of them immediately, because they would be afraid that those cities were also mined in the same way.

Senator TYDINGS. The fear which I have just expressed for my own country would be the fear of any other country if international tension were developed to a point where war was possible?

Dr. UREY. I would suppose so.

Senator TYDINGS. Thank you, Doctor.

Dr. UREY. There are difficulties in connection with the possibility of inspection. Industrial executives would not like the idea of having inspectors come into their plants and find out all about what they were doing; but what alternative is there?

I believe that when the alternative of the possible destruction of the industrial plants of our large country is brought home to these people, that they also will realize that the loss of a few industrial secrets is really a small price to pay for the security of this country and for their own industrial enterprises.

The atomic bomb only high lights the fundamental difficulty caused by modern wars. Other high-caliber weapons by themselves would also bring disaster to all countries. In addition other weapons such as bacteriological warfare, destruction of crops by chemical or bacteriological methods as well as others may easily prove as destructive in the future as atomic bombs are now. Any international control should include all weapons and other means of waging wars.

Four: Our present situation. At present we have no method of international control and no international organization sufficiently strong to enforce control of atomic energy. We do not know whether we are moving toward an atomic armament race or toward such international control. In the first place, let us assume that it will not be possible to secure an international agreement, at this time, in regard to the manufacture of atomic bombs. In this case, we must make atomic bombs, we must make them larger, we must make them efficient, we must develop what defensive measures we can. We can and we must devise means for delivery of such bombs to possible future enemies. If this is to be the case, peacetime applications are relatively unimportant and need not be considered.

In the second place, if we do not make bombs, that is, if there is international control, then the peacetime developments become important. There are many things which can be done that would be of great value to the citizens of this country. There is the possibility of power, which is not of paramount importance because of our store of other fuels. In addition to that, there are many possible peacetime applications of the details of the work that has been done in connection with the development of the atomic bomb. In case adequate international control is secured, it will be unnecessary to keep anything secret from any of the rest of the world. If there is an adequate international control preventing the manufacture of atomic bombs by any country we should publish everything we do in the field of atomic energy, since only in this way could the control be made effective. We should have the maximum liberty for universities and private industrial companies to work on this problem.

In the third place, we must consider the interim period, which in any case must obtain before we can go from the present situation in

which we are making atomic bombs on a modest scale either to one in which we make an all-out effort to make more and bigger bombs or to one in which no bombs are made by us or anyone else. This is a very difficult situation, for the manufacture of atomic bombs will cause suspicion on the part of other nations and may prevent international control while failure to make bombs might lead to a weakening of our military position if such control proves impossible.

I should like to add a brief insert at this point, if I may.

Much of the thinking and discussion on atomic energy is confused and often contradictory. Because of this situation, no legislation with regard to the domestic situation can clarify our muddled thinking and arguments. Only a rapid solution of the international problem will be effective.

The War Department does not know just what line of development to take at present, and any commission would be in the same situation. Moreover, it seems doubtful if both the military and peacetime work can be carried on at maximum speed. We can hardly afford to keep as large a group of scientists and engineers on this problem as we have during the war because of the urgent necessity of catching up with other lines of development.

I refer particularly to the need of training new men in sciences which has been so largely neglected during the war.

Five: Secrecy. In our present situation it is not possible to decide with confidence what degree of secrecy should be imposed on research, development, and manufacturing facilities. The fundamentals in regard to atomic energy are generally known, as are the general facts in regard to the direction we took in developing the bombs. Our present secrets are not of decisive value in an atomic armament race, but they are not negligible either. I estimate that the time required by other countries to secure atomic bombs might be decreased by about 25 percent if we published every detail of our scientific data and manufacturing procedures. Another competing country would be saved very considerable effort and cost by such publication. We must remember that secrecy hampers our own scientific effort very greatly. It seems most likely to me that complete publication of our present results and any secured in the future would be of more value to us in an armament race than it would be to any potential enemy.

Again the situation on secrecy calls for maximum efforts to clarify the international situation in regard to control of atomic weapons and other heavy arms. Obviously we should not attempt the control of atomic bombs only, for if this were done a war would start with the use of ordinary weapons and be continued with them until the atomic-bomb plants were in operation and the war finished with these weapons.

The secrecy conditions within the Manhattan project are, as nearly as I can learn, quite exceptional as compared with those in other scientific projects engaged in the work of the war just ended. There has existed and now exists almost a mania for secrecy not only with regard to the late enemies of the United States but also with respect to our own allies, our own citizens, our own elected representatives, other branches of our armed forces, and the scientific and engineering men engaged in the work. Those of us entangled in this net did not know whether this was necessary and mostly still do not know the detailed facts

in regard to the desirability of this constant interference with the transfer of information. My own belief is that it was, and is, largely unnecessary and that it did, and will, impede the progress of the work on atomic energy. This subject is one which may frighten us but it should not lead us to apply methods which all experience shows will stifle development, drive the best men from the field, and shift all rights to knowledge to those with least experience in the application of that knowledge.

I may say that I do not wish to place the blame for this situation on any particular group. It has existed from the very beginning of the work on atomic energy for over 5 years. I believe that it developed gradually, and to some extent universally, because of the very exceptional character of atomic energy and the atomic bomb.

Before the war we were all more nearly sane in regard to this question of maintaining secrecy in regard to scientific developments than we are now. The military have been accustomed from the beginning of history to keeping operational decisions secret. This is entirely feasible. Such things as the exact date of D-day, the point of attack on the coast of Normandy, the number of troops and ships to be employed are matters which can be kept secret and which obviously should be kept secret. Moreover, no advantage is to be secured by not keeping them secret. Moreover, these secrets can be told easily in a few words so that any reasonably intelligent spy can transmit the information.

The problem of maintaining secrets of this kind has led to definite methods of preventing any probable loss to the enemy. Thus compartmentalization of information has arisen. Individuals reporting to a higher echelon are not allowed to discuss their work with each other except when permission is granted by higher authority. Moreover, each individual is given only the information which in the opinion of the higher authority is needed for his own work. All of this type of organization is that needed for espionage work.

In World War I, and in World War II particularly, science has demonstrated its great effectiveness in developing weapons of war, methods of defense and operational methods and the military have come to appreciate these contributions to the art of war. But no one has had so great a field day as the "security officer." What vast numbers of "secrets" he has had. What great stacks, in fact tons, of secret documents. How he has risen to the occasion in compartmentalizing all these scientific espionage agents and controlling the movements of personnel and documents. And he has not realized that his methods are not applicable, that his efforts obstruct the work beyond anything that he can comprehend, and that all his efforts are bound to be futile in the end because scientific facts are the same and can be learned by the careful student of nature on both sides of any international boundary.

Perhaps the committee would appreciate some examples of what we mean by "compartmentalized systems" of controlling information.

The laboratory of Columbia University had the problem of separating the uranium isotopes. That in Chicago worked on the so-called piles. In connection with the work on piles, and especially the work at Los Alamos in New Mexico, the exact conditions which would lead to the explosion of our materials were studied and finally well understood.

The separation of the uranium isotopes did not require any such knowledge as that, and hence all flow of information from the metallurgical laboratory at Chicago and between the University of Chicago and the laboratories at Columbia University was interrupted and prevented. But at the same time, if material accumulates in our diffusion plants in sufficient quantities and in the right places, either an atomic explosion might occur or radioactivity of great intensity might be produced, both of which would be destructive of the plant and of the personnel involved. Of course, if any accident of this kind occurred we would lose our operating personnel which would make it very difficult to continue the work.

Throughout this time, great efforts were made, particularly by the Carbide & Carbon Chemicals Corp. which operated the plant, to secure for their own men the necessary data which would enable them to determine whether the plant that was being built might be explosive or not. Up to the last contact I had with this problem, no such permission was given. Competent men, Dr. Teller and Dr. Smith, were assigned from Los Alamos and Chicago, respectively, to the construction company, and they were expected to decide as to whether the plant would explode or not. They are very competent men.

We managed to get the plant built, and there was no difficulty of this kind, but throughout the whole period the operating company found themselves building a plant which might have been explosive, and had no way of securing information that would enable them to decide that question.

A similar situation, I am told, occurred in the case of the electromagnetic plant in which a solution of Uranium-235 made up in water would have been explosive, but the people operating the plant had no information which told them that such would be the case. By a rather rare accident and by a break-down of compartmentalization, this difficulty was discovered in time.

I could go on with many other illustrations of this kind. I might say one that I think was a little amusing occurred at the beginning of 1943, when I learned that the du Pont Co. was told not to inform me in regard to their method for the production of heavy water. I knew this because of my contact with my very good friends at the du Pont Co., and I also learned it by the backyard-grapevine route by which information leaks around compartmentalization barriers.

The lack of necessity for that has always appealed to me as quite remarkable, for the method they used was merely boiling water through apparatus that is standard apparatus used in the chemical industry. It was not a problem in which I was personally greatly interested, but I was greatly annoyed by the fact that that information was interrupted.

Recently there have been questions about the cost of heavy water which are not known to people who would plan and think of using it. It is quite a vital item of information to the research man on a job as to whether a material he proposes to use is expensive or not. Also the amount of Uranium-235 which might be available for their plans were matters which they were not allowed to have.

These are a few samples. I could carry on examples of this kind; they could be brought up by the hundreds.

Senator HARR. May I interrupt you there?

I think you said something which you would not wish to have misunderstood.

You were talking of the risks that were involved in certain plants; risks to personnel, I take it, because of what you term these extravagant methods of secrecy. Of course, there were risks all through, and no accidents did happen, which shows that very excellent provision was made to guard against them, and free insurance was carried, so after all you don't wish to be understood as saying that none of the personnel involved should have been facing such risks as those which are rather minor as compared with the risks which the men in uniform are taking, do you?

Dr. UREY. No; in a war we all expect we will take risks, and these problems were surmounted; but had accidents of this kind occurred, it would have seriously interrupted the work. How would we keep the personnel on the project? All the men would have walked out of the plant if they had realized there was such a great risk. At least it looks that way to me, and it was the opinion of the operating company that that was a serious difficulty they faced. It wasn't a matter that in a war you need to worry too much about a few human lives. Many are being lost, but it was important that the work should continue to go on.

Senator HART. Yes; but, Doctor, did you mean to say that that condition is what you consider an extravagant method of secrecy?

Dr. UREY. It is one illustration of what I think are the extravagant methods of secrecy.

Of course, the important part of this side discussion is not what was done in the past. I am perfectly willing to let the Pearl Harbor investigation take care of such matters, but if this constant frustration of scientific and technical men by artificial barriers to the flow of information is continued in the future, it will be a very discouraging feature to many scientific people. They will prefer to work in fields where no such interference with the information which they need occurs; and that is the important thing for us—nothing of the past, just what is the bearing upon the problem of future development.

While operational secrets can be told in a few ordinary words, scientific facts can only be told in many pages of highly technical discussion. Within a large scientific project the distribution of information is a very difficult problem. The reading of the German documents on atomic energy must be done by men who understand the subject matter. Scientific details are difficult to transmit to others, even to other scientists. For this reason compartmentalization of scientific information is unnecessary and only obstructs the necessary dissemination of information among men who need it. Of course, if scientific information were freely published during a war it would be of value to the enemy, since this gives us an opportunity to study the scientific details.

Certain types of information in our problems partake of the character of operational secrets, that is, the fact that a problem is being investigated, probable dates of completion of phases of the work, amounts of production, sizes of weapons, general processes being used, nature of critical materials used, and so forth. Some of these were made public in the Smyth report.

I think we were entirely justified in making those public in the Smyth report, for most of the information was of the type that would

have leaked very quickly in any case, and perhaps already had leaked before the Smyth report came out. Unfortunately, most of these cannot be compartmentalized without, at the same time, treating scientific data in the same way. Also certain information of this kind bears on public policy and during peacetime should be available to the public. Thus the rate of production of bombs and the number stored should be known to the people in the same way that the size of our Army and Navy is known to them, and in both cases is then necessarily known by the governments and peoples of other countries.

Before the war the distribution of scientific information was not restricted in any way unless it related to the detailed construction of weapons or defenses against weapons. We should go back to this same situation in the postwar period, since the advantages to be gained from a free science so greatly outweigh the immediate advantages of a few temporary secrets that no other course would be sensible.

Specifically, secrecy regulations under the assumption of no international control should be limited to the mechanical details of the bomb and certain details of construction of plants. It should not cover any scientific facts whether or not they are necessary for the construction of the bomb and plants. Only in this way can work on the improvement of the atomic bomb and on industrial uses be done effectively.

Moreover, as a matter of public policy, our capacity to produce atomic bombs and the number stockpiled should be known by the people of the United States. To keep such matters secret would be comparable to having a secret navy or army. Making these matters public will inform all other countries of our strength in this respect, but unless we intend to abandon an important aspect of our present system of government, these facts should be known.

Senator HICKENLOOPER. Mr. Chairman, may I interrupt?

The CHAIRMAN. Yes, Senator.

Senator HICKENLOOPER. Doctor, I do not mean to take issue with you on this argument about the number of atomic bombs except to raise this question: I cannot quite follow the desirability of announcing to every other country the exact number of our store of atomic bombs, assuming that we elect to keep a store of them. It would seem to me to be a whole lot like the moving-picture versions of the detective who counts the number of shots in the crook's revolver, and when he shoots six times goes in and gets him.

When the other nations, assuming we want to use this for war purposes, know we have a thousand of these bombs, or 500 of them, or the exact number, they might be able to perform the best defense possible against our use of them by merely dispersing their population and their industry until we shot all of our 500 bombs, and then know that we, at least at that moment, did not have any more.

That argument would appeal to me as being against the announcement of a particular number of bombs, as differentiated from statements concerning the size and number of our ships, for instance, or our military forces—information readily obtainable by any good spy.

Dr. UREY. Well, atomic bombs are a weapon of such a large magnitude that they represent something of the order of magnitude of capital ships in their importance.

I would also, along with my idea in regard to people of the United States knowing what number of bombs we have, believe they should

know how many ships we have in our Navy or how many soldiers in our Army.

I am only saying the atomic bomb is a major weapon, not a minor one at all. It is equivalent to an entire air force, or an entire navy or an entire army, and the people of the United States should know whether they are building up an army, a navy, an air force, or a stock of bombs.

Senator HICKENLOOPER. Well, I agree that the widest information should be given on these things, but I believe that perhaps we announce very glibly the number of ships we have and the size of our Army because we know anybody can find it out anyway.

In the case of the atomic bomb, which is a major weapon and perhaps for the time, anyway, a controlling weapon, there might be a little different element of human nature in there that would dictate whether we should conceal the fact if we elect to go on with the atomic bomb as a war weapon.

I hope we can arrive at a solution where we do not have to. If we elect to use it as a war protection, I conceive that it could be concealed just as we conceal the number of battleships and carriers we have, and, if we could do it successfully and hide them so no foreign agent could find them, I have no doubt but that we would be concealing the exact number of bombs.

Dr. UREY. My own idea would be the matter of whether we considered ourselves at war, or in an armament race where we expected to get into war, or considered ourselves at peace. But if we are at peace, my argument applies. If we are essentially at war I would agree with you.

Senator HICKENLOOPER. Thank you, Doctor.

Senator JOHNSON. Mr. Chairman, may I interrupt?

I understand your position, Dr. Urey, as being opposed to all military secrets, not only the atomic bombs, but every other kind of military secret.

Dr. UREY. Well, that is a rather broad statement.

Senator JOHNSON. Well, that is what I understood from your prepared statement.

Dr. UREY. No; I say that if we are going to engage in an atomic-bomb armament race, the things that should be kept secret are the details of the bomb, as we do in the case of all other weapons.

We do not tell the details of our bombs, or the details of our planes, or the details of our ships and things of that sort.

But also we do not suppress the scientific data upon which all of these things are constructed, and the same distinction is the only one that I ask in the case of the atomic bomb.

Senator TYDINGS. But what you say, Doctor, with a great deal of emphasis, as I got your testimony, is that we ought to try to establish a line between what might be classified as purely scientific research and development as differentiated from its application to weapons.

Dr. UREY. That is right.

Senator TYDINGS. In other words, to take a far-fetched example, if Einstein's theory is discovered, or if the philosophy or formula for the splitting of the atom is discovered, that should be passed along?

Dr. UREY. That is right.

Senator TYDINGS: But you are not attempting to say that all of the application of that theory to the actual mechanics of producing the weapon should be publicized?

Dr. UREY. That is right.

The CHAIRMAN. Then your point is, as I get it, that it would not be possible to develop—to use the Senator's illustration—an Einstein theory in the compartmentalization treatment of scientific matter?

Dr. UREY. A genius such as Einstein would probably bring forth his theory of relativity without a great deal of discussion with many scientific colleagues; but most scientific work is not done that way. I may say that the development of the theory of relativity was not done entirely that way, either. A professor of the University of Chicago tells me of the seminars they had in Berlin at the time Einstein was working on his theory of relativity, and I have no doubt but that Einstein found those discussions exceedingly stimulating at that time.

But somebody of that kind may from time to time bring out a startling piece of work without a great deal of stimulation from his colleagues, but that is very rare. Nearly all scientific work proceeds by one man making a discovery, moving the subject forward by a small amount, publishing his data, presenting it at a scientific meeting, everybody discussing this thing, and someone in the group goes home with an idea of his own that might be slightly different from that of the man who presented the work. Then he starts to work and he presents some paper, and somebody else picks up another idea. This constant interplay of many minds working on the problem is what makes the whole field of science go forward. If we must have secrecy on this problem within the United States in the next coming years, all compartmentalization lines should be destroyed so that we get as much discussion among the scientific people within the project as possible, so that a maximum number of good ideas can be brought forward.

That is my objection to the compartmentalization. If we must have secrecy, then the whole project should be in one unit in order to bring as many minds into one group as possible.

The CHAIRMAN. Did you protest this compartmentalization while it was going on?

Dr. UREY. I think, as I said, that the scientists somewhat helped it along. I believe that it started about in 1940, which was my first contact with it, and it was certainly in full swing at that time.

I believe the scientists dropped into it themselves because they did not realize how damaging it was, nor to what proportions it could grow, and only after swimming in this molasses for years have they come to realize that this sort of thing stifles their efforts and frustrates them more than they ever imagined when the thing started.

Senator HART. Doctor, I think I understand you better now. You are arguing against the continuation of the methods of employing secrecy which we carried on through the war?

Dr. UREY. That is right.

Senator HART. You are not particularly finding fault with the fact that they did carry them on during the war?

Dr. UREY. The whole job on the development of the atomic bomb was done, I think, very well. I could go through and find fault here, there, and some place else, but if you were to turn the whole thing

back to the beginning and try it again I don't know whether we would have done any better or not. I doubt it.

I am not complaining primarily concerning the things that were done in the past, and I am distinctly not blaming any particular person or any particular group. I think it is a thing into which we all dropped for a rather natural reason because of our appreciation that we had in our hands a very important development.

I am only saying at this time, "Let's not do it in the future; let's get out of our tank of molasses and make some progress in a much more effective way than we have done in the past."

Senator TYDINGS. But you even limit that statement to the qualification, as I get it, that the theoretical or scientific development, or the art itself should receive freer consideration; but as to the weapon itself and the technique that goes into it, you are not complaining of the secrecy imposed on that?

In other words, you want science free to explore without disclosing what it has done in the way of this weapon?

Dr. UREY. That is right.

TNT, trinitrotoluene, is a substance which we can investigate in chemical laboratories and find its properties all we wish to. But just as soon as it is being made into bombs, then we do not publish our results, and the same thing should be done in this field.

Senator TYDINGS. It is inherent in your testimony that the degree to which we transmit scientific knowledge should be international; that is, there should be reciprocity.

If we find that scientists are working in other countries under the restriction of their governments to transmit nothing to our science. I imagine you would approach the freedom of the interchange of ideas with more hesitancy than if there was a freedom everywhere.

Dr. UREY. I would say this: If we must have a competition on this subject with foreign countries, then we ought to have as large a degree of freedom in the United States as possible in order to get the maximum benefits. But of course there is no reason, if we are going to compete seriously with another country, why we should give them information and they not give to us.

Senator TYDINGS. You are requesting an interchange of international knowledge within the limits that could be exchanged without impairing our national safety?

Dr. UREY. That is right.

Senator JOHNSON. Dr. Urey, I think I understand your position much better now. The paragraph that threw me off was your second paragraph under "Secrecy," wherein you state [reading from a copy of Dr. Urey's prepared statement]:

* * * the situation * * * calls for maximum efforts to clarify the international situation in regard to control of atomic weapons and other heavy arms. Obviously we should not attempt the control of atomic bombs only, for if this were done, a war would start with the use of ordinary weapons and be continued with them until the atomic bomb plants were in operation and the war finished with these weapons.

That paragraph led me to the conclusion that you did not want secrecy with respect to any of the weapons of war.

Dr. UREY. I would say this: If we can secure an international control which we believe is adequate and can trust, it will necessarily lead to control on other weapons than the atomic bomb. Inspection

would immediately disclose the developments on other weapons as well as the atomic bomb.

If that were the case, if we could secure such control, then we should publish every single thing we do. If we cannot get that control, then we must have a certain amount of secrecy within the framework of our own group, and I am only pleading that in this second case the compartmentalization rule be broken down so that all people working on the various phases of this project can know about it.

Senator JOHNSON. I agree completely with that statement. However, until we get the international control in the satisfactory position such as you describe, I think you are making too much of a distinction between peacetime and wartime. I think we are continuously at war and must consider ourselves to be continuously at war until we have stabilized peace, the international peace to which you referred.

The argument which you made about everything being satisfactory in wartime, and not satisfactory in peacetime refers to the kind of peace that we have been enjoying, which is nothing more than a temporary armistice, an unstable peace.

Dr. UREY. That is exactly the reason why I plead so repeatedly for rapid movement on the international scale so that we can make a decision as to what we ought to do. I don't believe we can make any decision as to what we should do at the present time.

Senator TYDINGS. You are not advocating that we carry out anything you say tomorrow?

Dr. UREY. No.

Senator TYDINGS. You are simply projecting it as a possible premise upon which we might proceed when the circumstances permit it?

Dr. UREY. One of our difficulties is that none of us knows whether we should try to produce atomic bombs in great numbers at the present time, or whether we should not develop them at all and pay attention to peace.

What you do in one case will be quite different from what you do in the other. Until that situation is clarified, you cannot make up your mind what you ought to do.

In the first case, if we don't have to make bombs, we can publish everything we do. In the second case, where we must make bombs, we still must get as much freedom to the groups working on this in the United States as possible to get a maximum effort in the field.

Senator TYDINGS. Have you thought of this angle—and evidently from your testimony you have: All countries manufacture, perhaps in peacetimes, disease germs which can spread epidemics in hostile populations. I assume that many countries on the face of the earth during the war kept laboratories where these germs were made and could be dropped if any other country started that.

It was not done, for the very obvious reason that there was the fear that the other fellow might have a worse bunch of germs or a better bunch than you had yourself.

Have you given thought to the fact that if we have a store of these atomic bombs, it might stop the other man from using the atomic bombs that he has, because retaliation would come sooner or later, and even though he got the initial advantage by a surprise attack, if we had some bombs all over the country and the transportation facilities available so that atomic bombs would eventually be dropped on him, too, that the horror of the whole thing might restrain him?

Dr. UREY. I have thought about that a good deal. I don't think I would trust it. Take the case of poison gas. We undoubtedly did not use poison gas for humanitarian reasons. Perhaps the Germans did not use it for fear of retaliation; but back of the failure to use poison gas was probably a judgment that incendiary bombs were more effective than poison gas, and hence the effort went into the production of incendiary bombs rather than the production of gas in Germany.

Having proceeded along this line, they had not gotten ready to defend their population against poison gas, and hence did not wish to start it later.

I think it is very likely that the analogy, for example, to poison gas is not good. In the case of bacterial warfare, I don't know. Turning bacteria loose in the world is dangerous, because if you produce a very large diseased spot in some part of the world, the diseases have a natural way of spreading to places where you don't want them. Atomic bombs, the ones we drop, will not spread back on us.

Senator TYDINGS. No, but the other country has the germs to bring back on you, in the form of another atomic bomb.

Dr. UREY. Yes.

Senator TYDINGS. I think, if we had a large stock of these bombs, and some possible enemy had a large stock of these bombs, there would be a hesitancy on their part to start a war with us because of the inevitable retaliation that would come.

I am wondering whether you have pursued that very far, and what your opinion on it would be.

Dr. UREY. My opinion is that it would not be a sort of protection which I would like to trust.

Senator TYDINGS. Have we got anything better for the time being?

Dr. UREY. The only thing that appears to me to be worth while as a means of trying to avoid the destructive effect of atomic bombs is to try to induce the other governments of the world to agree to an outlawing of the bomb and to backing it up with an inspection to find out whether the outlawing is obeyed, and also with some means of bringing violators of law to justice.

I believe that means we must not manufacture bombs, because that enables us to introduce an inspection system. If we are manufacturing bombs at various places, I don't know how we would introduce an inspection service.

Senator TYDINGS. You made that clear in the first part of your remarks. I believe you looked ahead for 20 or 25 years to the period when probably five or six nations would have an ample store of these bombs.

The CHAIRMAN. He didn't say 20 or 25.

Senator TYDINGS. I am just assuming that.

The CHAIRMAN. He said 5.

Senator TYDINGS. Well, let's assume 20, 15, or 10, and they all have a large stock of these bombs.

Now, if that situation should come to pass, there would be no hope in the world that a war would be fought without atomic bombs.

Your assumption is that we ought to try the other thing and see if we can work it before we face that alternative, if it is humanly possible. That is the general line of your reasoning, isn't it?

Dr. UREY. That is right.

Senator TYDINGS. The other may not work. The alternative may not work, it may fail, but you think it is better to explore it and try it

than it is to rely on the day 20 years from now when there will be no restraint and every nation will have these bombs available?

Dr. UREY. Yes. Toward the end of this statement I have pointed out the difficulty of keeping scientific men on the job of making atomic bombs.

Scientific men don't wish to work on destructive weapons; they would rather work on constructive things. If they have a choice—and we still have a choice in this country to work on what we wish as individuals—they will drift into fields of work in which they will see constructive results of their scientific work. As a result, I don't know how you are going to maintain research on atomic bombs, except in one way. You will have to see that the international situation develops in such a way that each individual scientist is convinced himself that that is the only thing that can be done to defend the United States, in which case he will go to work on atomic bombs. I don't believe any artificial method will get an active development of atomic bombs except that feeling of necessity in the heart of every man that has to work on them.

Senator TYDINGS. Would you say, from your contact with fellow workers in the scientific fields—and imagine that contact is on a rather wide scale—that it is the universal opinion of the men who have built this Frankenstein creation, so to speak—and I say that with a smile, not with criticism—that the hope of the world lies in finding some means of dealing effectively with the atomic bomb so that its probable use will be prevented, and that any other thing that is allowed to drift means the ultimate destruction of the whole earth, let us say 50 years from now when it has gone through its whole evolution? Is that your thought?

Dr. UREY. That is right. I do not see this line of argument. The atomic bomb is exceedingly destructive. A picture in a morning paper shows what area of Washington would be destroyed by one atomic bomb. It is very destructive.

Second, there is no defense for it, and therefore we must make a large number of bombs.

The last step, somehow or other, does not follow logically in my mind from the first two. I do not believe it is a solution to the problem posed by the first two statements, and I would like to see us propose something that is at least a partial or a possible answer to the first two statements.

Senator TYDINGS. In other words, the ultimate conclusion of the first two statements is so horrible that you are not willing to accept that as a final answer without working with all your might and main to find, even though you fail, an alternative?

Dr. UREY. Well, making a lot of bombs is no defense to us; it is only the retaliation that you mentioned, Senator Tydings, that is the only defense involved in it. It still will not prevent our cities from being destroyed and people from being killed.

Senator TYDINGS. Scientists share your view, don't they?

Dr. UREY. I think they do.

Senator TYDINGS. Those I have talked to do, and I wonder if your experience was the same.

The CHAIRMAN. Doctor, I don't want to delay you unduly, but I wish to ask you the question I asked General Groves yesterday. You were probably in the room.

If country A was to take over country B, a small country, by fifth-column methods, and the attack was to come from country B although promoted by country A and although we had no proof of that fact, the only retaliation we could have would be on the basis of suspicion, would it not, that maybe country A did have something to do with it?

Dr. UREY. Yes, sir.

The CHAIRMAN. Now, it is possible that country A might be suspicious, but maybe, on the other hand, it would not have anything to do with it because a small industrial country might get these bombs to do the job.

Dr. UREY. I don't know what we would do in such a situation. It is a very difficult thing to answer. To attack the first country because you suspected them of having something to do with country B would be immoral, to say the least. I suppose that our country in that case would have to make some sort of a decision, and maybe just attack country A. I don't know.

The CHAIRMAN. We might be wrong?

Dr. UREY. And we might be wrong.

Senator TYDINGS. You heard General Groves testify, Dr. Urey, that in a war in the future, let's assume 25 or 30 years from now, between major powers we might have 40 large industrial cities partially or totally destroyed, and probably 40,000,000 people killed and that we would still fight on.

Do you care to comment on that statement, to enlarge on it?

Dr. UREY. Well, I mentioned in my direct testimony here that I feel in such a case we would have to have very large stores of material before the war started in order to be able to continue it.

Mostly we have fought our wars recently by letting someone else hold the enemy for a year or so while we built plants to make materials with which to fight a war, and then as the war progressed we kept up an enormous production to fight that war.

I don't see how we could possibly follow that pattern in such a future war.

Senator TYDINGS. That is gone.

Dr. UREY. That is gone. We would either have to have a large store, or else hope the other fellow was in exactly the same position so that we could fight it out on equal terms by much more limited methods of warfare than have obtained in this war.

Senator TYDINGS. But if the atomic bomb is in production among three, four, or five of the leading powers and there is a surprise attack on a big scale, the modern conception of Pearl Harbor 25 years from now, and our population is in the stage it would be in with the killing going on, what is your conception of what would take place after that surprise attack had pretty well been carried out with moderate success, let us say?

Dr. UREY. I would like to make a further assumption, namely, that our atomic bomb launching sites were not destroyed. We would destroy the other fellow's cities next. I think after that that the war would languish. I think we would all be so busy taking care of our own homeless and wounded people, probably without leadership, for our leaders would probably go with the first Pearl Harbor attack, that we wouldn't pay very much attention to the war for quite a long time, and neither would our enemy. That, I think, would be the probable outcome.

Senator TYDINGS. We would hunt the open spaces, wouldn't we?

Dr. UREY. We would hunt the open spaces and try to get enough to eat to take care of ourselves, and it would be pretty much of a stalemate from that time on.

The CHAIRMAN. If we had 100,000 bombs and if you adopt Senator Tyding's example that he gave about the trucks that would come into Washington, for instance, it is possible that we would not know who planted those and so we would not know at whom to launch the hundred thousand. What would we do—throw them widespread?

Dr. UREY. It would be an anonymous war, and I think it would be the greatest mystery of a long time as to "Who done it?"

Senator HART. I, like Senator Johnson, am afraid I misunderstood you.

In the first paragraph of your discussion on secrecy, you said that you thought we had more to gain than we had to lose by publishing everything that we know right now.

Dr. UREY. Yes, sir.

Senator HART. To me that sounds considerably like our noble experiment of the early 1920's, when we tried to get the world to disarm by example. It didn't work.

Would you wish to enlarge upon that, Doctor?

Dr. UREY. I told Senator Johnson that if we must get into a definite armament race I think we will have to have secrecy around the borders of the United States, as it were, and so that statement is somewhat inconsistent with what I have said there.

But in reply to your analogy, I would say this: There is a very great damage to scientific effort imposed by these secrecy conditions. You see, it isn't a clean-cut decision. We wish to get a maximum amount of effort and development on our side, and to minimize the effects of leaks to the enemy, and some place between the two postulates of publishing everything we do and keeping everything carefully compartmentalized and secret, there probably is an optimum position, and I think the optimum position lies far toward the side of making public our scientific facts, but probably not so much of our scientific or industrial "know how." That is, where I would place the maximum is probably close to the side of maximum publication.

Senator TYDINGS. Are you doing anything with the powers that be to achieve such a policy of a little more freedom in scientific research, and making headway?

Dr. UREY. I have been asked by General Groves to serve on a committee looking toward the declassification of scientific documents that have accumulated on this project during the war. My argument before that committee sounds very much like the one that I am presenting to this committee.

Senator TYDINGS. I imagine, then, there is an agency set up working on this problem to see how far, within the limit of what is conceded to be the Nation's interest, scientific freedom can be granted without jeopardizing our security.

Dr. UREY. That is right.

Senator TYDINGS. So that problem is being worked on?

Dr. UREY. That is right.

The CHAIRMAN. When was that committee set up?

Dr. UREY. Oh, I should judge about a month ago. There was a meeting of the committee on Monday preceding October 16, which was a Friday.

The CHAIRMAN. About 30 days ago?

Dr. UREY. Yes.

The CHAIRMAN. It wasn't set up before the War Department prepared their legislation on this subject?

Dr. UREY. No.

The CHAIRMAN. Go ahead, Doctor.

Dr. UREY. Six: Specific provisions for prospective domestic legislation.

I might say that that is a field in which I have a few suggestions to make, but I am sure the gentlemen on this committee are far more skilled in matters of this kind than I am.

The commission, in whatever form it is set up, should be responsive to the President and the Congress. This is especially important in the case of the control over atomic energy, which is moving very rapidly and involves so many points of foreign and domestic policy. Two forms of organization would seem possible to me.

A director of atomic energy might be established, appointed by the President, with the advice and consent of the Senate, and removable by him, as are Cabinet officers. This director is bound to exercise vast powers, and some check on his activities is desirable. This might be supplied by the use of the courts, though they are likely to find themselves uninformed on such a complex technical problem and hence unwilling and unable to review acts of the director which may be regarded as arbitrary by persons with whom he deals. In order to avoid this difficulty it may be possible to establish an advisory and appeal board.

A second form of organization would seem desirable to me. A full-time commission of, say, three or five men, with the Secretaries of War, Navy, State, Commerce, and Interior as ex officio members. The full-time members should be scientists or engineers and should be appointed by the President, with the advice and consent of the Senate, and removable by the President, just as Cabinet officers are. The commission could then appoint its administrator, with the approval of the President, who again should be a civilian without any other loyalties. This administrator should be a civilian for two reasons: One, he should owe allegiance to no other authority than the commission, and two, he should have had experience in handling men and organizations on a peacetime, nonmilitary basis.

Either the director, in the first case, or the administrator, in the second, should be men of broad experience, with the ability to handle very large problems, such as those which will occur in the case of atomic energy control. If it is feasible to do so, the salary should be high enough to attract a man in competition with industrial positions.

The powers of the director or commission should be adequate for this problem, but any blanket grant of powers should be avoided. Amendments to laws are always possible; and if the original powers granted are not sufficient the Congress can extend the first grant of power. Since this development has been carried through with Government funds, it is only reasonable to attempt to avoid monopoly by private persons. At the same time, the control should not be so strict that development is stifled by lack of incentives.

The director or commission must have the following powers:

One. The right to know where and by whom scientific, development, or industrial work on atomic energy is being done.

Two. The power to make rules and regulations covering hazards incident to such scientific, development, and industrial work and the power to inspect establishments to determine whether such rules and regulations are followed.

Three. The power to keep inventories on all fissionable elements and their separated isotopes. Ownership of U-235, Pu-239, and other elements of similar fissionable properties should reside in the Government.

Four. The right to use all patents and other information for work on atomic energy. The patents should be made available on a compulsory license basis.

Five. Certain legal and business powers dealing with organization of corporations, making contracts, etc.

Six. The right and, in fact, duty of licensing fissionable and other special materials on an equitable basis to private persons for use in research.

Seven. The right and duty of encouraging research, development, and manufacture of atomic energy and equipment for peaceful purposes.

In addition to these, other powers may be necessary. I believe that the Navy and Army should be permitted to carry on experimental and developmental work on phases of atomic energy having to do with national defense. The commission should also be permitted to conduct such studies.

I believe that the commission should not operate its own research and development laboratories but should secure the development of atomic energy through private laboratories or by letting contracts for such research and development with private persons. This suggestion runs counter to opinions of other people, and some explanation is necessary.

I may say that I am not sure I am right about this; that is just my opinion.

The commission, if it had its own laboratories, would be making grants to private laboratories and its own laboratories. It would immediately get a proprietary interest in its own laboratories and almost certainly would favor these laboratories relative to private laboratories. I believe that there would be an almost unconscious tendency to divert the work on the more promising lines to its own laboratories. Such things have occurred in the past in the minds of a number of people, and the effect is to make people in the private institutions very wary of any contact with the commission and its favorite "pet" laboratories. I noted with satisfaction that both the Magnuson and Kilgore bills on a National Science Foundation specifically required that the Foundation should not establish its own laboratories.

The Commission or director should have the power to classify information in accordance with the requirements of the Espionage Act.

Severe penalties should be provided for violation of regulations relative to safety hazards, diversion of fissionable materials, or failure to keep the commission informed relative to research or other work on atomic energy.

I believe that there should be no specific penalties for violation of matters covered by the Espionage Act but that the penalties of that act should apply to the work on atomic energy as it applies to other activities.

In order to secure maximum effort on atomic energy, every effort should be made to make conditions for individuals and institutions such that they will be attracted to this work, and this means that these conditions shall be as favorable for work in this field as they are in other fields of research and development. Specifically, penalties which can be applied in arbitrary and unusual ways should be avoided. I am a believer in free enterprise and do not believe that this system should be completely abrogated in this new field of energy utilization.

Finally, I wish to add one brief remark on conditions necessary for the development of atomic weapons. Scientific men are not particularly attracted to work on destructive weapons but would rather devote their talents to constructive development. The enthusiastic work during the war on weapons of all kinds by scientific men was done because all of us realized that this country was in great danger and not because the work was particularly interesting. As we enter a peacetime situation, it will be difficult and probably impossible to keep the more capable and brilliant men working on weapons of war. I believe that this would only be possible if these men are convinced that such work on weapons is absolutely necessary for the defense of this country. Again, I urge that all possible efforts be made to secure international control of atomic and other weapons. If these efforts are made and fail, our scientific men will rally again to the support of this country. Otherwise, I believe that the overwhelming majority will be attracted to other fields of effort.

Senator HARR. Doctor, would you add the management and governmental operation of those big plants to the powers you have laid down for the commission?

Dr. UREY. Yes; I think they shall have to operate those plants.

Senator JOHNSON. Doctor, in the proposals that you make for the specific provisions of prospective domestic legislation which you name, are they based on conditions without an international agreement or with an international agreement?

Dr. UREY. I should say that it doesn't make so much difference. I am assuming that the commission or the director will do what is needed in view of the developments in regard to this field.

If in the one case it is necessary to develop atomic weapons, I should think that a director, an administrator, or a commission would take their orders from the President of the United States and direct their efforts in that direction; and that would be done.

If, on the other hand, peacetime applications are necessary, they would direct their efforts in that direction as well.

Senator JOHNSON. Then you are not in conflict with the President's message to Congress making the domestic controls entirely independent of the international controls?

Dr. UREY. I am not, sir.

Senator JOHNSON. That was his procedure.

Senator RUSSELL. You of course read the joint statement of the President, Mr. Atlee, and Mr. King as to international control?

Dr. UREY. Yes.

Senator RUSSELL. Do you care to comment on that as to whether you think that is the best approach to the problem?

Dr. UREY. I think that is the way we should move on that problem. I was very glad to see that statement. I was only sorry it was not issued 3 months before. What is needed is as quick a follow-up with effective establishment of such a commission as possible. Immediate steps should be taken. I don't know whether those are being taken or not.

Senator RUSSELL. You are convinced then, Doctor, that a system of international inspection can be thoroughly effective in preventing the use of atomic energy as a weapon?

Dr. UREY. As General Groves has told you, I think it might break down and might not be perfect. I think that that is a danger we will face no matter what we try to do. No matter what scheme we try to work, out, there will always be the possibility that there will be imperfections in it.

I believe that the international inspection, providing the countries of the world agree that it shall be done, should be feasible. I cannot imagine that the inspection would work if the countries of the world have it imposed upon them in some way or other from without against their consent.

I am assuming we would secure agreement from the major industrial countries of the world; and if that agreement were given, then I think it would not be difficult to tell whether the large-scale development we have in this country were going on.

Senator RUSSELL. If it developed that any one of the nations refused to assent to that proposal, and refused to have anything to do with international agreements on this subject, do you think we should continue to manufacture these bombs?

Dr. UREY. Yes; I don't see anything else we can do. I think we ought to indicate to the other countries of the world our great willingness and great desire to discontinue our manufacturing, our willingness to dismantle our present store of bombs, and to disperse them into only peacetime uses, and that we ought to indicate to the world our willingness to do that if any adequate machinery can be set up for control.

Senator JOHNSON. Dr. Urey, on page 5, along the line of the question which you have just answered, the last paragraph in part II of your statement, you say:

My choice of time to do something about this threatening series of events is now or preferably 3 months ago, if it were only still possible.

What is the particular significance of "3 months ago"? That takes us back to the 28th of August, if your paper is dated today.

Dr. UREY. I wish very much that the President, Mr. Atlee, and Mr. King's statement had been made in August instead of now. I believe our international situations are being poisoned day after day because we are accumulating a supply of bombs. At that time we had no supply.

Senator JOHNSON. Prior to August 5 or after August 5?

Dr. UREY. I think after August 5.

Senator BYRD. Would you destroy, Doctor, the bombs we have made?

Dr. UREY. I would indicate a willingness to the people of the world to dismantle those bombs.

Senator BYRD. What do you mean by "dismantle" them?

Dr. UREY. There is an explosive charge which is fissionable material, and there is an auxiliary mechanism to set it off. I would take it all apart. I would take the material, and dissolve it and put it in the form of ordinary chemical substances, and tell everybody exactly where it was under those conditions.

Senator BYRD. We would have to destroy them so far as they could be used?

Dr. UREY. I would not destroy the fissionable material; it is valuable for other purposes.

Senator BYRD. Then that would be available to be put together?

Dr. UREY. Oh, yes, after a time.

Senator BYRD. Actually we would have bombs which the other nations would not have.

Dr. UREY. We would have material from which we could make bombs in perhaps six months.

Senator BYRD. And you propose to keep the other nations from having that same material?

I am trying to find out whether you would put this country on an equality with other nations.

Dr. UREY. The point is that if we do not intend to make the bombs, if the conditions were imposed that we were not to make or have large industrial plants and have only a limited amount of fissionable material in the country, I would judge that what fissionable material we have at the present time comes within those limits.

Senator BYRD. In other words, other nations should get the same amount of that material?

Dr. UREY. Surely, if we can get an international control we must expect that other nations will go forward to the same extent we think we ought to.

Senator BYRD. You have to start the use of this atomic energy to get that material. They would have to start the preliminary processes?

Dr. UREY. Oh, yes.

Senator BYRD. And then you would want them to stop at that particular point and not go further?

Dr. UREY. Yes.

Senator BYRD. It seems to me that is quite a weakness in your argument.

Dr. UREY. Let me point out this: If we ran these piles at rather limited power, we would produce all the radioactive materials that we could use for medicine, for industrial research and things of that sort. That would be a very valuable peacetime effort, but still would not accumulate for anyone a large stock of atomic bombs.

Senator BYRD. We are faced with this partial situation: Before action can be taken, we will have made a good many bombs. They will be in existence.

Dr. UREY. Yes.

Senator BYRD. Now, if we are to be on an equality with other nations, we have got to destroy those bombs or put them in some other kind of condition, and then permit the other nations to do what we have done.

Dr. UREY. Yes. There is no possibility of securing an agreement with any other country unless we are willing to establish a level and expect them to reach it also.

Senator BYRD. In these preliminary stages where you set this material back for some other conditions than what it is now, then the other nations can go that far and no further. That would be hard to police and inspect, it seems to me.

Dr. UREY. Perhaps you went to Oak Ridge; did you?

Senator BYRD. Yes.

Dr. UREY. You visited the pile down there?

Senator BYRD. Yes.

Dr. UREY. That pile is a very nice-sized pile for experimental work in the production of radioactive materials, and so forth, and it is not a very big plant, as you have seen. I think it would be feasible.

This would be my opinion, and certainly it would be subject to review by others than myself, that if we had piles of something of that order of magnitude in other countries, it would not be a serious threat to the peace of the world and would come within a level of activity which could be controlled by inspection.

Senator BYRD. But I am speaking of the actual bombs that will be made before this agreement you mentioned could be effectuated. They will be in existence, and something has got to be done with them. They have got to be destroyed or put in some other form, or something, and whatever we do in that respect we have got to permit other nations to do.

Dr. UREY. There is no level to get down to, except that we admit to other peoples the same rights we ask for ourselves.

Senator BYRD. You would not destroy the bombs?

Dr. UREY. I would not destroy the material, but dismantle the bombs.

Senator BYRD. Then we should permit other nations to go as far as we go in this preliminary stage in making the bombs. You have just said we could make them in 6 months if we had that preliminary.

Dr. UREY. That is a guess on my part. I did not work on that part of the problem.

Senator BYRD. What I mean is that we still have got that element of danger in existence, haven't we, under your plan, because of the fact that we have got the bombs or will have more bombs when this thing is finally settled.

Dr. UREY. If your argument is correct, Senator Byrd, and we can only control the atomic bomb by pouring fissionable materials down the Mississippi River and let it go, I think it is worth while to destroy it completely rather than run the risk of atomic bombs, if that is the only way it can be done.

Senator BYRD. I have not made any argument; I have taken no position. I am trying to find out what your plan is with respect to these bombs that are in existence, and I think that is a very important question. They must be destroyed, or something must be done with them. We must permit other nations to have exactly the same opportunity that we have had toward the manufacture of the bombs.

Dr. UREY. That is right, the same attitude, and if necessary we will have to destroy the materials of our bombs as well.

Senator BYRD. I think that is a very vital question in this whole matter, as to what you are going to do with what you have already got in existence.

Dr. UREY. And the more we have got, the worse the problem is.

Senator JOHNSON. Dr. Urey, the members of this committee and, insofar as I know, no one else unless it be General Groves and some of the people at the top, know exactly the amount of the compound that we have that is ready to go into the development of bombs.

It seems to me your paper displays a lack of faith that others might have in us.

Now, how are you going to convince the world, for instance, that we don't have a sizable amount of this compound stored away which can never be detected, never be discovered, that we are holding back from the world? You do not seem to think that the other nations will have very much faith in the United States' good intentions. Now, how are they going to have any faith in the amount of this compound that we have on hand, and I am not talking about the piles; I am talking about the compound that is ready to go into the manufacture of bombs?

Dr. UREY. In regard to the question of good faith between nations, I feel about it like I do when I make a contract with my brother. I love him, and all of that, but I put it all down on paper just the same.

I may feel that a country is intending to deal with us honorably, but at the same time I propose to make laws and regulations so that there will be no question about enforcement. That is just one remark on one side of it.

As to how much we have, a scientific or engineering man from any foreign country, if he visited the plants in the United States, could determine their capacity from the figures that we have on them, and I think it would be very, very difficult to deceive him in regard to how much we have made.

If we wish to convince him how much we have, the records on the plants will be adequate to do so.

Senator TYDINGS. This may be oversimplification, but as I have listened to your testimony very carefully here this morning, I take it that as a scientist who has been with this from the time it was born up until the time it was a grown man, so to speak, and who has looked ahead to see its possibilities, your testimony is predicated on the fact that we have at last invented a weapon which, if used with its ultimate evolution of further development, might conceivably destroy civilization?

Dr. UREY. Yes, sir.

Senator TYDINGS. And might conceivably wipe out a thousand years of progress?

Dr. UREY. Yes.

Senator TYDINGS. And faced with that alternative and the knowledge that sooner or later other nations will probably be in a position to do what we today can do, it is your considered opinion that international agreement is necessary for the control of this element, that everything that we can do to implement the success of that agreement by inspection or any other thing that may be conceived of is necessary, that that process may fail, that it may be a fond hope that will never be realized, but it is the only alternative to the complete destruction of all that we have worked to achieve.

Am I correct in that summary?

Dr. UREY. That is a very good summary.

The CHAIRMAN. Are there any further questions of Dr. Urey?

Doctor, on behalf of the committee, I want to thank you most sincerely for the careful and studied statement that you have made, and I am going to take advantage of calling you back again for further testimony at the proper time.

Dr. UREY. I will be very glad to appear.

The CHAIRMAN. We will meet again at 10 o'clock tomorrow morning.

(Whereupon, at 1:05 p. m., the committee recessed until 10 a. m., Friday, November 30, 1945.)

ATOMIC ENERGY

FRIDAY, NOVEMBER 30, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahan (chairman), Russell, Johnson, Connally, Byrd, Tydings, Vandenberg, Austin, Millikin, Hickenlooper, and Hart.

Also present: Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. Dr. Langmuir is our first witness this morning. Will you give your name to the reporter and the official position that you occupy in industry?

STATEMENT OF DR. IRVING LANGMUIR, ASSOCIATE DIRECTOR OF THE RESEARCH LABORATORY, GENERAL ELECTRIC CO.

Dr. LANGMUIR. My name is Irving Langmuir. I am associate director of the Research Laboratory of the General Electric Co., and have been in that laboratory since 1909, engaged mostly in fundamental scientific research in physics and chemistry, but also have had considerable experience in industrial research.

Senator VANDENBERG. I think the record ought to show that in spite of the doctor's modesty he is also a Nobel prize winner in chemistry.

Dr. LANGMUIR. Yes, sir, in 1932.

The discovery of the accessibility of atomic energy opens a new era in human affairs. If used for peaceful purposes, it promises to be of untold and unpredictable benefit to mankind. But, if it should again be used in warfare, it threatens to annihilate a large fraction of the human race and to give to an aggressor nation a complete domination over all populations which are permitted to survive.

International control of atomic energy and, particularly, of all possible manufacture and use of atomic weapons is thus of the utmost urgency. Since such progress toward an effective world government can only taken place gradually through successive steps which build up world confidence, it is imperative that we devise adequate but sound legislation for the control of the knowledge and of the processes which we now possess in the field of atomic energy.

I propose to analyze the proper objectives of such legislation and of the forms that it must take if it is to be effective.

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Peacetime applications of atomic energy: Much of the discussion of the human value of atomic energy has been based on the thought that such energy may displace coal and oil as sources of industrial power. This, I think, is a relatively trivial matter. Even if coal or oil cost nothing as fuels, this would not have a very great effect on our civilization: we would not use our automobiles much more and our electric power bills would not be cut as much as they already have been within the last 15 years by the improvements that have occurred in power production.

The greatest benefits that will accrue to mankind from our new knowledge of nuclear reactions will more probably come through its indirect effects in speeding up progress in science. We may now expect a series of great discoveries in biology, in chemistry, and in physics. Through such better understanding we may have better means of preventing and of curing diseases, such as cancer. We may similarly develop new or better and cheaper chemical materials and alloys. It is probable that most such benefits can be had by relatively small scale production of the new radioactive products that are by-products of the manufacture of plutonium.

Large-scale atomic power production will probably first be important for ship propulsion, but even this will be of vital importance only for naval ships or submarines if these still prove to be of value in an atomic age.

Our present ability to obtain vast stores of energy from the nuclei of atoms forever eliminates any danger from the exhaustion of coal and oil reserves, but this is something that, in any case, would not be important for a century or so.

The threat of atomic bombs: We now have atomic bombs and no other nation has them. As long as this condition exists we are in a secure position.

England and Russia, however, have already announced plans to produce the substances that will give them atomic power. Such materials could also be used to construct atomic bombs.

France, Switzerland, and Sweden are other nations which might successfully undertake programs aiming at the production of atomic power or atomic bombs.

It has already been brought out by all scientists who have worked in this field and have spoken about it that there is no "secret of the atomic bomb" which can be permanently kept. The Smyth report and the fact that successful bombs can be made by several processes enable any nation attempting to build bombs to concentrate on one process and to start work simultaneously on separate phases of the problem.

The laws of nature await discovery by anyone properly qualified and equipped. Thus, all the basic scientific knowledge needed for the construction of atomic bombs can surely be obtained by any of several nations. The difficult technical processes that are involved in the manufacture have been, so to speak, "right up our alley," but we must remember that the Russians long ago held the world's record for long range airplane flights and that during the war they devised and built in quantity tanks as good as the best made in Germany.

They are now engaged in the construction of a large experimental plant, of the order of \$100,000,000 to operate a blast furnace with

oxygen instead of with air. They have plans for using oxygen for all their blast furnaces at a possible cost of \$2,000,000,000. Such undertakings prove an ability to carry out large complicated projects like that needed in the development of atomic energy.

We must consider also that the Russians have continued the training of scientists during the war to a far greater extent than we have. Furthermore, they have available, in any atomic energy program, the knowledge and technical skill of German scientists and technicians. Russia certainly has ample resources in uranium.

If Russia decided that the incentives were great enough, she could mobilize her resources on such a program, just as she did between 1934 and 1939 in her preparations for war with Germany, and getting her people to forego a higher standard of living, devote 10 percent or more of her total production capacity to a 5 year atomic energy plan. Before the war the United States devoted about 0.04 percent of its national income to research and this increased to perhaps 0.5 percent during wartime. That is excluding the atomic bomb project.

National prestige at home and abroad may well induce nations to undertake atomic energy programs. A still greater incentive, however, can be furnished by the feeling of insecurity which results from our possession of atomic bombs and from any failures we have made or may make in the future in establishing the "atmosphere of reciprocal confidence in which political agreements and cooperation will flourish."

The insecurity which Russia may feel as to our possible use of atomic bombs may well be based on a misunderstanding of the American people and of our Government. But we also have much misinformation regarding Russia. What can we expect when, according to a recent letter from Moscow by Edgar Snow, there are only 260 Americans in all of Russia and only 2,000 Russians in the United States? How many Americans read or speak Russian? The Russians have recently taken a great step in fostering understanding by starting to teach English to all Russian children.

We can better understand Russian doubts about our policy of holding atomic bombs as a "sacred trust" by asking ourselves: What would American public opinion now be if we had had no atomic energy development but, near the end of the war, atomic bombs had been dropped on Berlin by the Russians without warning? Would our insecurity have been entirely relieved if the Russian Government, a few months later, had announced that it held an increasing stock pile of atomic bombs as a sacred trust?

It is thus reasonable to believe that the insecurity, which Russia may feel for the future, acts at the present time as a very powerful incentive to build her own atomic bombs.

If, in this way, an atomic armament race develops, I believe the Russians will produce their first atomic bombs in about 3 years. Thereafter, however, there is a definite possibility that the Russians might accumulate atomic bombs at a far faster rate than we do. The following factors give them certain advantages in such a race:

1. They have a larger population and it can be regimented, and is willing and has been trained to sacrifice living standards for an extensive defense program.

2. They have a remarkable system of incentives which is rapidly increasing the efficiency of their industrial production.

3. They have no unemployment.
4. They have no strikes.
5. They have a deep appreciation of pure and applied science and have placed a high priority on it.
6. They have already planned a far more extensive program in science than any contemplated by us.

These conclusions are based in part on my own observations of scientific work in Russia made when I attended the two hundred twentieth anniversary of the founding of the Academy of Sciences of the U. S. S. R. in Moscow and Leningrad last June.

Ever since 1933 the Russians have lived in a state of insecurity. During the war, as their armies became victorious, they looked forward confidently to an end of their insecurity. In June I found that all the scientists with whom I came in contact expected a long era of peace in which the devastated industries and territories could be repaired and then their standard of living could be raised to a level as high or even higher than that in America.

The atomic bombs in August must have shattered such hopes and brought back a state of insecurity like that of the years 1933 to 1939. I believe the impairment of the relations between our two nations since that time is a reaction to their disappointment regarding future security.

The security which we now possess through the possession of atomic bombs will thus be short lived. It will probably end completely within 5 or 10 years if an atomic armament race continues.

I believe all of the United Nations now desire future security above almost anything else. During this period of 5 or 10 years it is of vital importance that steady progress be made to develop means for the effective world control of atomic energy. Any steps that reduce insecurity will tend to remove incentives for an all-out atomic armament race and will thus extend the time available for the working out of the completely effective control mechanism. It is thus essential that such steps be started as soon as possible and that they be followed as rapidly as possible by other steps that will develop world confidence.

The November 15 declaration by President Truman and Prime Ministers Attlee and Mackenzie King is a most constructive program aiming at this world control of atomic energy. I hope that the Governments of the United States, Britain, and Canada make immediate contacts with the Russian Government to secure, if possible, their tentative agreement instead of relying solely on the more cumbersome machinery of the United Nations Organization.

I believe that this declaration will receive the wholehearted support of all Americans. The council of the National Academy of Sciences on November 15 approved unanimously the declaration of that date.

Although I believe that this program will ultimately succeed, we cannot now foresee how long the step by step progress toward effective world control of atomic energy will take. In the meantime it is essential that we have adequate but wise national control. The proper objectives of legislation designed to this end may be considered under the following headings:

1. The legislation should conform to and support the program aiming at world control as outlined by the November 15 declaration.
2. Security regulations which attempt to maintain secrecy in any fields of fundamental science must not be contained in this legislation.

Any such secrecy as we had during the war under military control would stop nearly all progress in those sciences. We may hope that other nations will reciprocate in an exchange of scientific information but whether or not they do, it is to our advantage to see that fundamental scientific knowledge is published as soon as possible.

At the June meeting of the Russian Academy of Sciences many Russians, as well as scientists of other nations, expressed the view that fundamental science had always been international in character and that everyone had profited by the cooperation and good will among scientists. All expressed hope that such cooperation would always exist.

Even during wartime the secrecy regulations in matters of fundamental science were not lived up to. Most of the scientists working on the atomic bomb project frequently had to violate the regulations to exchange information with one another in order that the work could get ahead effectively. In peacetime such regulations would be completely unworkable for any attempts to enforce them rigorously would drive all able scientists out of the field.

As an example of the ineffectiveness of military security regulations even during the wartime, I should like to tell of an experience of my own.

I had had only a trivial connection with the atomic bomb in some consultations I had at two of the laboratories during 1942 or 1943. I had been invited to Russia in May 1945, had accepted through the Soviet Embassy, had received my passport, and was told that the American delegation would be taken to Russia on a C-54 plane with transportation arranged by the State Department and by the President. The day before we were scheduled to leave two Army officers, who did not know on what grounds the request was based, asked me to decline to go to Russia. This would have meant that I would have had to invent excuses on my own responsibility. Since there appeared to be direct conflict between the War Department and the State Department, I refused to withdraw my acceptance at the request of the War Department and demanded that the matter be taken up with the State Department canceling my passport if necessary. I wholly disapproved of the manner in which this matter was handled. When others interceded and the War Department was made to realize how little I knew of the atomic energy project, I was finally allowed to go. Other Americans, however, who had been invited, were not permitted to go after having accepted.

This, of course, the Russian Embassy knew. They knew also that no physicists were among those who accepted the invitations.

When I reached Russia I was told by the English group that eight British physicists, who had accepted the Russian invitation, had had their passports canceled after they had reached the airport ready to fly to Moscow. All of the scientists and the whole of the British delegation were much incensed at these tactics. They believed that the passports were canceled because these men had worked on the Tuballoy project, which is the equivalent of our Manhattan project. I also heard the opinion expressed that this action must have been taken at the request of the American Government because no one outside of the American Army could be so stupid.

The English newspapers gave great publicity to the cancellation of the passports and called Prime Minister Churchill to account

before the House of Commons. This was all known in Russia, but it was never published in American newspapers.

I believe that these attempts to maintain secrecy resulted in giving to the Russians the very information which the Army most wished to keep from them. Any sensible Russian scientist knowing of these facts would have believed that we were developing an atomic bomb and were keeping it secret from the Russians.

3. Everyone agrees, I believe, that security regulations are needed at present to cover the manufacturing processes for making the materials used in the atomic bombs and, particularly, the details used in the construction of the bombs. These, however, should not go beyond those which are common in the manufacture of war weapons.

4. Fundamental research in nuclear physics should be stimulated and supported in universities, in Government laboratories, and in industrial laboratories. This may perhaps best be done through the machinery that will probably be set up through the science legislation, such as that proposed in the Kilgore-Magnuson bill.

5. Research, engineering, and development of better methods of manufacture of materials capable of releasing atomic energy should be planned on a large scale.

6. The peacetime utilization of atomic energy requires that the Government should furnish to research workers in this, as well as in other countries, materials such as radioactive substances and sources of neutrons of moderate intensity. This will greatly increase the rate of progress of scientific knowledge in this field. The results of all work done with these materials should be published.

7. As I pointed out previously the development of atomic power is of secondary importance. Exploratory, large-scale experiments should, however, be made to find what the possibilities are. It will probably be many years before profitable large-scale developments can be made from these experiments.

That ends the prepared part of my statement, but I would like to add a few more paragraphs.

The CHAIRMAN. Go right ahead.

Dr. LANGMUIR. Much fear has been expressed about the possibility of control of atomic power by monopolies. I think this will not be a possibility for many years. At present and for a long time to come, it is not an attractive field for industry. The possibilities should be explored, but obviously all rights should be retained by the Government.

Later, it might be necessary to help industry get started on applications of atomic power, if and when such developments become desirable, which I think will only occur after we have some form of international security.

I would like to add an eighth section.

The organization of the board to control atomic energy and the form of its administration is something that I do not feel qualified to pass judgment on. These are matters that our Senators and Representatives must decide.

I do feel, however, that the organization should be one which encourages cooperation on the part of scientists and places upon them a full share of the responsibility for planning and carrying through scientific programs. In particular, the scientists should participate in

the establishment of all security relations, for they are more likely than others to understand the harmful effects of unduly severe restrictions.

I spoke in one section about coordinating the work of the atomic energy board with that of the National Science Foundation, which may be set up under the Kilgore or the Magnuson bills when they become law.

There are two ways in which that can happen. First of all, it is very important that work in fundamental nuclear physics should be continued. The National Science Foundation will naturally have an organization that will be able to plan such work through universities and other laboratories, and it seems unwise to duplicate any such work through two organizations. Therefore, it seems to me that this organization of an atomic energy control board should operate through any science foundation for fundamental research work on nuclear physics.

Dr. Urey yesterday thought that it would be undesirable for the atomic energy board to operate laboratories. I think that is perfectly true, for laboratories such as those can be operated by the National Science Foundation.

However, I think we must recognize that any manufacturer of materials for atomic power or bombs will continually need research work of a semiskilled kind, which should be done in intimate contact with the production facilities. In other words, any organization that manufactures these materials should have connected with it a laboratory which studies processes and even develops new methods or the possibilities of new methods, and so it would be very essential for this board to operate laboratories in connection with those industries.

The other point where coordination is needed between these two boards is in regard to the training of scientists. Any extensive atomic-energy program means that we must have students coming along who are enthusiastic to work along the fields of nuclear physics.

The CHAIRMAN. Doctor, you would agree that the move taken, as reported in the press this morning, about deferring young men who have peculiar scientific ability, was a good one, would you not?

Dr. LANGMUIR. It is excellent and very important for these reasons, it seems to me: It is a very important part of the atomic energy program to coordinate the work with that of the National Science Foundation.

I have attended one of the hearings of the Kilgore-Magnuson committee and have been very favorably impressed by the way they have gone about these hearings, having 4 weeks of hearings, bringing in the best scientific opinion with free discussion.

Scientists have been almost unanimously agreed on the importance of the Government supporting and stimulating research on a very large scale under present conditions. There have been minor differences of opinion among them, but largely on the matters of administration which are things that automatically come down to Congress to decide and the President. I believe that whether or not the particular form of the board is a matter of discussion, it seems to me that that is a matter of relatively minor importance.

Most of the scientists I think would favor the control of the foundation residing in the board largely of scientists who chose their chairman, but if that proves to be politically unfeasible or unworkable, if it couldn't pass Congress, for example, or would be vetoed by

the President, it seems to me in no case must such legislation be prevented.

The most important thing is that we have adequate support. The particular form that proves to be workable is a matter in which I think the scientists are only moderately qualified to express opinions.

Speaking of the educational program for training men in nuclear physics, it seems to me there again we see how vitally important it is not to have secrecy in fundamental science. Think of a professor trying to get students interested in starting research work on nuclear physics when the professor perhaps has been connected with the project and knows a lot of things which he cannot tell the students because of security regulations. The students would know that immediately, and the professor would have to explain that that is a thing which he could not talk about; yet perhaps that is the thing that the student wants to work on, and it would absolutely stymie the whole educational program if the professor were not allowed to talk freely about fundamental science as well as other fields. Otherwise, students would be diverted from that field and would likely work in a field where they could discuss things freely and receive scientific stimulus.

This smashing of the cyclotrons is another feature that goes along with secrecy. I think it is a great mistake. In the future, it seems to me that will be compared with the burning of the books in Germany, or with legislation that occurred years ago forbidding the teaching of the theory of evolution in one of our Southern States. That is totally unnecessary. The cyclotron is not a device by which you can make atomic bombs; you can simply gain knowledge. Interference with the gaining of fundamental knowledge is always an unwise procedure.

I attended the hearing yesterday and heard Dr. Urey's testimony, and there are a few points there that I would like to touch upon and amplify to some extent.

In general, I agree completely with everything Dr. Urey said. He mentioned that in an atomic armament race there would be three stages. I would like to consider that there might be a fourth stage, and I would like to tell you what that is.

The three stages he spoke about are these:

1. We alone have atomic bombs. We are then secure at that time.
2. Other nations also have atomic bombs, but they haven't enough to destroy all our cities; but we have enough to destroy all of theirs. We are still relatively secure, and nobody is likely to start an attack under those conditions.
3. Two or more nations have enough bombs to destroy all cities, perhaps 10,000 bombs of the kind that we have now. That will probably come in an armament race. Retaliation, however, would be expected and that would be a deterring factor, but perhaps not decisive.

As was mentioned yesterday, and I think discussed by General Groves, 40,000,000 people might be wiped out in the United States by an attack of that kind, and it would not help us much to destroy 40,000,000 people in the Nation of attack.

The CHAIRMAN. Do you believe, Doctor, that any nation which suffered that kind of catastrophe could proceed with a war?

Dr. LANGMUIR. No; I think it would be crippled for perhaps hundreds of years, and with far less than 40,000,000 people. The 40,000,000 people that would be killed would be those that are in cities where

industries are located. The whole of the Government would be wiped out, all our railroad terminals would be wiped out, and we would have to go back to living, as in the case of colonies, on the farm to survive as best we could. We might fight atomic bombs with pitchforks, but it is not a good means.

When we have lost 40,000,000 people it may be that the other nation still has again as many atomic bombs; so, if we start to construct plants to build such bombs, they would be destroyed one by one. It would be complete annihilation of the whose existence of the country as such.

There is, however, a fourth stage which would automatically come sooner or later in any unlimited armament race. We can confidently assume that there are going to be discoveries made in this field. They may be made 4 or 5 years hence. They may be made 10 or 15 years hence, but it is almost certain that we will have atomic bombs a thousand times as powerful as those that now exist by means that are now undiscovered.

It could be done by a cheaper means of production. Instead of producing 10,000 bombs, it is conceivable that by cheaper means of construction you could have 300,000 bombs.

That would be enough to treat every square mile in the United States the way Hiroshima was. There would then be no retaliation. There wouldn't be 60 percent of the people left; there might be 2 percent of the people left, and under those conditions you can see what happens in the world.

Having wiped out one nation, the aggressor nation would then feel it necessary to control all others. There would be only one nation that could exist, and it has to operate the world possibly as a slave factor, or if they are troublesome wipe them out altogether.

It is a perfectly horrible state of affairs to look forward to, and yet it is the thing that will inevitably come sooner or later.

We cannot predict what discoveries are going to bring. We cannot predict whether we will be the one who gets to the fourth state first. It may be even a small country that succeeds in doing that by discovering bombs a thousand times more powerful, and perhaps cheaper. If they discover that first, and if they become aggressors,—and they are almost sure to become aggressors, because the state of uncertainty of the world at that time would simply be intolerable—you would be almost forced to take action under those conditions before the next fellow gets to that stage where he could destroy the entire nation in one blow.

Dr. Urey gave a very excellent discussion of the effective methods of world control and said, and I agree with him, that inspection will be one of the things that will be necessary, mutual inspection, inspection which is desired by all nations and not forced upon some nation but really desired for their own security.

One of the things that will be important in the preliminaries of the discussion is exchange of scientists on an informal basis first, and later a closer and closer cooperation.

When I was in Russia in June, I found that the Russian scientists spoke far more freely than we were allowed to speak. We were told we could not say certain things, but the Russians frequently told us the very things we were not allowed to tell them. There seemed to be

no restrictions on this field of pure science. We didn't get into industrial applications, for that was not in the field of the Academy of Sciences.

When you go to Russia and you find that Kapitza, Fersman, Frenkel, and Joffe—all of those men who are working on problems that have nothing to do with atomic energy—when Joffe tells me and shows me the cyclotron started in 1938, work on which was discontinued during the war and is now just starting again, and tells me the cyclotron will be finished in December of this year—and he is the most prominent physicist that has had anything to do with nuclear physics—when you see that, you are convinced they are not carrying through a Manhattan project.

Later, if we had international control and if our scientists could visit one another, it would be obvious that if any large scale atomic project were under way, scientists would disappear and it would be impossible to reach them. That would be one of the first indications and one of the most powerful things in international inspection and control. Later, it would have to be followed up by visits to factories.

As Dr. Urey pointed out, if you were going to have factories that make these fissionable materials—uranium 235 and plutonium, on a large scale for power production purposes, and those plants could be converted within a short time, possibly within a time so short it could hardly be detected, if those could be converted in a short time to the production of atomic bombs, the difficulties of inspection are tremendously increased.

If there are no such large factories, it would be relatively easy to find that a factory is being built for large scale production, for that could be seen by simple observation from the air. With the disappearance of certain physicists and the construction of certain mills for the making of all kinds of materials, it would be relatively easy to find.

Others will feel the same need for security that we do in that field, and if we reach a point where through agreement with other nations it seems we might have international control, it may well be that others will agree that control would not be satisfactory if we have large plants for making plutonium for peace time purposes or allegedly peace time purposes, like atomic power, while they have practically none. That would not mean security for the other nations.

Under those conditions, as Dr. Urey pointed out, it would be far better for us to forego completely any production of atomic power. But I want to go a step further; I say we ought to be willing and even consider that possibility now that when the time comes that it looks as though international cooperation or inspection would be possible, and if at that time it appears that the destruction of our plants, the renunciation of any power applications, the destruction of the bombs that we have and even all reserves of the fissionable material that could be used for peace time purposes was advisable, it may be highly desirable to destroy all of that in order to put ourselves equally on a basis with other nations.

We, of course, would not do that until we were satisfied that the control mechanism is adequate.

Senator MILLININ. I did not understand, Doctor, to what you referred when you said we should destroy something.

Dr. LANGMUIR. In order to be on a par with any of the other nations that might want to agree with us, we cannot be on a par if

we say 5 or 10 years hence, have a stock pile of bombs that we have accumulated during 10 years. It would not be sufficient to take the plutonium out of those bombs and say, "We are going to use it for power purposes," because within six months we could put it back into bombs.

It seems the only way we could be on a par with another nation that had not been manufacturing these materials on the same large scale that we have, in order to accomplish that result, would be to offer to destroy the whole thing, drop it all in the sea, destroy our plants, destroy our bombs, and destroy all reserves of materials in spite of the fact that they probably will cost us \$5,000,000,000. Five billion dollars is not an unreasonable price to pay for any adequate form of world security, and we must all look to having world security because the alternatives are simply appalling.

Senator HICKENLOOPER. As I understand it, you are discussing that phase of it solely from the standpoint of a military weapon, a military threat. In other words, you would not carry it further and say that our country having more automobiles than any other country in the world, we should destroy our automobiles down to the number existing in another country?

Dr. LANGMUIR. I am talking merely about the atomic bomb at present. The point is that you cannot have atomic power, or that you cannot keep plutonium which you have stored up and made during 10 years. You cannot put that anywhere in the world where it will not destroy the security of every nation. You could not agree to put it in Africa. You could not hold it in Canada. You could not do anything with it except completely destroy it.

The CHAIRMAN. You would not want the Security Council to hold it?

Dr. LANGMUIR. I wouldn't, because it is no good for police action. I don't say we should do this now. I say, if it should turn out that security or satisfactory world security should depend upon the destruction of that, then, for heaven's sake, let's destroy it. It would be a cheap price to pay.

However, if it progresses ahead fast enough, it may be we can come to some agreement which we cannot now foresee, but in five or ten years we may easily come to some agreement where it is decided to retain it only if we have safeguards that will prevent it being turned into atomic bombs.

Senator HICKENLOOPER. Wouldn't we run afoul of the very human tendency in the history of progress that no material advancement has ever been discarded by the human race?

Dr. LANGMUIR. This is quite a unique thing. It is a million times more dangerous than anything we have had before. That is the dominating factor.

Senator VANDENBERG. Suppose you could not get a satisfactory agreement. Then, what would you do?

Dr. LANGMUIR. Then I certainly would not give up the atomic bombs. I think under that condition you would have a 50-50 chance of being the one that wins the next war, maybe. But that is not satisfactory; there is no security in that. This whole insecurity problem is intolerable and will remain so, and sooner or later the nations will all agree that that has got to stop.

For that reason, we must make sacrifices, and it would not be too much to have us sacrifice in order to give security to other nations, to put ourselves on a par with them. In fact, I cannot conceive of an agreement with any other nation by which we would not start off as equals.

Senator AUSTIN. Mr. Chairman.

The CHAIRMAN. Senator Austin.

Senator AUSTIN. Taking your testimony as a whole, in connection with this process you are developing now, isn't it the logical conclusion that we should go back to the position we were in before this discovery?

Dr. LANGMUIR. I don't think we can do it now. I was saying that all of these things should be done only when we have reached and obtained and perfected a mechanism which would give security, international cooperation, and development of the UNO to a point far beyond where it is now. Only when we can get in return for this action security to ourselves should that be done.

At present, if we should destroy our atomic bombs or our reserves or stop making it, we would be looked upon as suckers by some of the other people in the world who have no intention of doing any such thing. We would be the laughing stock of them and they would go ahead and take advantage of that position. We have to have security, or the promise of security, but the possibility of security may depend on that very thing, on our willingness to go back to equality with other nations that have none or have very little.

If it comes to that, then we should be prepared. We do not have to decide these things now, but I want to see this legislation designed in such a way that we preserve the freedom of action. Congress has got to decide these things now. All it can do is pave the way now going in the right direction, but we should have the vision ahead of us, and in that vision we should preserve our freedom of action. We don't, if we stop making bombs; and I don't think any nation now would expect us to stop making bombs, because they would not do it, if conditions were reversed. But we ought to stop making bombs if and when world organization progresses to a point where everyone wants security so much that they are willing to make real sacrifices.

Senator JOHNSON. Dr. Langmuir, how do you compose your two different viewpoints? On the one hand, you say that this country should appropriate \$5,000,000,000 for scientific research; on the other hand, you say that this country should destroy \$5,000,000,000 worth of the products of science.

The scientists, according to your testimony, have made the world extremely insecure. Science has made, according to your statement just now, aggression inevitable and yet, at the same time, you say that we ought to keep on pouring money into science.

Dr. LANGMUIR. Science is not a thing that we make; scientists don't create science in that way.

Senator JOHNSON. But you create atomic bombs, and now you want to go and throw them in the middle of the ocean because they have made the world insecure.

Dr. LANGMUIR. In order to get security—in other words, we buy something by that. It is a price. You cannot get security for yourself without giving to other nations.

We have no security now for the future, because we are in stages one or two. We are now secure, but we can foresee the case that this security is only temporary, that the time will come when not only we but no nation is secure, and we must do something about that. We must start now to do something about it, because otherwise disaster lies ahead, probably a worse disaster for us than anyone else.

Senator JOHNSON. It looks to me as though you scientists have made the world extremely insecure, and now you are coming to the politicians and asking us to go about and make the world secure again by some sort of a political agreement.

At the same time, you are asking that the scientists who made the world insecure be given further appropriations to discover still another and more terrible destructive element than atomic energy.

Dr. LANGMUIR. But scientists did not go out to discover atomic energy. You have absolutely no knowledge of what science may do. Science may more likely at any time develop a cure for cancer through the use of atomic energy. That is important, for it will save more lives in a couple of years than we lost during the whole World War.

Science is not destructive as a whole. Our standard of living, our whole existence of America, has been developed through science. The reason we won the war was the basis of our civilization, which has been developed through science.

Senator JOHNSON. Then, the atomic bomb was merely an accident?

Dr. LANGMUIR. An accident.

Senator JOHNSON. Purely an accident?

Dr. LANGMUIR. It was absolutely unforeseen.

The CHAIRMAN. Yes, but the scientists were put to work on it by the Government to do the job, and as good citizens they did the job. Isn't that your contention?

Dr. LANGMUIR. Yes. We cannot have a holiday in science because we don't like certain aspects of science, because science only discovers the facts of nature. The facts of nature are there to be discovered by anybody. England is not going to have a holiday in science, if we do; Russia isn't; France isn't; and if we stop progress and stagnate, we will deserve to be exterminated in 50 years. We would just be cluttering up the world uselessly.

Senator JOHNSON. Of course. I believe that with all my heart, and I am a coauthor with Senator Kilgore of the Kilgore bill. I believe our security lies in the laboratory and in scientific development; that is my religion, but I am unable to understand your two viewpoints.

Dr. LANGMUIR. I think it is one viewpoint.

Senator JOHNSON. It is my fault, Doctor. I apologize, but I am trying to get straightened out.

Dr. LANGMUIR. I think we have a situation where we are going to have future insecurity unless we do something beginning now.

Senator CONNALLY. Right on that point, we are all interested in devising some international plan, if we haven't already secured one, to preserve peace and guarantee security. A little while ago you went on to say what you would do until such time as we got that arrangement. Doesn't that always involve an uncertainty? We have to assume we have got it, but maybe we haven't; there is no perfect agency, and that would be a risk.

Dr. LANGMUIR. We haven't now, but I have a strong feeling that this situation is going to get more and more critical, and if we do not find some solution—

Senator CONNALLY. The point I make is that you think you have got one, and maybe you haven't. That is a risk we have got to take.

Dr. LANGMUIR. But it is not as big as the risk we are now taking if we do not do anything.

Senator CONNALLY. You have got to be practical. You are going to base it on an international agreement, and on the belief that all members will honestly and in good faith carry out their obligations.

Dr. LANGMUIR. I don't want to depend on an agreement at all. I want to depend on a working mechanism, such as inspection.

Senator CONNALLY. I don't care whether you call it agreement or mechanism, but the mechanism has got to be based on some agreement, of course.

Dr. LANGMUIR. On mutual desire for security.

Senator CONNALLY. We won't have anyone coming around inspecting us until we agree to it.

Dr. LANGMUIR. That is right.

Senator CONNALLY. I say that there is an element there which we have got to take a chance on. Some nation might agree and then not live up to it. That is true, isn't it?

Dr. LANGMUIR. Then, our Congress and our people have got to decide whether the security is worth the risk we take, and we cannot decide that now, because we do not know what those provisions will be 10 or 20 years hence.

Senator CONNALLY. It is easy to say that we will make an agreement and settle everything, but we have got a practical problem.

Dr. LANGMUIR. The alternative is a war of atomic energy, which is worse than anything else you can think of.

Senator CONNALLY. Unless we have more atomic bombs than anybody else.

Dr. LANGMUIR. That would not help much.

Senator CONNALLY. I am not advocating that, but I am looking to the future and the problems we have got to face. There are a whole lot of people that say, "Yes, we will just solve that by writing it out, and that settles it."

If you are implementing these things, like we are trying to do now before the Senate, taking a week to do something that should take a day, you will find out. You can't do it in a laboratory.

The CHAIRMAN. Doctor, I think it is rather important that you comment, if you will, on Senator Connally's statement that having more bombs than anybody else gives any security.

Senator CONNALLY. I withdraw that if it is going to disturb the chairman.

The CHAIRMAN. It doesn't disturb me, but I think it ought to be answered for the record.

Dr. LANGMUIR. As I said, in stage 3, two or more nations will have enough bombs to wipe out all of the cities of the other, and you can be sure they will have them so placed that when we do wipe out the cities of the other nation we will not destroy the site from which bombs are launched. Therefore, there will be retaliation which will result in destruction of practically all of our cities.

If we had twice as many bombs, then we could go into the open spaces outside the city.

Senator CONNALLY. Just a minute. I predicated that on your question that we would try to arrive at some arrangement and some mech-

anism to prevent it. You then volunteered the alternative would be an atomic war in which we would be destroyed. I merely volunteered the statement, "unless we had more bombs than the other fellow."

It was predicated on the fact that when and if the war occurred—I am not advocating the war.

Dr. LANGMUIR. No, but, you see, having more bombs is of little importance. If some other nation had enough to destroy all our cities in one blow and we have twice as many, it doesn't do us any good.

Senator CONNALLY. Of course not. If we have another Pearl Harbor, it won't do Pearl Harbor any good to be destroyed before we act.

Dr. LANGMUIR. But we can have no security unless we have something like 100 times the number owned by another country, and then we get to the fourth stage.

Senator VANDENBERG. But you would agree with Senator Connally that an agreement per se is not so certain?

Dr. LANGMUIR. No.

Senator VANDENBERG. We have got to have a mechanism which justifies reliance on the agreement.

Dr. LANGMUIR. The Senators know that far better than I do. I agree with them.

Senator VANDENBERG. Is it your opinion that it is possible to implement inspection and control to a conclusive degree?

Dr. LANGMUIR. I think so, if the mutual desire for security is large enough.

Senator VANDENBERG. That is a pretty big "if".

Dr. LANGMUIR. No, I think it will automatically come when several nations have atomic bombs, and because of that insecurity will arise; and I think the demand for security will be such as to make a real desire for inspection. Other nations will almost want to insist on inspection of our country, and will have to have inspection of their own. Then, we have to find effective ways of doing it.

One of the most constructive suggestions that I have heard in this inspection business is Dr. Urey's suggestions that we have no plants for peacetime applications of atomic energy or atomic power pending that time when we have really come to the agreement that we know from methods we cannot yet conceive of that there really is world security. We have no security. We don't fear any danger of New Jersey attacking New York by atomic bomb. The time may come where all over the world you have such a state of world affairs that you no longer have any insecurity. If that exists, that is the time to develop atomic power.

Senator VANDENBERG. I would like to project your prospectus just one step further, to see what your answer would be.

Suppose we have this agreement. Suppose we have the mechanism and we are all pretty well satisfied with it, and suppose the inspection discloses that country A is violating the agreement. What are we justified in doing, and what would we do?

Dr. LANGMUIR. We do what we decide to do at that time, probably go to war if we have much sense, which is what we would do if we didn't have the agreement.

Senator MULLIKIN. Did I understand, Doctor, that you couple with inspection a universal intent, having no exceptions, that there shall be no violation of the peace?

Dr. LANGMUIR. I did not get the first part of your question.

Senator MILLIKIN. I understood you to say, in reply to a question by Senator Vandenberg, that you rely on inspection plus a universal intent to preserve peace.

Dr. LANGMUIR. And desire.

Senator MILLIKIN. Would you say that that would involve a fundamental change in the human nature of the rulers of the world and of the peoples of the world?

Dr. LANGMUIR. I don't think there is any change in human nature. I think the thing would be done for purely selfish interests among the peoples of the world. If it comes about, it will be the most constructive thing that has ever happened from the atomic bomb, far more important than atomic energy. It will have brought a state of world peace.

Senator MILLIKIN. Of course, I agree, Doctor, if it comes about. I am now trying to prove whether it has a chance of coming about through the selfishness, the greed, and the ambitions of unscrupulous rulers, and sometimes, of aggressive peoples.

Dr. LANGMUIR. I don't think there is any certainty that it will come about. I think it is a very well based hope that it will come about and never could have come about except through the atomic bomb.

Senator MILLIKIN. But if it does not come about completely, then we are right where we are now. Is that not correct?

Dr. LANGMUIR. Yes; if the thing is not effective, we are as bad off as if we had not started.

Senator MILLIKIN. In the meantime, we have disposed of our bombs?

Dr. LANGMUIR. No, we will not dispose of our bombs until we have a different attitude. We cannot now decide that we are ever going to dispose of our bombs.

Senator MILLIKIN. Until we are thoroughly satisfied that there are no unscrupulous rulers in the world and there are no people who desire war?

Dr. Langmuir. I don't know what we have to decide. We simply have to be satisfied 5, 10, or 20 years hence that that is our best bet.

Senator MILLIKIN. Doctor, I suggest we will have to base ourselves more solidly than that, because we are just talking theories in that event.

Dr. LANGMUIR. No, it will not be done until we believe that things have been accomplished.

Senator MILLIKIN. That is my point. I suggest that we may have to wait eternally for that point, and in the meantime this threat you speak of is in our hands.

Dr. LANGMUIR. I don't think it is eternally. I think the thing will come to a crisis within 10 or 20 years, and it has to be decided by then or else we will have a war.

Senator CONNALLY. According to your view, the industrial use of atomic energy—according to the dangers you point out—is a secondary matter, isn't it?

Dr. LANGMUIR. Almost trivial.

Senator CONNALLY. If we didn't ever use an ounce of it for industrial purposes, it would be worth abandoning it?

Dr. LANGMUIR. For large-scale power purposes. I did mention that small-scale production, which offers no hazard, might revolutionize science and medicine and bring us some extremely important developments.

Senator CONNALLY. On the other hand, if you did permit the use for general industrial purposes, you would manifoldly increase the difficulties of inspection and holding the military aspects of it in proper control, wouldn't you?

Dr. LANGMUIR. Yes. I think it is very hazardous. I think we ought to consider that ultimate security or any world control will involve unforeseeable uses, but we don't have to answer those questions.

Senator CONNALLY. But we can think about them; that is what we are trying to find out, is to get the basis of all these things.

The CHAIRMAN. Doctor, if I understand you correctly, you believe that control is scientifically feasible?

Dr. LANGMUIR. Yes.

The CHAIRMAN. Now, then, the second question arises: Is it politically feasible?

I gather that you are confident that it is, based on the fact that all people in the world want security above all else, and therefore they will be willing to forego some rights that they might otherwise have in order to attain that security.

Do you think that that desire, and in fact the compulsion of the situation could be brought home to the peoples of the world by demonstrations of the power of this monster?

Dr. LANGMUIR. I think it would be very helpful at a later stage, no doubt, after people have begun to more or less forget about Hiroshima, when I think it would be well to have through the United Organization a test or demonstration under proper conditions so that people can see just what this thing means.

The CHAIRMAN. I believe plans are going forward in the Navy Department to make a test on naval vessels. Do you think it would be desirable if representatives of other peoples could see the results of that situation?

Dr. LANGMUIR. Yes, I think full world publicity should be given to it.

Senator HART. Doctor, I gather that you do not advocate again making the attempt at disarmament by example, similar to what we did in the early 1920's?

Dr. LANGMUIR. No; I do not.

Senator HART. Doctor, referring to your testimony about secrecy during the war and the incident when your passage to Russia was somewhat interrupted and you felt somewhat resentful about it at the time—

Dr. LANGMUIR. The way that it was done.

Senator HART. Were you worried, at that time, lest Germany solve the atomic fission problem and create a weapon sooner than we did?

Dr. LANGMUIR. No.

Senator HART. You were not at all worried?

Dr. LANGMUIR. Well, not seriously. It was a possibility, but improbable, I thought.

Senator HART. Now, certain numbers of people of course, as you know, were very decidedly worried about it; and some of them were carrying the responsibility for seeing to it that Germany did not get any aid from us in that.

As you look back upon it now, can you blame their state of mind for taking overprecautions, or what looked to be overprecautions now, but which had a different aspect at that time?

Dr. LONGMUIR. I don't blame the intent of anyone who carried through these security regulations. I think it was all done with the very best intent, but I think the details of it went far afield in the methods that they used in many cases.

I think this is one of them. In the first place, the implication was that I would be drugged or tortured in Russia, which I don't think is a reasonable one for anyone to make. I was willing to risk my life. A lot of people had warned me that 16 Poles had been invited to Russia and did not come back; and that we were 16 Americans and might have better luck. I did not take that seriously.

Senator VANDENBERG. That is because you were an American and not a Pole.

Dr. LANGMUIR. As a matter of fact, the 16 Poles never were invited to Russia, you know.

Senator HART. Did you hold those same opinions then that you have been expressing this morning as to the ridiculousness of various of the security measures?

Dr. LANGMUIR. Yes.

Senator HART. You thought at the time they really were ridiculous?

Dr. LANGMUIR. Yes.

Senator HART. Another thing, Doctor: You said in your statement that the fundamental scientific information should all be disclosed now. Is it your thought that in Dr. Smyth's book that has not been done on a very considerable scale?

Dr. LANGMUIR. Oh, the Smyth report only contains a small fraction of the fundamental scientific knowledge, and it was stated at the end of the Smyth report that there would be other reports of a similar nature giving further progress; and the President's declaration says practically the same thing, that from time to time there will be other releases of scientific information. I hope that is implemented.

Senator HART. Have not some of your colleagues in the scientific field stated that 85 percent of the knowledge was disclosed in that report?

Dr. LANGMUIR. I don't know what they said, but I would not agree to that. The qualitative information was given; the more detailed information was not given, and yet that information can be obtained by anyone. They are facts of nature. As was brought out by Dr. Urey, the day and place of D-day is something you can keep secret, but you cannot keep secret the energy released by the fission of plutonium, because anybody can try that. It takes time to set up the apparatus, but the answer is in nature itself, and not in our hands.

It is absurd to try to keep fundamental knowledge away from the human race. It cannot be done.

Senator HART. You are talking now about the future, Doctor. I was trying to get the record straight as to what did happen and the statement that 85 percent of the disclosure has already been done.

Dr. LANGMUIR. I think that is largely a matter of definition as to what aspect of knowledge you are referring to.

Senator HART. In speaking of Russia you gave two estimates. You said Russia might catch up with us within a period of 3 years, and then I think you gave a somewhat larger estimate at another point. In making either of those estimates, did you take into account the devastation that has already gone on in Russia and the amount of

work they have to do to restore before they can get ahead with anything?

Dr. LANGMUIR. Yes. Remember, the 3 years I gave was the time in which Russia could get her first atomic bomb. That would not be very important. It would take longer than that before she could reach one of these other stages. It would be more nearly 10 years, where we might have a serious uncertainty or hazard in the development of the atomic race.

Senator HARR. One last question, Doctor, in the political field.

You stated that you did not wish to wait for the United Nations Organization to solve this question of world security, that you preferred that it be done by Britain, the United States, and Russia. Would you care to elaborate on that?

Dr. LANGMUIR. I did not mean to imply that the thing should in any way not be done through the United Nations Organization. I think it must be, but I think we should explore the possibilities of having a receptive approach to the thing by Russia by informal discussions which I presume are taking place. I hope so, at least, because I think that to propose the thing in a formal way and to go through the regular procedures—that is, if the motion could be brought before the United Nations jointly by the United States and by Russia, it would probably be helpful. The way for that might be paved by some informal discussions, but I don't put a great deal of stress on that.

Senator HART. Thank you, Doctor.

Senator HICKENLOOPER. Having seen the proof, Doctor, that fission is possible on substantial scales, and having been admitted to this at least first dawning of this great field of energy, is there any reasonable possibility that science the world over could be prevented in any way from dabbling in this thing further and going on?

In other words, science is inevitably bound to go forward with further experimentation in this field?

Dr. LANGMUIR. It is like the Catholic Church trying to stop progress in science. It just can't be done, because the knowledge already is there to be found. It is in nature, and to prevent us discovering the facts of nature is a hopeless job.

Senator HICKENLOOPER. And science will go on exploring this field despite what politicians or anyone else attempts to do?

Dr. LANGMUIR. If you regiment them here so they can not do it, they will go elsewhere.

Senator HICKENLOOPER. Therefore, in the light of that probability and almost certainty, I take it that it is your view that agreements and commitments and arrangements, whatever they may be, are about the only hope of solution of this thing to prevent destruction?

Dr. LANGMUIR. And all we have to have is a step-by-step progression toward something. We cannot ask now for an effective method of world control, for that would make it impossible to attain, because you know you cannot get it. That is utopia.

Senator HICKENLOOPER. I get back then to bringing up a line of suggestion you made a moment ago. I think probably it was a remote suggestion that we might destroy or suppress this. I take it you think that probably would not be a very practical thing.

Dr. LANGMUIR. I think that it is rather likely that in the progress toward world control it will become a desirable step.

Senator HICKENLOOPER. That is to suppress the bomb?

Dr. LANGMUIR. If you are going to suppress the bomb, you must suppress all the materials to make the bomb, and even destroy them.

Senator HICKENLOOPER. You think that might be a likely step in the future?

Dr. LANGMUIR. Yes.

Senator HICKENLOOPER. In the face of the fact that the thirst of science for knowledge in new fields will continue?

Dr. LANGMUIR. That has nothing to do with the thirst for knowledge. The thirst for knowledge in science comes in insignificant amounts of this material. We would not destroy all of this material, only that in pound lots.

Senator HICKENLOOPER. Experimentation in fission would go on in spite of everything, wouldn't it?

Dr. LANGMUIR. Certainly.

Senator HICKENLOOPER. And if they can explore new fields in minute amounts, that is the way this bomb was started.

Dr. LANGMUIR. That takes a long time, and by that time we hope we will have such agreement or such desire for agreement that even those things will be an international cooperative effort.

Senator HICKENLOOPER. It may be an arduous job to get from the laboratory to full production, but it still is an incidental thing in connection with this whole field of exploration—that is, the mechanical and engineering end of getting from the laboratory in minute quantities to the ultimate production line in substantial quantities is only a mechanical detail?

Dr. LANGMUIR. A mechanical detail, but it is the major part of the whole problem.

Senator HICKENLOOPER. But it is arduous?

Dr. LANGMUIR. It takes a tremendous amount of time. It is the thing that took the most time in the Manhattan project.

Senator HICKENLOOPER. As the laboratories increase their knowledge and produce different types of materials, and things of that kind, isn't it reasonable to assume that the methods of producing it in quantity will become easier?

Dr. LANGMUIR. I don't think so.

The CHAIRMAN. Doctor, now that the science exists, even assuming that we adopt your proposal to do away with it in any quantity, but of course leave certain minute quantities for experimental purposes—

Dr. LANGMUIR. Oh, leave enough for one atomic bomb, if you like.

The CHAIRMAN. You still have to have, because of the existence of the knowledge of science, an international inspection force to see that it does not go past the stage Senator Hickenlooper has outlined; is that true?

Dr. LANGMUIR. Of course, the whole problem, all of these details that we are discussing, really emphasize that we have got to learn to live with our neighbors in this world. We have to, and it is a question of relations between human beings. That is the real problem and the problem that has got to be solved.

Senator HICKENLOOPER. I understand that is your premise.

Dr. LANGMUIR. The mechanism by which things are to be facilitated is what we have to discuss at present. I think the magnitude of the problem is such that it is either existence or learn to get along with other nations.

Senator JOHNSON. How are you going to get along with a Hitler, a Mussolini, or a Tojo?

Dr. LANGMUIR. We cannot, but who takes the place of Hitler now?

Senator JOHNSON. I don't know.

Dr. LANGMUIR. I don't either.

Senator JOHNSON. But I hope he is the end of that string.

Dr. LANGMUIR. As far as I can see, I think every nation—I don't mean the people of Germany want everlasting peace, for we cannot trust them; we cannot trust the people of Japan, and that will have to be handled in a separate way—but I believe all the United Nations desire security more than anything else, and that was not the state of affairs before this last war.

Senator AUSTIN. Doctor, it really narrows down to a very simple, or perhaps oversimple proposition. Your ultimate remedy for destruction involves corresponding action by all countries, doesn't it?

Dr. LANGMUIR. Yes.

Senator AUSTIN. Therefore, we are really on a spiritual basis with the thing. It is a question of self-discipline by nations, is it not?

Dr. LANGMUIR. That is right. I just cannot see how we can ever get world cooperation except on a basis of substantial equality. You cannot go to a nation and say, "We hold bombs in a sacred trust, and we want it to stay permanently that way; you have got to trust us, but we don't trust you."

That is not world cooperation.

Senator TYDINGS. Doctor, would you advocate that a solution for this problem would be attempted by the three great powers, or through the United Nations, or do you think it would be well to consider a world conference to deal only with atomic energy at this time?

Dr. LANGMUIR. I am a scientist, and I am not a statesman. I don't think scientists should be asked to be statesmen. However, they are American citizens and they can all be able to express their opinions.

Senator TYDINGS. None of us are statesmen; we only work to try to be.

Dr. LANGMUIR. I personally would like to see the development of the United Nations. It will have to go way beyond what it is now.

When I suggested an informal conference before the United Nations I did it more as a way to paving action to present the thing to the United Nations, not only from England and America, but also Russia, because those are the ones that are mostly involved in this problem, obviously. Those are the Big Four, the United States, England, Canada, and Russia; so let us be frank about it and let us therefore present this thing to the United Nations if possible as the desire of all those nations.

If it can be done that way, it will go fast. If it cannot be done that way, then let us handle it through the United Nations.

Senator TYDINGS. Maybe you missed my question. I mean to ask whether you thought through the Big Four, as you delineate them, or through the United Nations, there was the best chance of finding the solution to this problem rather than by some conference called particularly to deal with it on an international scale.

Dr. LANGMUIR. I would say through the United Nations.

Senator BYRD. Doctor, you stated in the paper you read that Russia had ample supplies of uranium. Has that been discovered?

Dr. LANGMUIR. I don't know much about it, but I have had several conferences with people who presumably know a great deal about it. It is brought out very clearly that uranium is a widely spread material. It is known that some of the biggest deposits in the world are in Czechoslovakia, and I presume Russia could get those.

Senator BYRD. Do you know of your own knowledge that there have been supplies discovered in Russia?

Dr. LANGMUIR. No; I don't know. It is an element that is widely distributed in small amounts.

Senator BYRD. I was not here when you made this statement: "Russia certainly has ample resources in uranium."

Dr. LANGMUIR. Yes; but she doesn't need much, you know.

Senator BYRD. Is there any other source of atomic energy except uranium?

Dr. LANGMUIR. Not that we know of at present, but in the future there may be.

Senator BYRD. I have often thought that the inspection and the policing of it could be done more by the materials, by inspecting the materials that are used, than perhaps by the factories. What is your opinion about that?

Dr. LANGMUIR. My idea is that the control or inspection would come first by contacts between scientists, and that through mutual desire you would then implement that by inspection of factories and possibly the elimination of large plants, and probably simultaneously with the inspection of all production of uranium. It would be very effective and relatively simple.

I think there would be politically less difficulty in that than there would in a great many other things.

After that has been done, as I go on and say in my paper—that is a thing on which public opinion can really take grasp—if you have once set up the machinery for that, it seems to me almost inevitable and automatic that you extend it to all weapons of war.

Senator BYRD. Where are the known deposits of uranium now?

Dr. LANGMUIR. I don't know much about it.

Senator BYRD. Then you are not certain they have been discovered in Russia?

Dr. LANGMUIR. Not personally, no; but I have heard through various people, from some people who I believe know, that there are known deposits in Russia.

Senator BYRD. I was told on good authority that no deposits have been discovered in Russia, but of course there have been in Czechoslovakia.

Dr. LANGMUIR. Yes; but when you think what a large fraction of the surface of the earth is covered by Russia, and how little we know about it and how much the Russians know about it, it is reasonable to assume that there are such deposits.

Uranium costs \$2 or \$3 a pound, and nobody was interested in amounts of uranium at that price; but, for the purposes of atomic energy, you could afford to pay a thousand times that much, and that entirely changes the situation. Instead of paying \$1 or \$2 to work up the ore, you could now spend a thousand times that. You could take ores that have a thousand times less uranium, and still get away with it.

No one knows how widespread these ores are which have a small amount of uranium in them which might become workable.

The CHAIRMAN. You just made an interesting statement. I take it that you believe that if we get an agreement to eliminate this most horrible weapon that it necessarily follows, if the nations agree to give it up, that they would be willing to give up other forms of armaments?

Dr. LANGMUIR. I think so. I think the whole machinery could be carried through, and it would be desirable. After all, if you have no atomic bombs and no weapons, you still have poison gases and you may have perhaps biological warfare and what not that might be almost as bad. You will want a good solution for the thing. The same kind of mechanism, the same desire, the same motivation would lie behind the complete renunciation of war.

The CHAIRMAN. In other words, you regard this as a catalytic agent that would bring to people of the world the determination to disarm?

Dr. LANGMUIR. I don't think personally we need to worry about those things. We must not make them issues at present, because we now know that the most important thing is the atomic bomb. If that were solved, we then would come back to these other problems which would be almost as bad. The difference is that atomic bombs could destroy a nation in 24 hours, and the others might do it in a year or so.

What we have done in this war, doing nothing in the way of preparation until the war came and then building up our defenses, is out with the atomic bomb.

The CHAIRMAN. We foresaw quick death; but you fellows think slow death might still be more attractive.

Dr. LANGMUIR. I think most people feel that slow death can possibly be averted; but if quick death comes, then you need not worry.

Senator TYDINGS. Doctor, as to your idea of disarmament, if we have civil wars such as happened in China, or unrest such as has happened in India for a long while, you would have dictators springing up pretty much if you had no armaments.

On the other hand, we all meet ourselves coming back sometimes, don't we?

Dr. LANGMUIR. We have a police force that carries guns or clubs, and I suppose you will always need something like that.

Senator TYDINGS. It seems to me that in big countries like India, China, Russia, the United States, or parts of the British Empire, that if you had no armies at all you would simply give hostage to new dictators who might decide not to stay in the United Nations, and it might be hard to track them down.

Dr. LANGMUIR. I hope the United Nations will have an organization that can handle the policing of the world; but it does not need atomic weapons for that purpose. You can not use an atomic bomb on India; you cannot use it on Java, for instance, or the civil war in China. That cannot be settled by atomic bombs. It isn't a suitable weapon at all, any more than it could be used against a city in Louisiana which decides to do something illegal.

Senator TYDINGS. Suppose some man, though, wants to call a mob to his colors and start marking on the capital; what would you do about it under the United Nations? What is your conception of it even without the atomic bomb?

Dr. LANGMUIR. Well, haven't we a police force?

Senator TYDINGS. Suppose some leader arises in one of these countries and surrounds himself with a lot of reckless spirits and starts to march on the capital. That would be civil war. Would we have a right to interfere in the internal affairs of another country?

Dr. LANGMUIR. I think that has got to evolve. The United Nations, I think, is going to evolve faster than anybody had any idea of.

Senator TYDINGS. I hope you are right.

Dr. LANGMUIR. What form it will take, or the possibility that it may not take a desired form, cannot now be considered as a reason for not making progress. We cannot predict the future.

Senator CONNALLY. Doctor, as I get your testimony, you think that ultimately the abolition of the bomb would result in probable disarming in other respects; but I don't understand you to mean that before we do anything about the bomb we have got to agree on all these other weapons.

Dr. LANGMUIR. I say the opposite.

Senator CONNALLY. If we could deal with the bomb and make a success of that, then you think that would give cause for spreading it still further?

Dr. LANGMUIR. The machinery set up for handling the atomic-bomb security could be such, if it worked over a period of years, that there would be an inevitable desire to have that apply to all other forms of war.

Senator CONNALLY. I am trying to get the point that you would not do all that with one stroke, because if you did you could not do any of it.

Dr. LANGMUIR. I think even the first thing is a matter that no final decision can be reached on in the next 10 years. It may take 10 years to get to that stage by constant effort.

The other thing may take another 5 or 10 years, but to put those in as prerequisites will kill the whole program.

Senator CONNALLY. Now, you went on to say that there will be development of science, with which I thoroughly agree. You don't know and nobody else knows but what science in the years to come may discover other materials out of which this atomic energy can be developed.

Dr. LANGMUIR. I said I think it is probable.

Senator CONNALLY. Just the fact that you found one method and one group of elements does not shut the door on future developments?

Dr. LANGMUIR. Of course, the field has been pretty well explored and we have made really great progress; but, nevertheless, I believe it is probable that other forms of atomic energy will become available before the next war.

Senator CONNALLY. Thank you.

Senator JOHNSON. Dr. Langmuir, how long were you in Russia?

Dr. LANGMUIR. Eighteen days. The whole trip was 30 days from New York back to New York.

Senator JOHNSON. Did you see anyone there, or did you have conferences with anyone, or did you meet anyone outside of scientists in Russia?

Dr. LANGMUIR. Practically not.

Senator JOHNSON. Is it fair to base a conclusion on Russia and Russia's political intentions by these few scientists that you met?

Dr. LANGMUIR. No; certainly not. In 18 days you cannot get a very deep view of a country. Nevertheless, the things I did find were in so many cases so different from what I have been led to expect that it is rather interesting, I think.

What I meant to say is that the Russian scientists are people you can cooperate with; that I know, and that is a step. That is why I like to see in the President's declaration a statement that they are planning to exchange scientists with other nations. That would be a useful step.

Senator JOHNSON. All scientists, whether Russian, German, or American, from whatever source they may come, are internationalists in viewpoint; are they not?

Dr. LANGMUIR. A great many of the Germans were not.

Senator JOHNSON. The very nature of their science causes them to be.

Dr. LANGMUIR. A great many Germans were originally, but under Hitler ceased to be.

Senator JOHNSON. Of course they were regimented under Hitler.

Do you have any knowledge of the secrecy imposed by the Russian Army? I have been told on pretty good authority that the Russian Army did not permit any observers, even of their allies, to come within many miles of their battlefield to see their weapons or to see their military techniques at all.

Dr. LANGMUIR. And they did not come anywhere near our Manhattan project, so there was no cooperation in fundamental technique.

Senator JOHNSON. And you said, "because no one outside of the American Army could be so stupid."

Dr. LANGMUIR. These were British people saying that, not Russians. I am repeating something the British said.

Senator JOHNSON. And given it considerable emphasis?

Dr. LANGMUIR. Yes. They had had contact with the American Army; they had been here and they knew.

Senator JOHNSON. Do you agree with that statement, that conclusion of the British?

Dr. LANGMUIR. I think there is a certain amount of justification for it.

Senator JOHNSON. You don't think the Russian Army gives the American Army any competition along that line?

Dr. LANGMUIR. I don't know anything about the Russian Army, but I agree that the Russian Army did not disclose anything about their weapons.

Senator JOHNSON. That is your criticism of the American Army, because they were too secret?

Dr. LANGMUIR. No, not at all, but the way they did it. The way they did this was the thing that was so stupid, not the fact that these men were not allowed to come, but the whole way the thing was carried on was such as to disclose the very thing they wanted to keep secret. It was a blundering process, but it is the kind of blundering process that takes place when military people try to control secrecy in fields in which they are not adequately trained. They have done a wonderful job as to keeping secret D-day, but when they come to try to control scientists, they don't know how to do it and they make a mistake in thinking they can.

Senator JOHNSON. Does anyone else know how to do it?

Dr. LANGMUIR. I hope not.

The CHAIRMAN. Doctor, you know Mr. Kettering of General Motors?

Dr. LANGMUIR. Yes.

The CHAIRMAN. Did you see his observation that, "If you lock the doors of a laboratory, you lock out more than you lock in"?

Dr. LANGMUIR. I didn't see it, but it is good.

The CHAIRMAN. Looking to the international science and the freedom of exchange, we owe a good deal to the development in some very important fields to scientists in England, Germany, and other countries of the world, do we not?

Dr. LANGMUIR. Yes.

The CHAIRMAN. Do you know where DDT originated?

Dr. LANGMUIR. I think it first was discovered by a German scientist a long time ago, and then its insecticidal properties were discovered by someone in Switzerland.

The CHAIRMAN. How about uranium fission?

Dr. LANGMUIR. That was done, I think, by Fermi—no, it was done in Germany.

The CHAIRMAN. How about synthetic rubber from alcohol?

Dr. LANGMUIR. I don't remember, but the Russians certainly have done a great work in synthetic rubber.

The CHAIRMAN. Penicillin?

Dr. LANGMUIR. England.

The CHAIRMAN. And jet propulsion?

Dr. LANGMUIR. Also England.

The CHAIRMAN. Radar?

Dr. LANGMUIR. England, and it was at least going on independently in the United States, but the English were the first ones to reduce it to practice and use it on a large scale.

The CHAIRMAN. Did you hear General Groves' testimony?

Dr. LANGMUIR. I only heard yesterday's questioning and replies to the questions asked.

The CHAIRMAN. He testified that in his opinion there wasn't any nation that would, unaided, arrive at the production of atomic weapons within 20 years. I take it you don't agree with that.

Dr. LANGMUIR. I don't agree at all with it.

The CHAIRMAN. Doctor, have you any recommendations to make as to ways in which the research on cancer with radioactive materials, and other diseases, could be immediately stimulated?

Dr. LANGMUIR. Apparently the difficulty in cancer is that we don't understand it. We don't know what cancer is. We know that growth processes go in wrong directions, but we don't understand those growth processes.

By the use of radioactive substances, radioactive carbon, for example, and other radioactive elements that are now available relatively cheaply as byproducts of the production of plutonium, we get an understanding of chemical processes. The method is just being worked out, but it is sure to be amazingly successful in studying the complicated processes that take place in biology.

I believe that in a few years when a large number of physicists have these tools available and get to use them in routine work in the studying of fundamental problems, the rate of progress will be speeded up

manyfold over what it otherwise would have been. Although we might ultimately have reached a solution of the cancer problem in a certain number of years, now I think the chances are it will be reached in perhaps a third or a quarter of that time.

The CHAIRMAN. Common decency would require us, pending any arrangement for international control, to make some kind of interim arrangement to get small amounts of this material into the hands of men who can proceed experiment with it for the alleviation of these diseases?

Dr. LANGMUIR. I should like to see these materials given out, since we are the only ones that can produce them in reasonable quantity, not only to American scientists, biologists, chemists, and physicists, but also to those all over the world.

The CHAIRMAN. Doctor, you mentioned a project for cheap oxygen for blast furnaces being developed in Russia. Have we a comparable program in this country?

Dr. LANGMUIR. No, but I think the Russians have shown great vision in undertaking a program of that magnitude, and apparently with great success.

The CHAIRMAN. How did you find out about that?

Dr. LANGMUIR. It was told me voluntarily by Mr. Kapitza in Moscow.

The CHAIRMAN. Did he outline the program?

Dr. LANGMUIR. He told me a great deal about it.

The CHAIRMAN. Did he discuss the scientific details with you?

Dr. LANGMUIR. A great many of them. I talked to him altogether 2 or 3 hours on the thing, and he gave me practically all the information he could have given me in that time. He answered all my questions very frankly.

Since then, when I came back, we have been trying to get in touch with them to get more information on five or six things I saw in Russia away ahead of the rest of the world, and we have been trying, through the State Department, to get in touch with the Russians to get additional information and have had no success whatever.

Senator TYDINGS. How do you rate the Russian scientists as a body in comparison with the scientists of France, Sweden, England, and the United States? Are they about as good, generally inferior, a little better, or what—taking them as a whole?

Dr. LANGMUIR. Well, it is hard to put any definition on that thing.

Senator TYDINGS. The reason I asked you the question is that I have a hunch, without any knowledge of it, for I have no Gallup poll at my disposal, that the American generally thinks of the Russian scientist as being much inferior to the leading scientists of other countries. Is that true, or is it false?

Dr. LANGMUIR. There are some excellent Russian scientists doing very fine work, but the number of scientists doing such excellent work as compared to those in America or England—United States and England are certainly leading the world.

Senator TYDINGS. You would not say they are top-flight scientists?

Dr. LANGMUIR. I don't know just what you mean by that.

Senator TYDINGS. You mean some of the better ones in the world?

Dr. LANGMUIR. A few of them are right up among the best in the world; but on the whole the Russian scientists have suffered from lack

of good equipment, I should say, largely. Their laboratories, outside of Kapitza's laboratory, and some others who are building new laboratories, are equipped with the kind of equipment that would have been used in the United States 20 years ago.

Senator TYDINGS. Could Russia make those instruments, or would they have to buy them abroad?

Dr. LANGMUIR. Russia makes their own.

Senator TYDINGS. They have the precision tools, and so on?

Dr. LANGMUIR. Yes. In this oxygen development, for instance, that is really precision work, they have turbines and a lot of equipment there which represent a very high degree of mechanical perfection.

Senator TYDINGS. Let me ask you this question, which you have already covered, but pointedly: In your opinion, given a free hand under what you conceive to be the conditions and circumstances, how long will it be before it will be possible for Russia to turn out atomic bombs?

Dr. LANGMUIR. Well, I think I gave that.

Senator TYDINGS. Five years?

Dr. LANGMUIR. I put 3 years as about a minimum. That is, I put 3 years down, if Russia really seriously devotes her attention to it and starts on a big-scale production.

Senator TYDINGS. And they say publicly they are going to do that.

Dr. LANGMUIR. I haven't heard that statement.

Senator TYDINGS. Molotov made the statement that Russia would have the atomic bomb and more before long.

Dr. LANGMUIR. I think he said, "and other things."

Senator TYDINGS. That is right.

Dr. LANGMUIR. But he didn't say how big the project is.

Let me tell you about the project they already have.

The Academy of Sciences has six or seven institutes, and those are just for the rather pure scientific work, the basic science that underlies other things. We did not go to the industrial laboratories, of which there are a large number.

They have a new building for the Academy of Sciences, which has just fairly recently been completed, and they showed us pictures which looked to be about 10 times the size of that building which they are planning.

The whole emphasis that they place on it, the awards they give, the incentive system in pay and so on, all show that they place almost the highest priority on science.

In these meetings, they said that the whole future development of Russia depends upon application of science. They believe that the scientist should receive the highest possible facilities for his work, and they give the scientists the greatest freedom.

Senator TYDINGS. What countries do you envisage in the world that eventually would be capable of supporting a program for the manufacture of atomic bombs? The United States, Canada, or Britain, or Russia?

Dr. LANGMUIR. Of course, the United States already has the equipment and we know how to do it. We could extend that as far as we want. England, I think, has said she is planning to build them. Canada already has some plants for making some parts.

Senator TYDINGS. Russia would be fourth eventually?

Dr. LANGMUIR. Russia will be fourth at first. Russia, however, would far outrun England in the long run.

Senator TYDINGS. I am looking ahead 10 years or 15 years. What countries?

Dr. LANGMUIR. In 10 years, to my mind, it is very uncertain whether the United States or Russia will lead.

Senator TYDINGS. I am not asking who will lead, but what nations will be capable of producing atomic bombs if they make up their minds to produce them within 15 years?

Dr. LANGMUIR. Oh, many of them.

Senator TYDINGS. Well, name some of them.

Dr. LANGMUIR. France, Sweden.

Senator JOHNSON. Spain?

Dr. LANGMUIR. I don't know about Spain.

Senator TYDINGS. Czechoslovakia?

Dr. LANGMUIR. Undoubtedly.

Senator BYRD. Switzerland?

Dr. LANGMUIR. Switzerland would probably do it on a small scale. She would not have the necessary financial resources.

Senator TYDINGS. Germany, of course.

Dr. LANGMUIR. Of course.

Senator TYDINGS. Japan, when the military controls are withdrawn?

Dr. LANGMUIR. No, Japan, even if all controls are withdrawn, I think is going to be pretty weak.

Senator TYDINGS. But there would be some 8 to 10 of the leading nations within 15 years?

Dr. LANGMUIR. I would say in 10 or 15 years there is a possibility of German influence in Argentina, which might be very serious.

Senator TYDINGS. Suppose that eventually happens, and there are 8 or 10 nations that have these bombs, and nothing has been done—for the sake of illustration—to curb them or control them. In the next war, what happens?

Dr. LANGMUIR. I don't like predicting the future.

Senator TYDINGS. I would like to have it. I think we ought to have your views on this.

Dr. LANGMUIR. I think it is up to the United Nations to evolve the mechanism.

Senator TYDINGS. Some nation might violate its agreement.

Dr. LANGMUIR. As Dr. Urey said yesterday, the bombs may drop on Washington which will destroy the whole city, and simultaneously on Chicago, New York, and maybe some others, and everybody says, "Who done it?" Nobody knows, and never can find out.

The CHAIRMAN. There is no possibility of retaliation, because you don't know who to go after.

Dr. LANGMUIR. You don't know who to attack.

Senator TYDINGS. That is what I am trying to bring out. If 8 or 10 nations have these bombs and there is a formal declaration of war, not delivered in the Pearl Harbor style, what happens in the course of that war with the atomic bomb in the possession of 6 or 8 of the warring nations on the earth? What is your opinion?

Dr. LANGMUIR. Well, the warfare would continue one way and another until one nation came out on top. If it cannot get along with other people, it exterminates them and then goes ahead with a unified

population of all one race or one group doing whatever is necessary to see that nobody else ever builds an atomic bomb.

Senator TYDINGS. Which would bring us right back to where we are today to start over again with the remnants of civilization.

Dr. LANGMUIR. It isn't a pretty picture to look at, and there is no nation in the world today that ever desires to be a victor in a warfare of that kind.

Senator JOHNSON. Doctor, do you know of any other nation on this earth, including Russia, which would have published the Smyth Report?

Dr. LANGMUIR. England probably would have.

Senator JOHNSON. Any others?

Dr. LANGMUIR. England almost did, you know. They have a report almost as good as the Smyth Report, which is a wonderful report. It is shorter and different from the Smyth Report, but it is excellent in the way of presentation of the basic facts, and a little more popular than the Smyth Report.

Senator JOHNSON. It followed though; it did not lead?

Dr. LANGMUIR. Simultaneously, I think, it was issued.

Senator TYDINGS. Doctor, in your opinion, in a country that contains one-sixth or one-seventh of the world's earth surface, how much actual acreage would be necessary for the construction of a complete plant for the manufacture of atomic energy?

Dr. LANGMUIR. Well, I would rather leave that question. I never visited these plants, and some of the Senators here have.

Senator TYDINGS. Assuming, for the sake of argument, that it would take 200 acres, or let us say a square mile, or let us even say 10 square miles. Many parts of the earth are very thinly populated and very seldom visited. Wouldn't it be possible, even after the international agreement with the best intentions of well-meaning people to work out control, for some nation to decide to build such a plant in secrecy and to produce the bombs under present conditions of government?

Dr. LANGMUIR. That is a scientific question which, with proper data, could be answered. I think a great many scientists have gone into that kind of question and think it would be possible to expect under those conditions. Of course, in Siberia you have enormous wastes. In fair weather we can see 100 miles either way, which is 200 miles wide. A dozen or two dozen planes across Siberia with photographic equipment could show up every building in the thing. It would take only a reasonable number of flights to get a map of the whole of Siberia, which could be done every year.

Senator TYDINGS. The reason I ask you these questions is that if all the nations in the world had free press and free speech, and you could go in and out, our problem would be a simple one. But all the nations don't have that, and unless all the nations do have that, can any sort of inspection ever be efficient?

Dr. LANGMUIR. I would like to see, in the United Nations, some discussion to get those points on which the nations can agree, and then take the points of disagreement and try to analyze to what extent they hamper progress toward world government, and bring these matters up. Nothing can be done about it for 2 or 3 years, but one of the things that impresses me in Russia is the rate at which things are changing, and in every case I think changes for the better.

Senator TYDINGS. I think that is true.

Dr. LANGMUIR. Now, what may that mean in 5 years?

I don't know, but I am hopeful. I am hopeful that Russia will have a free press and will allow interchange of knowledge, because it will become her need to do so.

Senator TYDINGS. Until we do get that sort of climate in which to live, we cannot accomplish the inspection, and the whole thing would then be hopeless, wouldn't it?

Dr. LANGMUIR. Absolutely, but I think that we have something like 10 years in which we can accomplish these things, so let us not be discouraged by the fact that we cannot do them in two, or three, or five.

The CHAIRMAN. Doctor, the statement has been made that in the building of an atomic bomb, it is necessary for us to keep our lead over other nations which may develop the bomb.

What is meant by and what would be the purpose of this so-called lead? In other words, we would be better off, if other nations had bombs as good as the ones we dropped in Hiroshima, if we had developed bombs 10 or 50 times better.

Dr. LANGMUIR. You see, in dropping bombs, you first want to pick out the most important target. The enemy would attack Washington first, Pittsburgh, and several industrial centers, and the destruction by those bombs would be terrifically high. Then they would have to attack smaller cities of less importance, and then they would attack the more unimportant towns, and finally they would be able to attack all the cities and all smaller towns; and still they have only covered perhaps one-thirtieth of the United States.

If they had still more bombs, they could drop them in open farmland; but what good is that? Not much unless you have 30 times as many so that you can cover all the farmlands and wipe out all the people, or probably 100 times as many. In other words, if you take the total number you need to completely wipe out a country, 1 percent of that is very effective. The next 1 percent, 10 percent, and so on, are almost useless. It does very little good to be able to produce enough to wipe out the cities, and then produce ten times that much, which is trivial in importance.

Being able to outproduce some other nation is of no importance if we can produce enough to destroy their cities. Beyond that, we do not need them unless we go to a different order of magnitude.

The CHAIRMAN. Does our set-up in the United States make us peculiarly vulnerable to atomic bomb attack?

Dr. LANGMUIR. We are particularly vulnerable. Our cities are badly distributed. We have great concentrations of cities.

We have certain areas in the East where industries are very much gathered together, and other nations—at least, a country like Russia, of course, is already far better dispersed and much less vulnerable to attack.

The CHAIRMAN. Doctor, do you believe that the Government should have an absolute monopoly on the production of fissionable materials?

Dr. LANGMUIR. Yes.

The CHAIRMAN. And the processing of them?

Dr. LANGMUIRE. Yes.

The CHAIRMAN. Do you feel it is too important and too dangerous to have it in private hands?

Dr. LANGMUIR. Except it may be desirable to get cooperation through private hands, but the title and ownership should reside with the Government.

The CHAIRMAN. Yesterday, Senator Byrd asked as to what we ought to do with the bombs we have if an international agreement for control is reached. Would you care to comment on that?

Dr. LANGMUIR. I think I already have. I would go so far as to not only destroy the bomb, but destroy, if need be, all the materials from which the bombs are made.

Senator BYRD. What about the factories?

Dr. LANGMUIR. Destroy the factories, too, if need be.

If that is a critical point, let's yield on that point. That would put us in an equitable position with other nations we are trying to agree with, and how else can we do that except by putting ourselves on an equal basis?

Senator BYRD. You are talking about reaching these agreements 10 years from now. Every nation will have bombs 10 years from now.

Dr. LANGMUIR. I think the number that will have them 10 years from now—

Senator BYRD. I mean the nations which we have reason to fear would have them. Maybe the small nations would not, but certainly there will be five or six of the large nations that will have bombs.

Dr. LANGMUIR. The more nations there are, I think the easier it is to get an agreement. I think the United Nations is likely to be far more effective.

Senator BYRD. What assurance has anybody got with a bomb that you can practically put in your pocket that all of them would be destroyed?

Dr. LANGMUIR. You cannot put them in your pocket.

Senator JOHNSON. You could put them in a suitcase.

Senator BYRD. What assurance have we got?

Dr. LANGMUIR. I don't see any possibility of that. If a gangster in his attic or cellar can go out and make bombs and destroy anybody, I think the world is about out.

Senator BYRD. We had gangsters at the beginning of the war and will as long as the world lasts.

Dr. LANGMUIR. These have got to be very big gangsters.

Senator BYRD. Human nature doesn't change. You will have totalitarian dictators as long as you have a world. We have had them before, we have got them now, and will go on having them.

Dr. LANGMUIR. I don't know what human nature is, and in the second place, I don't know that it won't change.

Senator BYRD. It has not changed for the better in my lifetime. I think human nature in the last war was at the lowest level ever known. If there has been any improvement in it, I have not been able to judge it.

Dr. LANGMUIR. Let's hope for something better.

Senator BYRD. We cannot base our future on hopes alone.

Dr. LANGMUIR. The alternative of not doing something is absolute destruction. The risk in whatever you do is better than total destruction. Don't think there is a risk in undertaking these things; it is the only possible salvation. That is the thing we have to make clear. The worst thing that could possibly happen is to do nothing, so, therefore, let us do something and let us make it good.

Senator BYRD. I believe in doing whatever we can do, but when it comes to destroying the factories and all the materials to make the

bombs, I think we ought to know exactly where we stand before we do it.

Dr. LANGMUIR. How can you cooperate with anybody except as an equal? It is all right to hold bombs in sacred trust. I agree fully, but if, 10 years from now, we come to an agreement and say we are holding our bombs as a sacred trust, but we don't trust you, there can never be world agreement.

Senator BYRD. I can see a great deal of merit in your position, if what you mention could be done immediately; in other words, if what bombs we have on hand now—and I understand we have some—were destroyed before other countries had started to make bombs. But you intend to take action 10 years from now. Am I correct about that?

Dr. LANGMUIR. I think other nations will have them long before 10 years. I don't want to wait at all. I want to go ahead as fast as anybody goes ahead.

Senator BYRD. But you say repeatedly that you would not destroy the bombs in this country unless you were satisfied the other country would be in agreement with us. That cannot be done overnight.

Dr. LANGMUIR. No.

Senator BYRD. It has got to be done over a period of years, and in that time these other nations are going to have bombs.

Dr. LANGMUIR. We are not going to destroy our bombs unless they destroy theirs.

Senator BYRD. What assurance or guarantee can you get that they will destroy theirs? The bomb is not a large one, we will have to agree on that.

Dr. LANGMUIR. We will have to guarantee a time to destroy the bombs.

Senator BYRD. Would you take their word?

Dr. LANGMUIR. No, certainly not; and they would not take ours.

Senator BYRD. Here is a bomb that you can put in a satchel and carry around.

Dr. LANGMUIR. But the bombs can only be produced in plants employing hundreds of thousand of people, enormous plants. They have books and equipment which must all be inspected. Their records must all be gone over, like anything else in international affairs, and all cards must be put on the table before you could prove that you were really destroying all your bombs, and we would have to have similar assurances from other nations.

I cannot decide those things; I cannot even discuss them. It is a matter for the United Nations to work out, and it cannot be done next year.

Senator JOHNSON. I have one further observation to make, and that is that you scientists have gotten a long way ahead of human conduct, and until human conduct catches up with you, we are in a precarious condition unless you scientists slow up a little and let us catch up.

Dr. LANGMUIR. Scientists are not going to slow up; they are going faster.

Senator JOHNSON. Then, we will have to speed up.

Dr. LANGMUIR. You will have to speed up.

Senator JOHNSON. I am in favor of it.

Senator HICKENLOOPER. Mr. Chairman, I might suggest to Senator Byrd that we had one experience along the line he was discussing.

We sank a lot of battleships and other things, and the other nations didn't.

Dr. LANGMUIR. I don't recommend that.

The CHAIRMAN. Doctor, don't you think it would be more politically feasible to accomplish international agreement as to the setting of an inspection if this program was undertaken before other nations had atomic bombs?

Dr. LANGMUIR. Oh, yes. It must all be started, the sooner the better. The President's declaration of November 15 is excellent.

The CHAIRMAN. You will agree that if under the United Nations organization a commission could be set up and come back on the 1st of October of next year, we will say, with an agreed-on program that all nations are going into for the setting up of an inspection force, that is something you would like to see happen, isn't it?

Dr. LANGMUIR. Yes, but I do not believe the first time it is proposed that it is going to work. I think if nations could agree on inspection, fine. Then, it will have to be implemented; we will have to have teeth in it; we will have to have safeguards and all kinds of things which may take a few years to work out. If the intent could be expressed, and that may be done within a year, that would clarify the atmosphere tremendously.

The CHAIRMAN. I think it is dangerous, in view of your assertion that they could be produced by many countries within a period of 5 to 10 years, to give any impression to the American people that this is something that can be sort of taken easy in separate steps; but rather the desire should be to accomplish this just as quickly as possible in a working program.

Dr. LANGMUIR. Yes, but not to the extent of making an ultimatum that it has to be done next year or else.

The CHAIRMAN. I realize that.

Dr. LANGMUIR. That must not be done and we must not be disturbed or discouraged if it takes a little longer than we hope, because we must allow reasonable time in which these things can be done.

The thing that impresses itself on me is this: If you let things slide, as we did for 3 or 4 months after August, conditions get worse and worse and worse. They rapidly diverge and get into a more dangerous state of security.

If, on the other hand, you take constructive steps, get general points of agreement, when they first agree to inspect, that won't mean that inspection goes into effect right then and there. It means they begin to pave the way for mechanisms, and it may be 2 or 3 years before the thing comes to a point where there is inspection.

The CHAIRMAN. Winston Churchill gave as his estimate that unless we, so to speak—I don't suppose he would use this expression—but toned it up within 3 years, that the prospects for any kind of world security and peace would go.

Do you remember reading that statement?

Dr. LANGMUIR. Something like that; yes. I think I would agree that what is done in the next 3 years is perhaps the most important of all; but if at the end of 3 years we have not got our world security, that would not worry me much. If we have made progress toward it, and if we have an increasing desire to see the thing through on the part of several nations, then I say we have made great progress and there is great hope.

The CHAIRMAN. Do you think, if an invitation were issued by this Government to scientists from other countries, that they would be universally permitted and allowed to come here?

Dr. LANGMUIR. I think so; yes, within a reasonable time.

The CHAIRMAN. One further matter, Doctor. General Groves stated yesterday that many of the good men were leaving these projects because of uncertainties, which I believe is the way he phrased it.

Do you concede that that is the reason why these fellows are leaving these projects, these scientists, or do you believe that the fact is that they don't want to work on bombs?

Dr. LANGMUIR. Well, I don't think I am particularly qualified, for I don't know a great many of these men, but those I have talked to have expressed the opinion that the thing they like least of all are the security regulations and also they don't like to work on bombs. They are really scientists, and would rather work on nuclear physics. That is the thing that seems to them their life work. They have become engineers, and they don't like it; they would rather be scientists.

The CHAIRMAN. I might state, Doctor, for your information and for the record, that we have called for a report from the National Academy of Sciences. We have asked Dr. Jewett for a comprehensive report about the known sources of uranium and thorium. We will have that in a short time.

I want to thank you very much indeed, Doctor; you have been very helpful, and I want to thank you for coming down to talk to us.

The committee will meet on Monday at 10 o'clock.

(Whereupon, at 12:15 p. m., the committee recessed until 10 a. m., Monday, December 3, 1945.)

ATOMIC ENERGY

MONDAY, DECEMBER 3, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding:

Present: Senators McMahon (chairman), Russell, Johnson, Connally, Byrd, Tydings, Vandenberg, Austin, Hickenlooper, and Hart.

Also present: Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. The committee will be in session.

Dr. Bush, will you proceed?

STATEMENT OF DR. VANNEVAR BUSH, PRESIDENT, CARNEGIE INSTITUTION OF WASHINGTON, AND DIRECTOR, OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

Dr. BUSH. I have a brief statement, Mr. Chairman.

First, to identify myself, I am president of the Carnegie Institution of Washington and director of the Office of Scientific Research and Development.

I have had official connection with the development of atomic energy since June 1940. At that time, the National Defense Research Committee was established by President Roosevelt under my chairmanship, and the Advisory Committee on Uranium, headed by Dr. Lyman J. Briggs, which had been functioning since the fall of 1939, was reconstituted as a subdivision thereof. It was reorganized at this time, its work was somewhat expanded, and it proceeded with investigation of the possibilities of fission. In June 1941, I became director of the newly formed Office of Scientific Research and Development, of which NDRRC became one major part. Under this arrangement, work on the uranium project was expanded, and over-all responsibility for it continued to be a part of my assignment.

It became apparent during that time that there was a strong possibility that a bomb would be developed during the war. The recommendations I made at that time for an all-out effort were based on the recommendations of two committees, two strong scientific and technical committees set up by the National Academy of Sciences at my request, which reported unanimously and which gave strong recommendations.

By the summer of 1942, the point of large construction had been reached, and the project was thereupon turned over to the Manhattan

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Engineer District, Army Service Forces. On certain auxiliary research, and in other ways in aid of the War Department's program, OSRD remained active. My own connection with the development work took the further form of chairmanship of the Military Policy Committee, with Dr. James B. Conant as my alternate. This committee was dissolved this fall. As a member of the Interim Committee also, I have had a continuing share in responsibility for the program.

Development of systems for the control and utilization of atomic energy is the most important task ever faced by the governments of the world.

The CHAIRMAN. Doctor, do you mind being interrupted?

Dr. BUSH. Not a bit.

The CHAIRMAN. This Military Policy Committee was dissolved this fall. Why was it?

Dr. BUSH. It had completed its work, Mr. Chairman. I will enlarge upon that somewhat.

In the summer of 1941, when an extensive program was recommended, the President instructed me to report to an over-all policy committee which consisted of the Vice President, Mr. Wallace, and the Secretary of War, General Marshall, Dr. Conant, and myself. I took up with that group all matters of major policy from there on. When the program was turned over to the Army, to the Manhattan Engineer District, there was formed at the instance of that committee a Military Policy Committee, of which I was chairman, with Dr. Conant as my alternate, and on that committee were General Styer, then Chief of Staff of the Army Service Forces, and Admiral Purnell for the Navy. General Groves was made executive officer and had complete management of the program. He reported to the Chief of Staff, but he was instructed to review all of the major programs and policies with the Military Policy Committee in regard to the construction of plants and the like, so that his reports and recommendations received the endorsement of that committee before they went to the Chief of Staff.

That committee had entirely a wartime function and assignment to develop a bomb for use; having completed its assignment, it was dissolved at the time that the parent committee was dissolved, the major policy committee, at the end of the war.

For the continued progress of civilization, it is imperative that people be safeguarded against sudden destruction by atomic bombs. It is highly to be desired, for the betterment of living for mankind everywhere, that the great resources of useful power offered by further development of atomic science become generally available.

No more intricate and exacting problem was ever posed to governments than this one. It is inherently complex because the science of the atom is complex. The fact that the deadly military potentialities of the atomic bomb and the beneficent industrial applications of atomic power are almost inextricably intermixed complicates it further. The urge to prevent wars is very strong in all minds, for we have just emerged from a terrible war. The desire to enjoy the better life promised by applications of atomic power is strong also. Because the means of producing this peaceful power can readily be converted into an atomic bomb for destruction, the mechanism for world peace and the mechanism for world control of atomic energy are profoundly

interrelated. Preventing war is a long task, which must be done bit by bit, step by step; so also is the development of peaceful atomic power. The two must be related in our thinking, and what we do toward achievement of the one must be weighed in the balance of its effect on the other.

In a nationalistic world, all peoples will seek to attain an equal footing with respect to anything so powerful as atomic energy. If the mechanism of world peace is available and is strong enough, peoples may be expected to relinquish something of their traditional nationalism to attain that equal footing through international organization.

The CHAIRMAN. Wait a minute. You say, "In a nationalistic world, all peoples will seek to attain an equal footing with respect to anything so powerful as atomic energy," which means that all powers who are competent to do so are striving for it now; isn't that right?

Dr. BUSH. They either are now, or they will be in a nationalistic world, certainly.

The CHAIRMAN. If they relinquish nationalism to an international organization, they wouldn't try to stop getting atomic energy, would they?

Dr. BUSH. I think not, but my point is that if there is a strong enough international organization, instead of doing it independently, they may be expected to relinquish some of the nationalistic viewpoint in favor of attaining an equal footing through an international organization.

If no dependable mechanism is available, a secret arms race in the surreptitious development of atomic bombs may be foreseen. Any well thought out plan for orderly progress toward the banishment of war will start here, with the prevention of such secret preparations. The end of open preparations may then follow, to be followed in turn by the end to war itself. The start of the journey toward this great goal is in such a seemingly simple thing as the establishment of the complete flow of information—particularly of basic scientific information—across national boundaries.

The three governments which shared knowledge and skill to enable scientists to achieve the chain reaction and industry to create the materials for the bombs that ended the war have fittingly made the first move toward the establishment of mechanisms for the control of atomic energy and for the development of peace for which that control is an essential requirement. The declaration which grew out of the recent conference of President Truman, Prime Minister Attlee, and Prime Minister King is a very important document. It would have been important simply as a declaration for a peaceful world. It is of the very greatest importance because it chose the right path to that goal, blocked out the journey into practical, sensible stages, and clearly mapped the crucial first marches. The declaration is notable, moreover, because it entrusts to the United Nations Organization this momentous international responsibility. It is of the utmost importance that the member states, especially the great powers, upon whose cooperative effort success depends, do all within their capacity to assure that success. The way to international collaboration and control has been opened. But it will be a long way. As we progress along it, the separate national states must set their own houses in

order, establish their own internal systems of control, and thus bring into being agencies which can support the international agency.

Eagerness to assure world peace is laudable enough. The great hazard is the kind of over-eagerness which cannot endure the long patient work which will be needed, and which therefore argues for quick answers, such as "outlawing" the atomic bomb. Premature outlawry could well be disastrous, for it is impossible to outlaw when there is no effectively supported law. The first task is to create this. A good start has been made. The best possible support which our Government can bring to that good start is the expeditious passage of sound legislation for domestic regulation and development of atomic energy. During the lengthy period necessary for creation of an international system, it will be possible for this Government not only to enact the needed legislation but also to operate, test, and if necessary revise the domestic control system which that legislation establishes. By the experience of so doing, we may well secure experimental evidence that will be helpful in the performance of the international task.

Moreover, the passage of suitable domestic control legislation is urgently needed for purely domestic reasons. The present state of world affairs demands a strong United States. This is no time to let delay dissipate our strength, to let doubt and indecision hamper the great program of atomic science on which we are well embarked. People are getting tired of hearing about the atom, and when people get tired, they tend to turn away from issues. This is an issue which cannot in conscience be so ignored. Between the First and Second World Wars, the United States experimented with disarmament in an unorganized world—to sad result. The sort of thinking which that involved should long ago have been discredited. If we are to do our fair share in the exacting, patient work of international regulation, we must vigorously get at the domestic task now. Though the problem itself is great and new, it is susceptible of solution by the same means which have brought governments into being, gradually rendered them more efficient as agencies for the general betterment of man's lot, and reached a high point in the United Nations Charter. Those means are hardheaded analysis and honest good will. The first, used to the full in determining our internal control system, will clear the way for the second in international affairs.

From this point of view, then, let us consider general principles which legislation for internal control and development of atomic energy should embody.

The vast physical plants, the stock piles of materials, the varied applications of knowledge which taken together constitute the Manhattan Engineer District belong not to any men or group of men, nor to any corporation or group of corporations. They are the property of the people of the United States through their Government, in which are vested title to the physical properties and patent rights covering the engineering processes. This is as it should be, for the power of this development, for good or for ill, is too great to be otherwise held. Legislation for the further control and the further extension of this development should fortify this condition. At the same time, it should make proper provision for the active participation of private individuals and private corporations in the further utilization of atomic energy, under sound regulatory procedures embodied in a sensible licensing system.

For the years immediately before us, the deadly rather than the beneficial power of atomic energy will continue to hold first place in men's minds. Until suitable and effectual means for international control of military applications of atomic energy have been established and proved, the atomic bomb will continue to be a menace. Rigorous provisions for security concerning military exploitation of atomic energy, therefore, will continue to be essential. Our experience here will be of double value in the international effort, for it can become the basis for provisions to eliminate from the war machinery of nations not only atomic weapons but also other weapons nearly as deadly, by which we should be seriously imperiled in another war if atomic bombs had never existed. To solve the problem of the bomb is important in itself and of greater importance still as a contribution toward solving the entire international problem of war.

The manufacture of fissionable materials is by long odds the most dangerous manufacturing process in which men have ever engaged. The process is accompanied by the production of radioactive by-products as poisonous as the basic material itself; should the process used in producing power be ill-managed and get out of hand it would produce a great and deadly volume of such poisons. Improper or incautious manipulating of substantial amounts of fissionable materials by inadequately trained or irresponsible investigators is a danger to the public safety which Government must avert. Legislation for the internal control of atomic energy would be short-sighted, indeed, if it did not make thorough provision in this regard.

No better illustration of the complexity of the atomic energy problem can be had than the dilemma posed by this need for security and public-safety provisions as against the need for scientific freedom in the further study and investigation of atomic science. Atomic energy as we now know it and as we have employed it in the making of atomic bombs came about as a result of long and patient experimental investigation. If we are to press forward with the further development of atomic science for employment in peaceful power installations, if we are to explore to the full the beneficial possibilities in medical use of the radioactive byproducts of the fission process, if we are to go ahead with the search for pure knowledge in the field of which our present atomic knowledge is but a small part, we must so arrange controls that the research worker will possess the right and the freedom to carry on his studies.

A nice line of distinction hence must be drawn in security and safety provisions, in order to make possible not only untrammelled investigation but also the publication and sharing of results through which alone can we be sure of the fully productive thought on which scientific advances are based. The best way of determining this line is to define the critical situation that trenches on safety or security and provide for regulation up to that point only.

The United States is on record in favor of open doors in laboratories throughout the world and has declared its readiness to open its own doors if others will do likewise. Our legislation must be so drawn as to give substance to this declaration. Study of safety and security provisions must in addition take into consideration such questions as whether we should go beyond the declaration and open our laboratories before we are sure that this is world policy, and

whether we should specifically provide for the dissemination of our findings regardless of reciprocation.

The CHAIRMAN. I notice that you do not come to any conclusion in that paragraph, which interests me very much and raises the question: Are you studying further the question of opening the laboratories?

Dr. BUSH. As matters now stand, I think that question is not too pertinent at the moment. It is clear it will be some time before our internal legislation is enacted.

We know now that the United Nation's movement for some form of commission is likely to start as early as January. Certainly what we do in our domestic legislation depends upon the progress being made internationally. I think it might be much easier to approach that question specifically when the legislation is more nearly ready to issue.

Extreme care in the formulation of the legislation, extreme judiciousness in the selection of men to administer the legislation once drawn, are essential if we are to insure against freezing the science at its present stage, hamstringing further study, and repelling able minds from this field.

Not at once, but surely in a reasonable time, it will be practicable for man to use the controlled energy of the atom for direct peaceful purposes. Atomic energy as a source of steam power and of electric power will in due course—and not necessarily a long course—become available. If only because the best way to insure against the existence of atomic bombs is to separate and distribute their components in industrial installations, we should seek to bring about the industrial use of atomic power at the earliest moment. There are many regions of the earth where a supply of cheap power would be the greatest of boons. Wise legislation will therefore encourage to the full this undertaking.

The foregoing five principles, it seems to me, must be properly recognized in legislation for the domestic control and development of atomic science. Such legislation should insure to the American people their control of plant and process, should safeguard knowledge of the military applications of atomic energy, should properly guard the physical well-being of the people against the many hazards to life and health which the investigation and production of atomic energy involve, should provide for free and full research and interchange of knowledge in this new and promising field, and should reckon with the future task of putting fissionable materials to useful work. The five parts of the problem are of unparalleled difficulty; to meet them successfully will demand unprecedented authority and responsibility on the part of those whom the Government calls to carry out the provisions of its laws in this respect.

I hope to see the Congress enact legislation which will provide for all five of these issues and which will bring into the public service to effectuate it a group of men selected for their competence, disinterestedness, and judgment. Under the leadership of two farseeing Chief Executives and with the guidance of two farseeing Secretaries of War, the Manhattan Engineer District under General Groves has enabled American science, engineering, management, and labor to bring about an achievement of profound significance in the history of the human race.

It is imperative that as we move ahead into a world rendered more promising and more difficult by this achievement, and as others take up the burdens that have been thus ably carried during the emergency, we have leadership and wisdom of equal stature.

To this end, I hope that through its atomic energy legislation the Congress will make the grant of authority fully as broad as the task demands, and that it will so constitute the resulting agency that the most qualified and public spirited of our citizens will be proud to serve thereon. This is imperative both to insure the effective internal control of this vast new wealth and to give firm basis for the United State's effective international collaboration in dealing with a problem of vital concern to every living human being.

The CHAIRMAN. Senator Tydings.

Senator TYDINGS. Dr. Bush. I take it from your testimony that the hope of the world in the field of the atomic bomb is by international agreement.

First, your premise seems to indicate that they will promise not to manufacture the atomic bomb. Is that correct?

Dr. BUSH. I would put that rather late in the stages.

Senator TYDINGS. I mean eventually, not tomorrow.

Dr. BUSH. Eventually, most certainly.

Dr. TYDINGS. They will agree, by treaty through the United Nations or through some international medium, never to manufacture the atomic bomb.

I think that it will be necessary, under the premise you lay down, to have very rigid inspection all over the world on the theory that nations will not keep their word, and we cannot afford to take a chance.

Dr. BUSH. Quite right.

Senator TYDINGS. That will entail a great change in the internal policies of some of the governments of the world, access in and out, more freedom of speech, more freedom of the press and the right to publish what you want, and so forth and so on. Do you agree to that?

Dr. BUSH. Yes, sir.

Senator TYDINGS. It will also entail some sort of transportation system because many areas of the earth are not settled, and therefore we will have to have international airplanes that will have the right to fly over without interruption, and to survey, just as we would plot topographically the area of any other country.

Dr. BUSH. Yes, sir.

Senator TYDINGS. I take it that that international force would have the right to go into any plant where suspicion seems to indicate that atomic energy or atomic bombs might be in the course of manufacture.

Dr. BUSH. I think ultimately that would certainly be the case.

Senator TYDINGS. And without all those things—and they are not all, but some of them are preliminary things—there is no hope of an international agreement worthy of the name that would be effective.

Now, therefore, our task seems to be not only to get this international agreement which might come quickly, but to get the implementation of that international agreement so that it would be worth something.

Dr. BUSH. Quite right.

Senator TYDINGS. So, in order to get that, we would have to ask nations to alter their present governmental systems to the extent that they would fit into the premise.

Dr. BUSH. Let's say their practice under the system, and not necessarily the system.

Senator TYDINGS. Their system of ingress and egress, and so on.

Dr. BUSH. Yes, sir.

Senator TYDINGS. How do you suppose we could best bring that about?

Dr. BUSH. I think we would bring that about, sir, to best advantage if we realize at the outset that it will take time, and if we have plenty of patience. I believe also that it will come about to best advantage if we utilize the mechanism already set up under the United Nations Organization for that purpose; but in so doing we ought to use care on one point particularly. We should not overload the United Nations Organization with tasks that it cannot perform at the outset.

Certainly everyone wishes the United Nations Organization to be a success, and in order to be a success it must particularly be successful in the first tasks that it undertakes. Hence, I urge that our recommendations to the United Nations Organization involve at first only the parts of this long program which can be accomplished within a reasonable time and with almost certain prospect of success in their fulfillment, and to step on from there to the point where we arrive at the situation you describe.

Senator TYDINGS. There must be a certain amount of candor in these discussions, and no idea of hostility toward any nation if we are to achieve progress.

Have you given thought to the matter that the delegates to the United Nations from any country will probably have to telephone back to their own governments each time they commit their nation to any international program? That applies in varying degree, according to the country affected. Have you therefore given thought to the question, if an international plan is to be set up, considering all the difficulties which need not be mentioned of a change in the outlook of some governments toward inspection, and so on, as to whether or not that task could be best performed through the United Nations Organization or by a meeting of the heads of the three or four or five big powers of the world so as to prepare the groundwork and make these long interchanges of communications between the governments and the UNO workable?

Dr. BUSH. I think we all know, Senator, that any such large body as will be the United Nations Organization works to best advantage with some of the principal participants having preliminary interchanges and preliminary discussions on every work that is contemplated.

Senator TYDINGS. You have answered my question. I take it you think that the degree of success would be greatly heightened if, preliminary to turning this over to the UNO to implement the basic plan and the basic conditions, not all of them, not the mechanics in detail, but the basic plan and the basic implementation be first agreed to between the leading nations of the world.

Dr. BUSH. I think that would be excellent. I would go so far, Senator, as to say that the objectives and the general plan should be discussed, and then the first steps discussed in great detail, because no one, I think, can lay out the entire plan at the present time.

Senator TYDINGS. That was not my plan. First of all, there must be a meeting of the minds of the nations affected that they want to

outlaw the atomic bomb, and then there must be a discussion of the ways, and there are three or four principal things without which you cannot make any progress unless those three or four things receive some degree of settlement.

Now, therefore, my question after this preliminary discussion is this: Do you favor now a meeting of the leading powers of the earth, apart from the UNO, through their chief representatives, whether they be presidents or marshals or prime ministers or what not, to explore and prepare the preliminary ground before this is turned over to the UNO?

Dr. BUSH. We have already had one such set of discussions, and I think successfully, and quite properly that first discussion occurred between the three countries that have principally participated in this affair during the war. I think, as far as time allows, the more such discussions there are the better.

Senator TYDINGS. Then, you would favor, I take it, now that the three have agreed on their plan—that is, Canada, Great Britain and the United States—and have presented it to the world, that before the UNO deals with it that those three invite three or four more of the leading nations of the world to see if they accept the proposition we offer, and under what conditions, and to see if a preliminary arrangement can be agreed to?

Dr. BUSH. Apart from the exact mechanism, Senator, as to how it is done, I certainly favor such discussions as are possible in the interval before the United Nations meet, realizing there is not now very much time.

Senator TYDINGS. When do you favor this meeting between the leaders of the nations in the future for this purpose?

Dr. BUSH. I think, Senator, that I could not prescribe that. It depends upon a great many things about which I know very little.

Senator TYDINGS. Do you favor it as soon as it can be held, or can we put it off?

Dr. BUSH. I don't think we could go into the details of specifying how or when. I simply say that personally I am in favor of all such discussions as can be arranged before we get into the large meetings.

Senator TYDINGS. I think, too, from our answers, the obvious idea involved is that to turn this over to the UNO without this preliminary spadework between the heads of the great nations is to turn it over to a society that will debate it to death, and that one will have to turn it back to his or her government over and over again before any action can resolve.

Dr. BUSH. We have no United Nations Organization at the present time. An organization consists of people, and consists, also, of people that have learned to work together. It will be some time before we have an effective working United Nations Organization.

To turn over to the United Nations Organization the entire problem at this time would, in my opinion, be absurd—

Senator TYDINGS. Thank you for that specific answer.

Dr. BUSH. As absurd as to talk today about outlawing the bomb before we have talked about the means by which outlawry of this bomb and other weapons of mass destruction can be made in force.

If I may add one other word, I think it is entirely proper to turn to the United Nations Organization the beginnings of the matter and to hope that they will take some initial steps fairly soon.

Senator TYDINGS. I think I follow you, but I would like to make it a little more specific, and with no idea of being captious with it at all.

I take it you say now that, if we turn this whole problem over to the United Nations Organization for settlement, the prospect of success, which is so essential to this first undertaking, is not too bright; and that therefore the great governments of the world should make sure, through preliminary exploration and conference, that when it is turned over to the UNO there is that promise of success which we all hope for.

Dr. BUSH. I think that they ought to make plans so that the United Nations Organization will have something specific to work on, with the definite assurance that the great powers are anxious to see the thing move along that path and will cooperate.

Senator BYRD. What plans can we make? What should be done prior to the meeting of the United Nations Organization to consider this matter? What do you have in mind that can be done?

Dr. BUSH. I think one very great step was taken when the two Prime Ministers and the President joined, studied the entire matter, and made a specific proposal and plan.

Senator TYDINGS. But there was nobody present at that conference to accept it or reject it or to say, "That is all right, but how about doing it this way, or how about leaving that out and putting this in?"

Dr. BUSH. That was one suggestion; there may be others. There may be better ones, but there can be other conferences.

Senator TYDINGS. How can you get action if just three men give out a statement when the recipients to whom that statement is directed are not present? Do you see what I mean?

Dr. BUSH. I don't quite follow you, Senator.

Senator TYDINGS. I mean to say this: Do you think that you can achieve the preliminary success in this undertaking without a further conference of the leaders of the great nations of the world and particularly those that were not present when the three men gave out their original statement?

Dr. BUSH. But note, Senator, that the declaration itself indicated the desirability of further conferences among the great powers on this same matter prior to the United Nations operations.

Senator TYDINGS. Do you advocate that they have that further conference now?

Dr. BUSH. I was entirely in agreement with that conference, with that declaration throughout and that is one of the points in it.

Senator TYDINGS. I understand that, but we cannot let it hang right up there on the limb. Where do we go from here?

Dr. BUSH. Senator, that is someone else's guess, and not mine.

Senator TYDINGS. What do you mean?

Dr. BUSH. Well, that the President and the State Department proceed with the matter, as I judge they are doing at the present time.

Senator TYDINGS. And try to bring others in this field to see if they are in accord with this offer that has been made?

Dr. BUSH. Either formally or informally, I think there should be further conversation, and I judge such will occur, although I know nothing about it.

Senator TYDINGS. Until that is done, the hope for handling this successfully by the UNO is not too promising?

Dr. BUSH. I think that the UNO will undoubtedly have discussion of this matter just as soon as it starts. I hope it will proceed toward the formation of a commission on this subject, because I believe in that commission, internationally, discussions in regard to details of the plan can prove to best advantage.

I think that that will go on from step to step, and I hope that through the next several years, when that is occurring, that there will be not only that procedure in the United Nations Organization, but also continued conferences among the principal members.

Senator TYDINGS. Dr. Bush, you and the other men who have preceded you have all indicated the same general approach to it.

As a legislator that may have to take a stand on this sometime, I believe the theory is pretty clear, but I think where we are weak is that nobody is presenting to us possible steps that should be taken. They say eventually it should be decided by the UNO, but the UNO may fall to pieces. It may be a great success. We may be a long time in meeting. There may be obvious difficulties, and they may take up other matters.

Now, in the meantime, isn't it important that what preliminary work has been done be immediately followed up?

Dr. BUSH. Yes; I think it is important that all of this be followed up.

Senator TYDINGS. Where will we follow it up?

Dr. BUSH. Let me point out that the declaration to which I referred did not talk in generalities. It made two very specific suggestions of immediate and rather simple steps that would go, in my opinion, a considerable distance along the path that you outlined a moment ago; and that path is exceedingly important as you outlined it, because I believe fully that even in the absence of international agreements to that effect, if there was free interchange throughout this world, a free flow of information that there is in this country among the States and which did not always exist, then we would have removed three-quarters or nine-tenths of the danger of great wars by that mechanism alone.

Senator TYDINGS. That goes back to my question that in some countries perhaps that free flow will not be permitted, and therefore how can you achieve what you think is so desirable—and I agree with you if it can be worked out—without having this meeting to prepare the ground so that we can make progress along these lines?

Dr. BUSH. It seems to me, Senator, that the trend in this world is all in the direction of the free flow of information, the free flow of knowledge that we have talked about.

Now, it is not true today that it flows unimpeded everywhere, not by any manner of means; but the trend is in that direction, and I believe if we encourage it sympathetically, patiently, and in a realistic manner, that that can be brought about in time.

Senator TYDINGS. But how should we encourage it?

Dr. BUSH. I think the first step should be by the interchange of scientific information of a fundamental and basic character.

Senator TYDINGS. Can that be done until the other governments of the world agree to meet us on that same basis?

Dr. BUSH. I think the governments of the world will be anxious to meet us on that basis.

Senator TYDINGS. How can you achieve that without bringing the heads of these governments together?

Dr. BUSH. I think that will be almost, but not quite, automatic. Before the war we had full and free interchange in the scientific fields to an extraordinary extent. There may have been impediments here and there, but there were certainly no more impediments internationally to the flow of fundamental scientific information than there are internally in the flow of applied science in industry.

Senator TYDINGS. Hasn't that been changed somewhat recently?

Dr. BUSH. During the war every nation, of course, placed restrictions; but the point is that we do not need to create a wholly new situation. We simply wish to return to the situation that occurred previous to the war in regard to the flow of fundamental science and to improve upon that. We have had some indications in that regard already, and in this very field.

We had the courage, and I think the wisdom, to publish the Smyth report with a great deal of the fundamental information in it, which was certainly a gesture, it was certainly an indication that we wished to proceed down the path of free interchange of basic scientific information.

We have not yet gotten back to the point where scientists flow across boundaries easily, because of transportation difficulties; yet, a while ago, Russia invited a group of American scientists to visit them, and that was done quite successfully.

I believe that by encouraging that procedure, by making it clear that we as a country wish to encourage it, that we can bring that very simple point about without very much difficulty.

Senator TYDINGS. Assuming that that simple point, which is a good point, is of such transcendental importance, and that this whole problem is like Damocles' sword hanging over all of civilization, it seems to me that the natural result that would flow from what you have said is that there must be a meeting of the leaders of the great nations at some place to arrive at an understanding of the fundamentals that must be present before any of these things can take place.

Dr. BUSH. When it comes to the particular mechanism by which governments and peoples get together, Senator, I think you are in a better position to judge what will work effectively than I am.

Senator TYDINGS. The reason I ask you this in such detail is that I share your belief, as you imply, that this is a pretty big task to hand over to the UNO as one of their first problems, and that if it fails, civilization will be consumed with fear, and the one instrumentality set up for the keeping of the peace of the world will be given an awfully fatal blow.

Therefore it seems to me that as we are in this stage where we don't want that to happen, and we are confronted with that problem, that it is a natural conclusion that the heads of our great governments—and I am a Democrat, understand me.

Dr. BUSH. I thought you were, Senator.

Senator TYDINGS. The heads of our great governments, some five or six of them in particular that I won't name, have got to get down to the table and see whether or not they can eliminate the fears that attend the interchange of information and the outlawing of the bomb, and all of that sort of thing, before you can proceed anywhere.

The United Nations cannot bind any government internally.

Dr. BUSH. We can remove the fear only as we make progress, and it will take us years to make progress to the point where the peoples of the world can have the fear removed from their minds on the atomic bomb.

But we can't get there in a moment by wishful thinking. It is going to take patience and hard work. Hence, the things that I urge are, as far as our influence extends, as far as the United Nations operates on this matter, that we urge that they go step by step and deal only with such steps as can be carried into effect effectively, and do not try to take the whole problem at once and jump to a quick solution which does not exist.

Senator TYDINGS. One of your first steps is that we must have this interchange of scientific information to eliminate fear and to free genius, so to speak. How can you do that unless the leading nations of the world agree on the fundamentals that must be present when that solution is arrived at?

Dr. BUSH. I think there will be no difficulty whatever in getting the nations of the world to agree on the ultimate objective. The ultimate objective is to abolish war. Short of that objective, there are other objectives that are more easily attained, and those can be placed in steps.

I would point out this: First, it will be possible when there is an adequate system for obtaining full knowledge—and I don't call it an inspection system; it is not necessarily in that explicit form—to remove from the world at that time the fear of the use of atomic energy in bombs, and also of other weapons capable of mass destruction, for there are others that are just about as bad and might be worse.

Short of that, even, it may be possible by international agreement and with full knowledge to remove the threat of sudden surprise attack. If we could remove from this world the fear of sudden attack by atomic bombs, or otherwise, we would have gone some distance. Now there is a long path to proceed.

Senator TYDINGS. But before you can eliminate one single "if" with which your whole premise is studded, how can you remove one of them until the leading representatives of these great nations, in many but not in all cases the only men who can speak for their nations, eliminate the weeds and the undergrowth so that you can get a foundation in which you can plant this seed?

Dr. BUSH. I have already said that I hope they will do just that.

Senator TYDINGS. And you would advocate it in general terms?

Dr. BUSH. Yes.

Senator TYDINGS. Then I think I have the answer to my question, which I will summarize as follows: That this is too big a task for the UNO to take in its present form and under present circumstances with a reasonable hope of success.

Dr. BUSH. Without all the help that can be given by prior conferences.

Senator TYDINGS. And that nations, through such intermediaries as they may set up, either through direct dealings with governments—which is preferable—or something similar, must prepare a vast field of small but important details before any of these things that you desire or think are wholesome for ourselves in the world can follow.

Dr. BUSH. That is right.

May I go back to one point that you raised previously which comes right in on that.

You spoke about an inspection system that would go into every factory, that would go into great detail in every country.

Senator TYDINGS. Not necessarily go, but have the right to go.

Dr. BUSH. That is a very great difference. That is an ultimate situation. There are much simpler situations before that is necessary.

For example, for an early step I think that the nations of the world might readily agree that they would disclose to one another and make available completely through the United Nations Organization full information in regards to the sources of ore of the principal fissionable materials, that they would make known the movements of those ores, the extent to which they are prepared and shipped.

Senator TYDINGS. All the raw materials?

Dr. BUSH. All the raw materials. Now, we know what those are. We know just about where they are in the world in general, and it would not take a great inspection system to determine whether such facts as were supplied by every nation were correct or not. In fact, it would take very little beyond the visit of a few geologists to the principal sites of the world, mining engineers, to know what the facts are in regard to that.

Yet that very simple thing, if the nations of the world all knew what every other nation was doing in regard to the preparation of the raw materials, would be a significant step on the path that I have outlined, and a step that could be taken with assurance.

Senator TYDINGS. Obviously that would help, but let us suppose that in Canada—with no reflection on Canada, which I pick out because I am sure it would not happen in Canada—there were charted all the places where uranium exists that are known at present, and let us suppose that some place up in the Hudson Bay country that is not very accessible to the outside world a new deposit of pitch-blend or uranium was discovered; and let us suppose that a group of men who discovered it did not communicate that, for patriotic or other reasons, to the Canadian Government or to the world organization. What would you say to that?

Dr. BUSH. I think they would have a very difficult time, indeed, even if there were no international inspection system, because they would need to consult geologists and mining engineers. They would need to purchase mining equipment.

Senator TYDINGS. I don't mean to manufacture it; I mean to let it lie there. They would just discover that it was there, and would not do anything about it, but would not report it.

Dr. BUSH. Well, why worry?

Senator TYDINGS. Why worry? Well, I would want to know where the raw material is; it is essential that we know where all the raw material is.

Dr. BUSH. But it is far more important to know whether the raw material is being mined and processed.

Senator TYDINGS. You are starting out by saying, "If we know where the raw material is." What I am getting at is that then we might work on the supposition that there is raw material which we do not know about.

There wouldn't be any bank robbers if everybody would abide by the laws of the State.

Dr. BUSH. My policy is a small step, but I think a significant one and relatively easily enforced, because I think a relatively simple system of gathering of information would disclose the salient and principal facts. There might be some that would escape, but I don't think they would be significant.

Senator TYDINGS. Having in mind Pearl Harbor, and other instances which I won't delineate, as one who has some little responsibility I would be pretty reluctant to exchange information with the world unless I knew that the preliminary steps had all been taken first so as to make certain that exchange did not impair our own safety.

Dr. BUSH. Certainly; so would I.

Senator TYDINGS. Therefore I want to know before we exchange that information, if that were deemed wise on thorough thought, whether or not the other nations were really going to permit this exchange and have an open and aboveboard transaction, or whether we were going to be in somewhat the situation we are in today.

Dr. BUSH. That is why, Senator, I would proceed by stages, step by step, on a system, if you wish to call it so, of partial payments, so that the accomplishment of each step successfully will, in the eyes of the world, prepare the way for the next one, so that confidence in an international organization will be gradually developed over the years, and so that—incidentally, and a very important point—there will be developed within the United Nations Organization an inspection system under a commission which has great pride in its accomplishment and great esprit de corps. That is possible, and when that occurs we may gradually come to have confidence in its pronouncements and to feel that it knows the facts on which it makes those pronouncements.

When that day arrives, we will have come to the point where we can make enforceable national agreements for the purpose of removing from the scene the principal methods of mass destruction, whatever they may be, but not before that; and I believe that our steps at the present time should be planned to develop that situation gradually and definitely, and we should have all the patience in the world in so doing.

Senator TYDINGS. I have just one more question. There is nothing more difficult to outlaw than the atomic bomb, is there?

Dr. BUSH. Oh, I think it is equally difficult to outlaw any other mass weapon.

Senator TYDINGS. Why shouldn't we outlaw everything, while we are outlawing the atomic bomb—the battleship, the artillery, and the whole business? Why stop at the atomic bomb?

Dr. BUSH. The idea, Senator, is to stop wars. I am against wars of every kind carried on by every means.

Senator TYDINGS. I agree with you; but why do we limit this to the atomic bomb? Why don't we go at the whole thing at one time?

Dr. BUSH. I would not limit it to the atomic bomb. I would say, "Let's remove from the world the fear of every other weapon of mass destruction and let's remove from the world finally a fear of war itself."

Senator TYDINGS. How?

Dr. BUSH. By the path that you and I have discussed, and over a period of many years in which we will have to have patience and perseverance to work through the United Nations Organization and

to support it; but if that doesn't work, to try again by other means and to keep on trying until we succeed in producing an international system under which we can remove wars.

The CHAIRMAN. Dr. Bush, I am more impressed every day with what Aristotle said, that politics was the art of the impossible, and it is rarely repeated.

I am a little bit disturbed about these long periods of time that you envisage in getting control of this problem.

Now, we have a weapon that, produced in any kind of quantity and used aggressively, could wipe half the population off the earth by action of the other half. This, I presume, is known to the statesmen of the world; I don't say it is known to all the peoples of the world.

Don't you feel any sense of urgency about trying immediately to accomplish an over-all control of this thing?

Doesn't it worry you any that these steps are to be taken years apart? Don't you feel that the accomplishment of the art by other nations will make perhaps more difficult the mechanics of control? Is there not something to be said for the laying down of an over-all control plan that is fair and equitable so that the fear of the peoples of the world can be removed at the soonest possible moment, and that we won't have to go along this long series of years with that fear overriding everybody?

Dr. BUSH. Senator, there is a difference between the sense of urgency and the sense of panic. I have, indeed, a sense of urgency. The problem should be attacked at once, as you gentlemen are attacking it. It should be analyzed, and we must proceed with expedition down the path.

But that is quite a different thing from the sense of panic that wants a solution overnight. There is no solution overnight.

The danger, as I see it, is this: The American people are a great people, but they have one fault that I know full well. They like immediate, over-all solutions, and on this particular matter we are, all of us, tired of hearing about atomic bombs and atomic energy. I may be more tired than you gentlemen are, because I have been thinking about it intensely for 6 years; but you gentlemen, everyone, are tired of hearing about this thing. We, all of us, wish we could suddenly remove this threat and could forget this element. We can't.

The danger, as I see it, is that in that mood, quick——

The CHAIRMAN. I don't want to interrupt, but don't you feel, Doctor, that mankind is so constituted that it depends upon the intent of the purpose with which you approach an objective as to whether or not you are going to get that objective?

Dr. BUSH. The point of view of mankind will depend upon whether progress is being made, not upon whether a solution is brought out immediately.

The thing that I am afraid of is that in the urge to get too quick solutions, we may do things that are not wise.

Let me go back to one other point of your remarks, which I want to enlarge upon.

Senator VANDENBERG. You discriminate between hysteria and prudence?

Dr. BUSH. Quite right, sir.

The CHAIRMAN. I hope that the questions that I suggested did not denote any state of hysteria on my part, Doctor?

Dr. BUSH. No; but I think you felt as I do, that there is some hysteria as this thing is thought about.

But I want to make two points: First, you spoke of a situation where there are enough atomic bombs in the world to destroy a large part of civilization. That situation does not exist today. Now, of course, I don't want an open session to go into the question of how many bombs are available, or any such thing; but every country, every people in the world, knows that today we have not got such great quantities that that statement would be true in its generality.

The CHAIRMAN. We would have to make that knowledge available, though, before we got any other country to agree to turn up the uranium sources they have, wouldn't we?

Dr. BUSH. We would; and under proper circumstances and proper controls I would be entirely in favor of making it known.

Senator HICKENLOOPER. I get the impression from your statement, Doctor, that there are two things involved here: One is the physical and mechanical development of this monster we have created, that that is our responsibility, that we have it along with England and Canada, but that we cannot hope to arrive at any point of mutual confidence in the world until the moral questions are settled.

Those moral questions involve the moral attitude of other nations.

I would like to ask you this: Do you think there is any remote hope of any security against the use of atomic energy as a weapon until those moral problems have been substantially solved within the nations themselves?

Dr. BUSH. Well, it is all according to what you mean by "moral," Senator.

Now, I come from New England. My forebears came from Cape Cod. There are small towns on Cape Cod that live in peace, and yet I wouldn't want to say that they do so because they are highly moral in the specific sense. But they have an understanding; they have a basis of interchange. The word "moral," I think, carries too much.

Senator HICKENLOOPER. I mean in the broadest sense. Perhaps I should amplify or explain that a little.

There are certain nations in the world today that are very vitally interested in controlling atomic energy because the peoples of those nations have a fair understanding of its potential or its actual power.

There are other nations. Let's, just for the sake of our discussion here, go back to the conditions in Germany before this present war started, where the people were kept completely in ignorance of many of the things that went on in the world and were fed a propaganda that only suited the needs of the leaders.

In that case, if there should have been, or if there were, any moral weight to be exercised by the people of Germany, it did not have a chance to be exerted or exercised because of propaganda that directed their thinking.

Now, until the peoples of the more or less enlightened nations of the world pretty universally know what they are facing in the possibility of this atomic power, do you think we have too much chance of getting any moral support—I mean the honest, well-intentioned support—of all of these nations?

Dr. BUSH. Yes; I do. Eight years ago there were two countries in the world whose people had been trained for over a generation

to prepare for a war of aggression, Germany and Japan. The leaders of those countries had their peoples so propagandized and so under control that they did not know the world situation; and that was an enormous threat to the world, and out of it came a great war.

No such situation exists today, and those two nations are conquered and under control and should remain so. We have no nations in the world today that do not wish a long, fruitful period of peace; and in my opinion, every country is anxious to bring that about, not only the peoples of every country but the rulers of every country. We have no situation as then existed.

We will have misunderstandings; we will have friction; we will have difficulties. But I am perfectly sure, personally, that there is no danger of great wars breaking out until there has been time to work this thing out with care and deliberation, and fully; and in that sense, I am optimistic; I believe it can be done.

Senator HICKENLOOPER. Is it not possible that, either now or within some reasonable time in the future, the leadership of some nations may persuade their people that it is desirable to have space, that they may personally desire peace, and yet is it not possible that they may be willing to adopt a policy of war in order to obtain their own ends?

Isn't there a danger that the leadership of some nations might desire peace but still cling to the policy of war as national policy?

Dr. BUSH. We have got to be sure, of course, that there will be no more Hitlers or Tojos, all right. However, that is not a question merely of a rule of a country by a single person. We have got to be sure that no nation, over a long period of years, becomes oriented in the direction of conquest. That can come about if we have the right international understanding, so that the nation that became thus oriented would immediately become a pariah among nations of the earth.

Of course, we have gone through that. We have seen Hitler rise to power in Germany and, step by step, many of them rather obvious, prepare for this war. What he was doing was evident to every one, to all nations; yet the nations either did not have the courage or ability or vision to stop the march of that machinery working toward war.

But that is not the situation today, the situation I have mentioned. That situation is absent now. Then the nations of the earth did not join and make that nation, Germany, a pariah. If they had, we never would have had a war; Germany could not have started it.

Senator HICKENLOOPER. I like your statement very much, Doctor, and I think you have given us a lot of food for thought.

However, I had a rather strong feeling—I am not at all encouraged to think that we will be able to do too much, in immediate or positive agreements, until the peoples of the countries involved began to exert their moral influence. I feel that perhaps we will, whether we like it or not, face substantial delay; and I do feel that it might be in this period of delay that we perhaps might have to exert our greatest fortitude.

Dr. BUSH. This is the period, right now, when it must be done and when we must not lose time and when we should proceed with all possible diligence. Now is the time.

Senator TYDINGS. May I ask the doctor a question?

The CHAIRMAN. Certainly, Senator.

Dr. BUSH. I would be glad to have you do so.

Senator TYDINGS. Do you think it is possible to accomplish in the world a free exchange of scientific knowledge—in a world that does not permit the free exchange of religious knowledge?

Dr. BUSH. I haven't thought of that particular parallel, Senator. If you are making a premise that the world does not permit the interchange of religious knowledge and that that will continue, I would say "yes"; I think that is true.

However, I disagree with you when it comes to science, because I think that the flow of scientific knowledge can be brought about in the world largely as it was under the conditions which existed before this war.

Senator TYDINGS. Well, why can't the flow of religious knowledge, likewise, be brought about?

Dr. BUSH. Well, Senator, I am an engineer, primarily. I would not try to qualify as a man schooled in religion and its international aspects.

Senator TYDINGS. I agree with your premise that the spread of scientific knowledge all over the world would be a very desirable thing, if we could get it done, if it could be accomplished. I would like to have thought move freely and remove the barriers to thinking.

But I do feel this, that if we cannot do it in one field, what hopes may we have that we can do it in another field? If freedom of the mind is interdicted, so to speak, by the Government in one of the oldest and strongest traditions, why is it reasonable to believe that the freedom of the mind will not be interdicted in this other field of science?

Dr. BUSH. Science, Senator, has always been more or less free; it has always had a flavor of internationalism, you know.

Senator TYDINGS. So has religion.

Dr. BUSH. It has always been the practice of the scientist to publish his discoveries so that his colleagues all over the world can read them. And, as the scientists become more and more specialized, they will become more and more international.

There is a reason for that. Suppose we take the field of mathematics. The man who is in the top rank of mathematicians may publish a paper. In this paper which he may publish there may not be more than 8 or 10 men in the whole world who can read that and understand it, who can go into such an intensely specialized thinking. And those 8 or 10 will not be located in his country, they will be all over the world.

Those men will read that publication, no matter where they are located, and by reading that publication and understanding his thinking, they will be his colleagues. That is international.

Senator TYDINGS. But, suppose that man is not allowed to send out his thought?

Dr. BUSH. Well, I am simply saying that in this particular field it is easier to bring about the international pull than otherwise.

Senator TYDINGS. I think it is logical, as you say, that perhaps you can achieve more success in other parallel fields than in religion. Nevertheless, where there is a reticence on the part of the government concerned, where there is a feeling that the national safety might be endangered, there is another situation. Suppose that the government believed it imperative to suppress that knowledge;

whether or not it rightly believes so, they might hold that information back, having the preservation of the government in mind.

Dr. BUSIR. Right, and it is that hesitancy to allow free interchange of knowledge that we shall have to overcome. I think we can overcome it. I think it will be comparatively easy, in the field of science.

Senator JOHNSON. I have heard what the other Senators on this committee have said about your presentation. I want to add that I think it is very logical and comprehensive, and I enjoyed it very much. I would like to refer you to some of the conversations between you and Senator Tydings before the Senator got into the question of theology, his first line of questions.

It seems to me that international factors are something like the game of checkers. First it is your move, and then it is the other fellow's move. Now, as I see it, Britain, Canada, and the United States, the nations possessing the knowledge of the atomic bomb, have made the first move.

They met at a conference and laid down a very simple formula for the interchange of atomic knowledge, and, especially, the controls to be placed over the atomic bomb.

The other nations have not made so much progress yet in the atomic bomb, but it is their move, isn't it? There is no way in which you can compel another nation to take an interest in the control of the atomic bomb, if they don't have that information. We have the atomic bomb. We created it. We have laid down a broad basis for its interchange.

Now, if they don't come along and say, "All right, I am interested, although I do not altogether like your terms; I would like to see some amendments to your terms, but I am interested," if they don't make such a move, you are almost stymied, it seems to me, in going about settling the question in which Senator Tydings is so interested, the international control of atomic bombs and atomic energy.

I would like to go to another question that you raised in your prepared statement.

You refer to atomic energy as a source of steam power and of electrical power. You say that we will, in due course, and not necessarily a long course into the future, have that available.

As I recall it, when Dr. Langmuir was here, he touched upon this question.

He indicated that the peacetime and domestic potentialities of atomic energy are trivial, as compared to its wartime possibilities, its destructive possibilities. I think he used the word "trivial." I think he was speaking in relative terms.

If I remember his statement correctly, he emphasized that you cannot create steam or other power with uranium; that you cannot use atomic energy for such purposes without that energy having an atomic bomb—

Senator VANDENBERG. Potentiality.

Senator JOHNSON. Yes; an atomic-bomb potentiality. That is, every plant which you are using for making power would be, essentially, connected with the possible creation of atomic bombs.

I listened to a discussion, not very long ago, where they were talking about the industries of Germany. They seemed to agree that we have got to crush the industries in Germany that are making steel bridges,

that we have got to crush them, that we have got to destroy them, because an industry which can make steel bridges can make weapons of war.

The feeling was that war and industry are so closely interrelated in this machine age, in this advanced age, that every manufacturing possibility, every industrial possibility, is also a warmaking possibility.

Now, my question is this: Until the over-all international question of the development and the control of atomic power has been made, is it safe to go ahead and be thinking of the domestic and industrial applications of uranium energy?

Dr. BUSH. Well, Senator, there seems to be nothing safe in this world. Let me, however, expand on this point of yours a moment before I answer.

I think that before this committee finishes these hearings it ought to bring before it one or two engineers that can answer the questions you want answered better than I can, in regard to the industrial possibilities in this field. I am an engineer, it is true, but I think I am a bit rusty as an engineer.

I can suggest a number of people whose names come immediately to mind who know the power-plant situation. I think you should have those people to testify as to those matters.

As I understand it, I think that the situation is this:

The power applications of atomic energy are not trivial in any absolute sense. Water power—

Senator JOHNSON. I am talking about in a relative sense.

Dr. BUSH. Well, if you want me to go on to that point, I would say that it is very difficult to compare atomic energy in industry as opposed to its destructive power in war. They are not quite comparable. I would not want to try to give you a relative figure on that aspect.

But, speaking about the industrial power application of atomic energy, I say that I think it is not trivial. Water power is certainly not trivial. It is an important source of power, in spite of the fact that we have coal and oil.

Now, as I see it, the distinction is, with respect to the utilization of atomic energy, largely the same as with respect to water power, about the same kind of distinction. In order to develop power by atomic energy, you have to have an expensive plant. This is also true with a hydroelectric plant.

You have to consider the total cost that is involved in the price of the power. There is the cost of operation, including the cost of fuel and the cost of the plant, the amortization and the interest on it, and the other costs.

A hydroelectric plant has a high cost, yet hydroelectric energy competes with coal and oil and hydroelectric energy has been very important in the economic development of certain nations.

Now, in this field of atomic energy, looking ahead, there are certainly certain possibilities of developing power in large quantities for steam and electrical purposes without any fuel costs.

We do not know what the cost of the plants will be, the atomic energy plants, but I cannot see, myself, why they should be very much greater than the cost of the steam plants.

Now, if that is the case, it can make a very considerable difference in the economy of some of the other nations of the world. It may not

make so much difference to us. We have oil, coal, hydroelectric power. We have our power sources pretty well developed. But it would certainly make a much greater difference in some of the undeveloped parts of the world, particularly where they have got natural resources and no power at the present time.

I believe, therefore, that ultimately and over a period of years we will see power come in this fashion. I think it will produce not sudden transformations but a gradual lowering of the cost of power, which will make a difference in the industrialization of the country which utilizes atomic power.

I do not think that we will see it running the family automobile; its subdivision is not easy. I do not think that we will see it immediately because there are problems concerned with safety.

Let me say another thing: I think it is fortunate that atomic energy has an application for power purposes as well as an application for explosive purposes. I use the word "fortunate" because there will be a great urge among the peoples of this earth to use such fissionable materials for power purposes where they can confer a benefit on the general national economy, rather than to leave them stored up simply in the form where they can be used for atomic bombs.

I think that will be one of the factors which we will face as we work toward a solution, as we work toward a general understanding, where the use will be for power purposes and not otherwise.

Senator JOHNSON. But, Doctor, in your comparison of electric power with atomic power, it seems to be that you overlook the fact that in the use of atomic power, uranium power, that that is just one step, one very important step, toward the creation of atomic bombs.

That is, it seems to me, that there must be two steps. First, you have to collect large amounts of uranium. That is the first and most important step. Then, the second important step is the process of creating explosives. It is a step in the creation of an atomic bomb.

Now, you do not have those two steps in hydroelectric power or in the creation of electric power, and I think that was the point that Dr. Langmuir was referring to.

Dr. BUSH. Now, if you are raising the question, Senator, of whether we should start making fissionable materials, at the present time, internationally—

Senator JOHNSON. No.

Dr. BUSH. I would say we are not ready to do that in any case, so we might as well forget that part of it. But fissionable materials are going to be made.

The CHAIRMAN. They are going to be made?

Dr. BUSH. They are going to be made, of course.

Senator JOHNSON. That is not my point. My point is simply that, until we have an international control set up over atomic bombs, is it safe to go ahead with the use of uranium in the creation of power?

I have in mind the fact that we have been talking here about inspection and espionage and all those things, of discovering the amount of uranium that is available and whether anyone else has atomic bombs stored back some place in their safety vaults. We have all those questions involved.

Now, is it safe to go ahead and use uranium in the creation of power until these international questions are settled?

Dr. BUSH. My point, Senator, is this: Whether it is safe or not is beside the point. We do not have any means, effectively, to prevent it from being done, at the present time, and we won't have for some years.

"Is it safe?" you ask. It seems to me a question we cannot answer until the time when we have come to have effective enforcement of international control.

Now, at this time, I make this point: Since fissionable materials can be used in power plants, where they will confer a great industrial benefit, there will be an inclination on the part of nations, generally, to use that power, rather than to hold it in an inactive, nonproductive form, simply as material for bombs.

As I see it, if the nations of the world feel sufficiently secure in their international relationships, they will do that very thing and use fissionable materials to generate power.

Now, you say and it has been said by others that it can be taken out and made into bombs. Certainly it can.

You can do it. But when you do that, you shut the power plants down. It can be taken out as bombs but it takes a considerable time to do it. Certainly, if it is being used in the power plants, the danger of its sudden, surprise use is remote.

Moreover, if it is in use in the power plants, it would be very difficult indeed to take it out of there and make it into bombs without its being internationally known, because you could hardly do it without disrupting the entire power situation in the country where it is being used for important industrial purposes.

Hence, I say by all means let us bring the time up when this material can be used for industrial purposes to such great advantage. That is the way it should be used, for the good of the world, and that is the natural way that people will use it, for industrial purposes.

Senator AUSTIN. May I ask a question?

The CHAIRMAN. Certainly.

Senator AUSTIN. In your statement you speak of the five points that you think the legislature ought to consider in determining the policy or declaring the policy of the country with respect to this matter.

You speak of, first, this vast machine, the physical plant, the stock pile of materials and the varied applications that have been made or can be made of the scientific aspects of the matter, the special knowledge.

You say that we should consolidate our position rather than retreat from that and that we should maintain what we have gained thus far.

The question arises in connection with your last remark, concerning the cost, the money cost to the taxpayer of performing that first function to be carried on. My question is, can that first function be carried on and continued in our economy unless we do utilize these things in an industrial way?

Can we continue, in other words, to maintain a city of 75,000 people on our pay roll, operating a huge plant such as we have at Oak Ridge and as we have at other places, though not so large; can we continue that in our economy unless we do progress to the point where the thing begins to pay for itself?

Dr. BUSH. Until we arrive at the time where we can disarm internationally, with assurance and with the guaranty and the knowledge that it is going to be done by all peoples in the world, until we arrive at that time and until we arrive at the point where we have international, enforceable understandings generally, this Nation has got to retain its strength.

There is no question about that. The cost of remaining strong is going to be large. There is no question about that, either. How should that cost be distributed among the various elements?

That should be determined by the people who study that and have great, detailed knowledge of it, who can say what size Army we need, what size and nature Navy we need, and what amount of money we need to produce atomic bombs, and so on.

I cannot tell you offhand what fraction of our effort should be thus distributed on the atomic-energy angle, but I do feel sure that the plants we have at the present time should be kept operating.

Senator AUSTIN. You do feel sure, then, that we should keep organized this very technical group of scientists, who are, at the present time, gradually separating from the organization?

Dr. BUSH. Yes. That group is rather disintegrating at the present time, naturally.

I feel that we should, at the earliest possible moment, complete a proper and deliberate study of what the legislation should be.

I think we should quickly decide whether it should be in the hands of a commission, the control over this matter, rather than in the War Department, as at the present time. The War Department itself has suggested that transfer to a civilian commission and I think it is a wise step.

The CHAIRMAN. Do you feel that some of the scientists have left these projects because of "uncertainty," whatever that may mean, or because they have been working on making bombs and they are not particularly interested in that?

Dr. BUSH. Why, Senator, let me answer that rather generally, because that brings up an odd situation.

I was put in a position, during the war, by the action of President Roosevelt, where I had a great deal of responsibility for keeping the scientists in the plants, enforcing the security regulations and the like.

Now, no scientist likes to be regulated in any way whatever. However, it is necessary, we all know, in time of war, to have enforceable security regulations, which do not fit well with a group of scientists.

The CHAIRMAN. But which they obey under the compulsion of war?

Dr. BUSH. But which they obey under the patriotic impulse, their patriotism in time of war, and which they accepted very well indeed in this country. I am proud of them, I am proud of what they did, these scientists connected with my organization.

I think we have a right to be proud. In regard to security during this war, they did a grand job, holding things secret that should be held secret.

Nevertheless, no scientist likes to be subject to control, that is inherent in a scientist and I would not expect him to like it and he would not be a good scientist if he did.

Now, we have had a very long period of time during which the scientists in this country have voluntarily submitted to arbitrary con-

trol. The question is not whether it was too rigid at one point or another or not rigid enough. Those are details. Those controls had to be there and they were there; but they did not like them.

When the war was over, I fully expected that the scientists in this country would begin to break loose of such controls and would make a great deal of the point that they have been kept under rigid control. I have been surprised that there has been as little said on that subject as there has been. I have been surprised that the scientists not only during war patriotically submitted themselves to an organization in which they did not feel natural, but I was also surprised that, at the end of the war, so little outcry has been made about it. The scientists have done very well indeed and I am proud of them.

The CHAIRMAN. But that is one of the reasons, this release from patriotic compulsion, war compulsion. Don't you think that that is the reason why a good many of them have left?

Dr. BUSH. Yes, for that reason, of course, with the war being over. Most scientific men, engineers, and so forth, felt a great inclination to leave the development of weapons, and so forth, and get back to their normal pursuits. That is only an inclination which is natural, not only natural, but a wise one.

It is wise, because we need in this country plenty of scientists in industry to aid in reconversion. We need, also, men in the colleges to train returning veterans. Due to our manpower policies during the war, we have a decided deficit in scientists and technical manpower. The effects of this deficit in this country we will feel for many years.

There has been a natural inclination for scientists and technical men to leave war work and get back into industry and universities and that is where they should be. That disintegration, as you called it, that has extended throughout the entire range of war research and development is going on in my own organization. We are down to about 5 percent of our maximum operation.

We are carrying on a certain amount of work, primarily on medical research, on new instructions from the President, rather than having an abrupt termination. However, practically all of our work on weapons has been stopped since the war has been over.

So, of course, the men want to go back and they are correct. They should go back.

Now, in this particular field, these scientific men have done a very difficult job; it has been a hard work and they are all tired out, they want to get away from the war.

Senator RUSSELL. The scientists and the soldiers are GI Joes under the skin.

Dr. BUSH. That is right, they have the same feeling about it. The scientist, due to the nature of his training, had to serve in the laboratory rather than in the field, but they both think the same way about it.

Senator VANDENBERG. I imagine you could not compete with industry, in the scientific field, when it comes to pay?

Mr. BUSH. In the Manhattan project, under contract with some of the companies we had competition. I think there is no reason why we shouldn't be able to compete in a reasonable way.

However, I do not think that that is quite the point. I do not think that the matter of salary usually enters into it.

The CHAIRMAN. I have some more questions, but I do not want to monopolize this hearing. Do any other Senators have questions?

Senator HICKENLOOPER. I have just one question here.

The CHAIRMAN. Certainly, Senator.

Senator HICKENLOOPER. And I just wanted to ask you this, Doctor. Assume that a nation of the size and resources that we have will make promises not to use atomic power for bombs. Assume that secretly, in the minds of its leaders it intends to go right ahead and pursue a policy of making bombs.

In your mind is there, at this time, any effective control against such deception?

Dr. BUSH. At this time?

Senator HICKENLOOPER. Yes.

Dr. BUSH. At this time—

Senator HICKENLOOPER. At this time or within the reasonably near future. I mean, is there any effective control except in the sense that we might be prepared to use immediate force when we find out about it? In other words, other than force, the use of force at the present time, do you think that we can defend ourselves against a nation which might be following what might be called a dishonorable attitude, giving lip service toward peace and seemingly in conformance but secretly not?

Dr. BUSH. Well, there is nothing improper about any nation arming itself in order to maintain its security to a reasonable extent. We are doing so, other nations are doing so, and it is quite appropriate. I feel that the way in which they do it is up to the nation, that it is not our affair at the present time and should not be until they have arrived at international cleavage. There is no violation of an agreement, because none exists.

Now, if you are looking toward the future where there may be such an agreement, I would say let us approach this problem in such a way that when those agreements have been made they will be kept and not avoided.

In order to do so, let us go forward, let us make those agreements in such steps that each step will be one which the nations can and will wish to carry out.

Senator HICKENLOOPER. And that is the reason for your strong recommendation that we take this matter progressively by stages?

Dr. BUSH. Yes, sir.

Senator HICKENLOOPER. And not attempt to rush full-blown into it in the very immediate future?

Dr. BUSH. Yes, sir.

Senator HICKENLOOPER. Thank you.

Senator RUSSELL. I have just one question. It is not really a question, I will ask it merely for the purpose of my own information.

My attitude toward scientists, to use an illustration, is pretty much like the attitude of the boy living in the country going to the country doctor. He thinks the doctor can do anything.

Dr. BUSH. Some of the scientists do, too, Senator.

Senator RUSSELL. I am glad to hear that.

Now, I would like to know what are the possibilities of generating atomic energy from other elements, other than uranium.

Dr. BUSH. Well, I am not a nuclear physicist, of course, and I think that you might get better testimony on that from some other men.

My understanding on the matter is this, that the utilization of atomic energy at present can be found only among the elements at the

extreme of the periodic table, primarily in the very heavy elements, such as uranium and polonium. Hence, if other elements are brought in, I think that they will also be the very rare, unusual elements that are beyond uranium in the periodic table.

Personally, from what I have learned and from what I know about it, and I have associated with these men for many years, I think it is highly improbable that atomic energy will be produced out of any such things as common materials.

Senator RUSSELL. Lead, for example.

Dr. BUSH. Lead, for example.

Senator CONNALLY. Well, they will keep on trying, will they not, scientists will keep on experimenting, will they not?

Dr. BUSH. Well, even scientists do the things that they think can probably be done.

Senator CONNALLY. That is true, but they will be trying other things, they will be working in other fields and among the other elements. Maybe they think that they will fail, but they will keep on trying.

Dr. BUSH. I think the better answer will be that I am quite sure that the efforts of scientists will be devoted to those elements that are at the extreme of the periodic table, because that is where progress can be made and where they will feel that there is a probability of success.

The CHAIRMAN. Dr. Bush, you stated in answer to Senator Johnson's question that fissionable materials are going to be made. You mean by several countries or continued in this country?

Dr. BUSH. Russia, I believe, has already stated that they will. I believe Molotov made the statement to the effect that they propose to develop atomic energy. From Great Britain there have been statements in the Commons, I believe, to the effect that the Government is developing a plan for making atomic energy available. I think, as any other country becomes economically in the position where it can undertake such a project, it will.

The CHAIRMAN. Now, Doctor, you spoke about our economic resources with reference to power in this country and how well developed they are as compared with some of the other areas of the world.

I take it that you feel—if I misunderstood you, I wish you would correct me—that it would be an unfair requirement, or shall I say an unlikely requirement, unlikely in the sense that they would not agree to it, to specify, in some kind of an international agreement which we might go into, that the peacetime use of atomic energy not be permitted?

Dr. BUSH. No. Think what you would be asking the world, Senator. In the first place, it is not the atomic bomb alone that threatens the world. Let me make that clear.

I will make it clear this way. By the use of incendiaries we wiped out great areas of the Japanese cities. The most effective of those incendiaries was developed in my organization. I knew what it could do, I knew from the studies which had been made what it could do to the Japanese cities.

The decision to use them was made by President Roosevelt, after due consideration of what it meant. It was a difficult thing to answer: Would we wreak devastation on Japan's cities, realizing that in order

to wipe out the industries within those cities we were bound to kill innocent people?

We did, because only in that way could we shorten the war and save lives. At the time that that decision was made, I had a serious problem in my mind as to whether that was justified, but fortunately I did not have to make the decision myself.

I had the same question when the atomic bomb came along but to me it was not much of a question in my mind because I knew that it would end the war and save many lives.

The point I make is that it is not the atomic bomb alone that this world needs to fear. If there had not been atomic bombs, the application of science and technology had reached such a point that another great weapon—

The CHAIRMAN. For instance, bacteriological war.

Dr. BUSH. Yes. Science could produce devastation beyond thinking. We must avoid war, not just control an atomic bomb.

Now, other methods of warfare, involving incendiaries, rockets, aircraft, guided missiles, or what have you, came out. These weapons involved the entire industrialization of the Nation.

Are you going to say that no nation shall have any industrial capacity of building war materials? That, certainly, is impossible. In the same way, we are not going to say that no nation shall be industrially dependent on atomic energy.

We are going to say, rather, that all industries shall be for peaceable purposes and we will make international agreements to be sure that they do not get diverted to making war materials. I would say that would apply to atomic energy plants, as well as to any other kind of manufacturing plant or power.

The CHAIRMAN. Isn't much of what you have said based upon the feeling that it is impossible to suppress anything that is good for the health, comfort, and wealth of nations, because it goes against the very essence of human nature?

Dr. BUSH. We don't want to suppress this, gentlemen, if we could.

The science of atomic energy is in its infancy. It is probably in the stage where electricity was at the time of Faraday. Let us go back to an earlier time than that. Let us go back to when gunpowder first appeared.

When gunpowder came out, there was an attempt to outlaw it internationally. When the crossbow first appeared there was an edict of the Pope against its use in war.

Gunpowder, nevertheless, came in as an explosive. Certainly it might have been outlawed as an explosive. If that had been the case, it would have been of no good to man. Its utilization as an explosive material was merely the entering affair; it led to a vast chemical development, out of which have come all sorts of chemical industries, out of which have come a contribution to the rise of our standard of living.

In the same way, electricity came in. We can use electricity for guiding a missile from a launching platform to hit a target. But we can also use it and we do use it for communication and light; electricity has created a rise in the standard of living of the world.

In the same way, atomic energy comes in, first as an explosive. Any new thing is likely to come in the simplest, easiest way. Uncontrolled

explosion is, on the whole, much easier than the controlled use for development of power.

But no man can say today where this new path may lead. If we believe that the path of expansion of knowledge, expansion of man's control over his environment, that long path—if we believe that that path is, on the whole, upward, then we must believe that this new knowledge will also take its ultimate place where it will be useful for man's purposes for good and to where we will learn to control it, for the purposes of good.

The CHAIRMAN. Doctor, to reach the objection proposed by Senator Johnson and also advanced by some of our other witnesses, that peacetime use of atomic energy in power plants complicates the problem of control, would it be possible or feasible, do you think, to have any such peacetime power plants, controlled under the United Nations Organization, to be internationally maintained with, perhaps, a stock to be owned on a basis of contributions, such as the UNRRA organization. That is, each country putting in that portion which their national income will justify for international control of these power plants, internationally inspected and internationally operated?

Dr. BUSH. It certainly would be possible, whether it would be desirable or not.

I think, myself, upon that question that, in certain places, owing to certain considerations, such as territories under trusteeship, that such an arrangement could be used to bring atomic power to remote districts, that it might be advisable.

However, I have no idea that nations that do not have power plants owned by the nations themselves would like it. I think it is necessary to avoid that. I think that that is just one feature of the whole international economy which needs a better understanding if we are to eliminate war from the world.

The CHAIRMAN. Doctor, it has been testified, or I believe there has been published, information that we are continuing to manufacture bombs. Have you any comment on that policy?

Dr. BUSH. I would make simply the comment that we are also continuing to maintain an Army, although it is rapidly becoming very small. We are continuing to maintain a Navy. We are continuing to maintain the varied elements of our armed forces for our own defense which we think necessary.

So long as we proceed down that path, to the point where we have a reasonable strength, I do not think that any nation in the world will think that we are building that strength for aggression.

I do not think, therefore, that it will interfere in any way with the procedure of coming to international understanding with other nations which are doing the same thing.

The CHAIRMAN. Doctor, this fissionable material that we are making to fabricate into bombs could be used right now, some of it, for peacetime purposes—in medicine, for example?

Dr. BUSH. No, not quite, Senator. Some of the byproducts would be useful for medicine. Just as soon as the commission is set up, I hope that it will make arrangements as rapidly as possible for getting those byproducts disseminated for medical experimentation and other scientific experimentation, but that is a byproduct.

Now, as far as the fissionable material itself that is useful for bombs, it will also ultimately be useful for power purposes, but not immediately. We need a period of time, a period for development.

Senator VANDENBURG. What do you think it is, a year, or 2 years, or what?

Dr. BUSH. The first step could be taken almost at once, and that is the development of heat for industrial purposes. I could see its being used right now for heating. For instance, it could be used for heating the buildings in Washington. We could today, I believe, let a contract to a company to change the installation we now have over to atomic energy, if we wanted to. That is a very simple step, the only problems would be problems of safety, of taking care of the radioactive materials in such a manner as to be sure that there was no danger of poisoning the population.

Senator BYRD. What about the comparable cost?

Dr. BUSH. Within a few years—

Senator BYRD. What about the comparable cost?

Dr. BUSH. I think probably today, Senator, the comparative cost, if we did it immediately, would probably be more than it would be if we waited. I don't think we would want to plunge into that tomorrow. While we could place such a contract, I think we would not. But I do think that within, oh, 3 or 4 years, as industrial companies study and work on this matter, the application of atomic energy for heating purposes will be made economically feasible in many parts of this country.

Senator JOHNSON. The water would be radioactive?

Dr. BUSH. No, not with proper precautions. That is the point I have brought in, that there has got to be ample precaution taken to control the radioactive products.

I feel quite sure that can be done and done with reasonable cost.

Now, suppose we go beyond that, suppose we go to the use of atomic energy for developing power. That is somewhat further out. How long it will take I don't know. It depends on how hard we are going to work on it. Until that time comes, of course, we have no use for fissionable material except for storage. It does not deteriorate and we can store it and, when the time comes when it can be used for generating power, it will be available for that purpose.

The CHAIRMAN. Doctor, most men in the field have had some estimate as to how long it would take other nations to get into production of fissionable materials. I suppose that estimate would have some bearing upon our sense of urgency in arriving at a system of control.

Now, what, if you would care to give it, is your best estimate? I realize it would be an estimate. What time will it take for any other nation to get into operation?

Dr. BUSH. Well, I would like to qualify my answer, in order to be clear, because conditions determine the answer to such an extent.

To take an example, Great Britain could, if it wished to throw its industrial effort into it, if they went into the thing on an all-out basis, there is no doubt that they could build and put a plant into operation in, say, 3 years.

On the other hand, I think it is highly questionable that Great Britain would wish to do it on such an accelerated basis. They might be able to do it in a year if they put wartime efforts into it—priorities and all sorts of measures taken in wartime.

I think, rather, that they would wish and choose to do it on a longer time scale, and hence more economically.

The CHAIRMAN. Of course, Great Britain would have no fear of any stock pile of atomic bombs which we might have.

Dr. BUSH. I agree with you, I do not think they would have any fear, any more than they would be afraid of our Navy and Army.

The CHAIRMAN. How about other nations?

Dr. BUSH. Well, take a nation like Russia. I think she, if she threw her full weight into it and if she imported freely those things which she does not herself manufacture adequately at the present time, then I think in 4 or 5 years she could have a plant in operation. On the other hand, if she did it relying entirely on her own resources and building those up as she proceeded, meaning by that that she would have to build plants to make the parts before she could use those parts, I think it would take them somewhat longer, it might take as long as 20 years, if she did the entire process that way.

Now again, if she wishes to accelerate the process by making it very important, all-important, in her economy and if she makes the sacrifices in her standards of living in order to accomplish it at a maximum rate, it might shorten the time somewhat. I do not think she would choose to do it that way because it would be uneconomic.

Senator TYDINGS. May I ask a question?

The CHAIRMAN. Yes.

Senator TYDINGS. Dr. Bush, have you any doubt—first, preliminary to my question, let me say this: I don't believe that it has been shown that this new government which has come into being in Russia has ever been guilty of bluffing. It has had the merit of saying it would do something and then doing it, and it has taken a very realistic approach to things. It was realistic with respect to Hitler and the German crisis.

You will remember that they did reduce the standard of living of the Russian people so far as was possible to prepare for this war, over a long period of years. It was their own program.

Now, keeping that in mind, and in view of a statement of Mr. Molotov that they would have atomic bombs "and more," is there any room for doubt that the Russians are now proceeding with all their might and main, so far as they know how? Can there be any doubt of that?

Dr. BUSH. I think it would be very doubtful, sir.

Senator TYDINGS. Why?

Dr. BUSH. At the time when Russia had her 5-year plan and when she made her sacrifices which you mentioned, she was threatened by Hitler and by the military development of Germany and she knew that she would have war.

But now, it is different. I do not believe that they feel that way now.

Senator TYDINGS. But how do you know that the Russians do not still consider themselves threatened?

Dr. BUSH. I am quite sure that the Russians do not feel that we are a threat. We do not have interests which conflict seriously. They know that we are not warlike; they know that for a fact.

If I believed that Russia feels threatened by the United States, I would despair of their realism. I think they are very realistic.

Senator TYDINGS. Do you think Molotov was just simply making conversation?

Dr. BUSH. All he said was that they were going to have atomic energy.

Senator TYDINGS. He said they would have the atomic bomb "and more."

Dr. BUSH. What are, do you think, "and more"?

Senator TYDINGS. The discovery of new weapons.

Dr. BUSH. All he said, as I got it, was, "We are going into the development of this field." That is what Russia is going to do, and I feel quite sure that they will do it well. He did not say that they were going to develop it at the maximum possible speed. I would be quite surprised if it was made a matter of such urgency, under the present circumstances.

Senator TYDINGS. You don't think it will be made a matter of urgency under the present circumstances?

Dr. BUSH. I say there is no reason whatever why they should make it such a matter of urgency, why they should sacrifice all of their other interests.

They have a great interest in restoring their economy after this war; they will be busy.

Senator TYDINGS. That is true. They also have an interest in survival, as we have.

Dr. BUSH. Let me say once more that there is a great difference between Hitler and the Germans and this country, and the Russians know it.

Senator TYDINGS. Well, if I were a Russian, I would want to proceed with all possible speed right now. I don't mean what I am saying as criticism, but I do say that if they had a bomb I would want my government to proceed.

I think they are just as human in their feeling toward their own country. They love their country, and they want to protect it.

Furthermore, I think it would be contrary to all recent Russian history if they did not try to keep abreast with all the others.

Dr. BUSH. We have to think of it as a whole. If we limit it to one factor alone, we might distort the whole picture.

For instance, there is the matter of delivery of the bomb, whether it be by airplane, guided missile, rocket, or other means, we have the problem of delivery of—

Senator TYDINGS. And the suitcase.

Dr. BUSH. Yes, although when you mention that, that brings up something I would like to comment upon.

You have the elements of war. You have the Army, the Navy, submarines—the whole power of war. The atomic bomb is one element only, a very important element and the deciding element at the end of this war, and in the future, when bombs are plentiful, if they ever are, I think it will be controlling.

Today, however, in thinking of our national defense, we don't think of atomic bombs alone, and we should not think of them alone. We think of a great many elements.

So does Russia. I believe that Russia, like ourselves, will maintain such armed forces as she will determine will be needed for her national security in a reasonable manner as to—

Senator TYDINGS. And also maintain its plant?

Dr. BUSH. Yes, as a part of that system, that is quite right.

Senator TYDINGS. And, therefore, you think that they are approaching this in a rather leisurely way?

Dr. BUSH. Not leisurely, but in the same way we are, with a determination of reasonableness.

Senator TYDINGS. I cannot imagine anything more important in the national defense, so far as Russia would be concerned, right now, than the production of atomic bombs in Russia. I say that in no spirit of criticism. If I were running Russia, knowing that one nation had this great weapon and that we did not have it, it seems to me that I would be getting on the job right away to get it. I would get it so that I could be in as strong a position as any other nation for the business of war.

To show you what I mean, I would not want to sit down in a poker game where one fellow had a royal flush and I had two deuces, three treys and a five spot—

Senator BYRD. I would ask for another deal. You would be holding six cards.

The CHAIRMAN. Do you want to amend your hand, Senator?

Senator TYDINGS. Well, let it go.

Dr. BUSH. My point is that I don't think they will sacrifice their national economy.

Senator TYDINGS. You don't?

The CHAIRMAN. Dr. Bush, you spoke of atomic bombs as being capable of control, that they could be controlled when they came into existence and after they came into existence.

Now, we had here last week some testimony, and I believe it was Senator Tydings who brought up the example of 40 of these bombs being planted in 40 of our major cities and activated at the same time, and there was discussion of the consequent tremendous loss of lives, maybe 40,000,000 people.

Do you believe that the country could wage any war after such an event?

Dr. BUSH. I don't believe the event would occur.

The CHAIRMAN. Well, I don't think so either.

I didn't think Pearl Harbor was going to occur, but it did.

Dr. BUSH. Yes, but we don't have to believe in miracles. I can say this, that this situation is serious enough without going back into Jules Verne and Buck Rogers. I have been annoyed in recent weeks in reading some of the discussion about these possibilities. We have realistic things enough to think about, without going into the realm of fantasy.

The CHAIRMAN. I am interested in the realistic, too. What is unrealistic about carrying in an atomic bomb in sections and planting it in one city, if not in 40 cities?

Dr. BUSH. Well, thinking realistically about it, I would say that at the present time there are no atomic bombs in the world except the ones we have got, and we certainly don't intend to do it.

Now, what are you asking?

Are you asking about now or 10 years from now? I will have to know that. I want to know the conditions, the conditions of international understanding, and approach the question from that standpoint.

I think the question is without meaning at the present time because it is in regard to the future. We do not know the nature of war as

it might be then, and until we do know I don't have any answer to the question, I can make no comment as to such a fantastic way of using bombs, whether it would be feasible or not.

Senator AUSTIN. But you have heard about that, about suitcases?

Dr. BUSH. I have heard about suitcases until I am tired of hearing about them.

Senator TYDINGS. Doctor, you do know that there were plenty of plans for sabotage during the war—of course, with such things as dynamite, and so on, not atomic bombs. Most of the plans were frustrated during the war because we captured the saboteurs when they landed from a submarine.

We also know about Pearl Harbor; we also know about Poland, and we also know about many similar cases throughout history.

We have got to prepare not only for this hour and this minute and the next 6 months, we have got to enlarge, imagine, and comprehend this thing not only as to what it is but as to what it will be 5, 10, or 20 years from now. We have got to lay a foundation.

Dr. BUSH. That is quite right, Senator.

Senator TYDINGS. The only thing I am interested in is this: Is it possible, in your opinion, in 5, 10, 15, or 20 years from now, assuming that a foreign nation or a group of nations intended to make war, that foreign agents, undetected, could come into this city with atomic bombs and plant those bombs and explode them simultaneously?

Dr. BUSH. You mean simply from the standpoint of not being interfered with?

Senator TYDINGS. Yes.

Dr. BUSH. Such as driving a truck across the border?

Senator TYDINGS. Yes.

Dr. BUSH. The answer is "Yes," of course.

Senator TYDINGS. Also, for instance, they could drive a submarine up the river here and carry it in on a truck into Washington?

Dr. BUSH. I think that is a little complicated; it sounds that way to me. Without going into details, however, the answer is "Yes, from a technical standpoint."

Senator TYDINGS. The point is that it could be done?

Dr. BUSH. Yes. But by the same token, it is technically possible to drive 10,000 trucks across the border, each with 10-ton bombs, and do in the same way. That is a technological thing only. It is an entirely different question, whether any nation would do such a thing—quite different.

Senator TYDINGS. Well, as the world is constituted today, perhaps it wouldn't be. I saw Germany rise again after the last war, and I am not certain that she will not rise again after this war, in spite of its disasters, and I am not certain that, in another 20 years, there will not be another Hitler to bring the world into war again.

We don't know what will happen. Maybe the stock market will be as high as it was in the 1920's and people will be more interested in gambling than in national defense.

We have to look into the future, 10, 15, or 20 years ahead. I see no reason in the world to assume that we might not have another Hitler and that he might not send his agents over here to blow us up.

Dr. BUSH. Senator, I would not want you not to look into the future, and I would not urge you not to use your imagination.

My point is simply that we have plenty enough to think about that is very definite and very realistic—enough so that we don't need to step out into some of these borderlines which seem to be, to me, more or less fantastic.

Let me say this: There has been a great deal said about a 3,000-mile high-angle rocket. In my opinion, such a thing is impossible today and will be impossible for many years.

Senator TYDINGS. But not ultimately impossible?

Dr. BUSH. I say nothing is ultimately impossible, because I do not know. But I can say with confidence that I would not know how to do it today, and I do not think that any man in the world, today, would. I am speaking about a 3,000-mile rocket.

Senator TYDINGS. What would you have said, 10 years ago, about the 100-mile buzz-bomb?

Dr. BUSH. I would have said, 10 years ago, if anybody wanted me to design a 100-mile buzz-bomb, that I could readily get people to do it.

Senator TYDINGS. What do you think will be the limit, 10 years from today, as to range?

Dr. BUSH. Buzz-bomb?

Senator TYDINGS. Yes.

Dr. BUSH. 2,000 miles.

Senator TYDINGS. 2,000. Then, what is there to stop you from putting on that rocket or buzz-bomb with a 2,000-mile range an atomic bomb?

Dr. BUSH. A buzz-bomb flies in the air; an airplane flies in the air. You can leave the crew out and you can control it by remote control. The buzz bomb can fly just as far as an airplane and carry the same load, and it is subject to all the antiaircraft interception that an airplane is subject to.

Senator TYDINGS. But there is no reason why the atomic bomb could not be put in that device?

Dr. BUSH. No, there is no reason why you could not put an atomic bomb in such a device. It could be delivered in an airplane, say, over Japan, without a crew, if somebody wanted to do that.

But the people who have been writing these things that annoy me haven't been talking about that. They have been talking about a 3,000-mile high-angle rocket, shot from one continent to another, carrying an atomic bomb and so directed as to be a precise weapon which would land exactly on a certain target, such as a city.

I say, technically, I don't think anybody in the world knows how to do such a thing, and I feel confident it will not be done for a very long period of time to come.

Senator TYDINGS. Of course, it would not take much brain power to use an aircraft carrier or some modification of an aircraft carrier and equip it with rocket-firing guns and get within 100 miles of the shore and use the atomic bomb from there, from 100 miles?

Dr. BUSH. That is what I mean when I say that we have got enough troubles, enough serious practical problems to deal with now, without letting our imagination roam.

The CHAIRMAN. Well, Dr. Bush, I read in this week's Collier's magazine an article by General Carl Spaatz of the Air Forces. I would like to have you read that article.

Dr. BUSH. That would not worry me in the slightest degree. I have just been criticizing the report of General Arnold of the Army Air Forces.

The CHAIRMAN. I wish that you would, sometime later on, comment on that article.

Senator TYDINGS. What does it say, Mr. Chairman?

The CHAIRMAN. What it says, Senator, is that the Germans, the year preceding the end of the war, were designing a rocket, and were pretty well along on it, that could carry from that continent to this continent and that would contain a warhead. They did not, of course, at that time have in mind an atomic warhead. That is my understanding of the article, at least.

Of course, I do not qualify General Spaatz as an engineer, but he has written this article in Collier's.

Dr. BUSH. If you were talking about 400 miles or 500 miles, I would say by all means. That is what the Germans did with their V-2. I would say yes, even with 2,500 miles.

But 3,000 miles? That is not just a little step beyond, it is a vastly different thing, gentlemen. I think we can leave that out of our thinking. I wish the American public would leave that out of their thinking.

Senator TYDINGS. If you were Secretary of the Navy or Chief of Staff, as Admiral King is, and had the responsibility for keeping our fleet up to par and ready for all emergencies, and you had Congress in back of you, what would there be from hindering you from taking one or more aircraft carriers and modifying them or adapting them so that they could have an equipment of guns that would fire an atomic bomb 200 or 150 or 100 miles?

Dr. BUSH. I would like to say not a gun, a rocket.

Senator TYDINGS. Whatever it might be. You could then stand off the coast out of sight and level the cities along the coast, could you not?

Dr. BUSH. Provided the country you are trying to level doesn't do anything about it.

Senator TYDINGS. But they would not know about it. We did not know about Pearl Harbor until too late.

Dr. BUSH. If I were the Secretary of the Navy, I would be sure to see that the best possible group of people, both Congress, military men, scientists, engineers, industrialists, study every angle of the armament of the Navy to see what the relative emphasis ought to be on the developments of today.

More than that, I wish that that could be done effectively and rationally and not merely service by service, because we need a national program of research and development on weapons and we have not got it at the present time.

However, whether your particular scheme would fit in that, Senator, I do not want to say.

Senator TYDINGS. Pearl Harbor made a profound impression on me, and so did the development of the atomic bomb. I don't want to be caught napping twice at the same open switch.

Senator JOHNSON. Dr. Bush, you are just about the most reassuring witness we have had. You are different from the other scientists which the committee has had; they were all gloomy scientists, and they have made these hearings virtually a chamber of horrors.

Dr. BUSH. On the other hand, please don't misunderstand me. This is a tough problem and it is going to be a long time before we have a solution to it, but I am not pessimistic.

Gentlemen, I believe the advent of the atomic bomb means the end of great wars, world wars. I hope that I am right. But it is going to take a long time and a lot of hard work to get to that consummation.

Senator JOHNSON. I possess the same kind of optimism that you have, and I believe that this new creation will stop wars.

Dr. BUSH. As General Eisenhower said, it might blackmail the world into peace.

Senator JOHNSON. I hope you are right. But, using your illustration of a few minutes ago, you said that when gunpowder came out, and the crossbow, and other weapons of war, they tried to outlaw them. On the other hand, there was the statement made with each of those weapons, as it came out, that it would be so bad that it would stop war. Well, they did not.

Dr. BUSH. There is a lot of difference, Senator. I think this is the first time we have had a new element come into it of this type.

I cannot imagine two nations, each of which had atomic bombs in quantities and in each of which the people knew all the facts and knew the world situation and in each of which the government was responsible to the people, I cannot imagine two such nations ever going to war.

Senator TYDINGS. Your imagination outstrips mine. To me it seems as if you have laid down a premise of two great nations that have all the things that go into the making of a war.

I think that we have even a longer road before us to travel than you have indicated in the control of the atomic bomb. I hope it is not so. I am really in sympathy with your objective and my only reason for asking questions is that I want to make sure that our use and consideration of this new weapon does not tie us to a state of unpreparedness.

Dr. BUSH. Right. Right. But let me repeat, as I said before, that meanwhile this Nation has got to be strong.

SENATOR TYDINGS. That is right.

Dr. BUSH. We ought to be so strong as not to threaten anyone else's security but so strong that there will be no question about our own security.

Senator HART. I do not want to ask Dr. Bush a question. I want simply to say something about him.

I learned of his wartime activities some time ago. Naturally, what I learned primarily was his activities as a scientist. I followed them somewhat and I was particularly struck all the time by the doctor's balance and his innate and continuous common sense throughout this difficult time, these difficult years which we and he have been going through.

This statement which he has produced this morning is very representative of those qualities in him. It is, as we might expect, a brief statement and I sincerely hope that it will be published in full all over the country. I have not seen anything which would be so effective as this statement, in my judgment, much more effective than this article in Collier's Weekly, the article which you referred to, Mr. Chairman.

The CHAIRMAN. I hope you understand, Senator, that I do not vouch for what General Spaatz said, but since 5,000,000 or 10,000,000 people are going to read it, it probably would be well if we could have some comment on it from Dr. Bush.

Now, Dr. Bush, General Groves in his testimony before this committee mentioned a figure of \$500,000,000 a year for the operation of these plants. Have you given that matter any thought at all?

Dr. BUSH. No, sir; I haven't been into those estimates.

The CHAIRMAN. If, to take it hypothetically, if such were the figure, what part, what proportionate part do you think we should devote to further peacetime uses and what part to military uses?

Dr. BUSH. It is very hard to separate them, Senator, of course. In fact, you might say that every part of material produced would be capable ultimately of being put to commercial purposes, peaceful purposes, if the commercial development is successful, as I feel quite sure it will be.

Senator HICKENLOOPER. Mr. Chairman, may I ask a question?

The CHAIRMAN. Go ahead, Senator.

Senator HICKENLOOPER. I just want to revert to a statement you made a moment ago, I believe to Senator Johnson, in which you said you could not imagine two nations where the people of the countries knew, that you could not imagine those nations going to war with each other.

With regard to your approach there, the point he was trying to raise a while ago, I think, that ultimately we would reach our final production of this bomb and there would be a time when we could relax.

Do you feel that there might come a time when the people of the country might realize the enormity of this thing and realize the potential destruction, and do you think that then, in turn, they will police their officials, if you please, to keep the heads of the governments from using this power to the destruction of people?

Dr. BUSH. Quite right.

The CHAIRMAN. Dr. Bush, do you believe that a scientifically feasible control system can be worked out?

Dr. BUSH. Scientifically, such a system could be worked out. I would go more than that. I think a practical system, a system practical and feasible, can be worked out in time, after we have gained a knowledge sufficient for the purposes of control; yes, in time.

The CHAIRMAN. In time. Well, now, if the principal nations or the United Nations were to meet in session and agree to a scientific system of control, would you not be in favor of putting it in immediately?

Dr. BUSH. I don't think I know quite what you mean.

The CHAIRMAN. Let us assume that they meet in the United Nations Organization and that they set up a commission. The commission reports with a recommendation for scientific inspection, inspection of all the countries of the world.

Dr. BUSH. For what?

The CHAIRMAN. To see whether or not there is fissionable material made and, if so, by what process and whether or not any military use was going to be made of that material. Would you not be in favor of putting it into working order immediately?

Dr. BUSH. I think that would be going rather far for a first step.

The CHAIRMAN. Well, if it could be accomplished, it would be highly desirable, would it not?

Dr. BUSH. Yes; but I imagine that there will have to be several steps. The first one might well be an agreement among the nations

through the United Nations Organization to make known all the situation in regard to resources in war materials and the extent to which they are being moved, and so on.

The CHAIRMAN. To that extent you would be in favor of an agreement?

Dr. BUSH. To that step, certainly.

The CHAIRMAN. Or to all steps to a scientifically feasible inspection system?

Dr. BUSH. But an inspection system, Senator, has got to be for a purpose. There is no use talking about an inspection system in the abstract. What is the inspection system supposed to do?

I have given you one example and in that example, that case, the inspection system would be to find out the facts in regard to the distribution of the resources and raw materials and their shipments. As I say, I believe such a system could be set up and it would work effectively.

Now, if we could find another step, the next step—

The CHAIRMAN. What would be the next step?

Dr. BUSH. Specifically, it does not need an immediate setting up under the United Nations Organization of an inspection system with vague and general commitments. Rather, it means that we set up first an agreement among the nations to make certain facts known and then an inspection system to produce explicit effects—which is a very different thing.

The CHAIRMAN. Well, do you think a demonstration of the power of this thing to statesmen of this world might hasten their agreement to a completely implemented inspection system?

Dr. BUSH. No. There has been sufficient demonstration in Japan.

Senator HICKENLOOPER. In other words, the statesmen of the world know what this thing can do now.

Dr. BUSH. Of course, and so does everybody.

Senator HICKENLOOPER. We have got to the point where we have rubbed the lamp and the genie has come out and we cannot get him back into the lamp.

Dr. BUSH. That is right.

The CHAIRMAN. My point is, Doctor, whether or not you agree that we should take a lot of steps, fast, Doctor, which might be for the betterment of the future health and safety and security of the world.

Dr. BUSH. Right, but not too fast, Senator. We must adjust the burden to the means that can be employed and we should proceed with such deliberation that we can be assured that the agency we set up is successful from the outset and will continue to be successful and shall not be overburdened.

The CHAIRMAN. Dr. Bush, I want to thank you on behalf of the committee for your statement. It may be that we might ask you to come back here later.

Dr. BUSH. I would be very glad to come back any time.

The CHAIRMAN. Thank you.

There will be no session of the committee tomorrow. We will resume on Wednesday at 10 o'clock.

The hearing for today is adjourned.

(Whereupon, at 12:30 p. m., the committee adjourned until Wednesday, December 5, 1945, at 10 a. m.)

X

ATOMIC ENERGY

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

FIRST SESSION

PURSUANT TO

S. Res. 179

A RESOLUTION CREATING A SPECIAL COMMITTEE
TO INVESTIGATE PROBLEMS RELATING TO
THE DEVELOPMENT, USE, AND CON-
TROL OF ATOMIC ENERGY

PART 2

DECEMBER 5, 6, 10, AND 12, 1945

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III

ATOMIC ENERGY

WEDNESDAY, DECEMBER 5, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Johnson, Byrd, Austin, Millikin, Hickenlooper, Hart.

Also present: Representative John R. Murdock; Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. We have with us this morning Dr. Oppenheimer, a most distinguished nuclear physicist, who was in charge of the Los Alamos laboratory, which was one of the most important parts of this project.

The doctor has flown across the country to meet with us. I am glad to see you, Doctor, and if you have a prepared statement, go ahead and make it; and at the end of that we will ask you some questions.

STATEMENT OF DR. J. R. OPPENHEIMER, PROFESSOR OF PHYSICS, CALIFORNIA INSTITUTE OF TECHNOLOGY

Dr. OPPENHEIMER. I think you may wish to know my qualifications. I am a physicist and teacher of physics at the California Institute of Technology in Pasadena and at the University of California in Berkeley.

During the war I was in charge of that part of the work which had to do with the use of the special materials, Uranium-235 and plutonium, for the actual design and making of atomic bombs.

There are one or two important respects in which I am not a qualified witness, and I think I should point these out to the committee. The operations in Tennessee and in the State of Washington took very great advantage of American industrial organization, and, once the basic principles and designs of the process were elaborated, enormous demands were made on some of the greatest corporations for the actual construction and operation of these plants.

In the work which we did in New Mexico, we were neither able to take advantage of industrial experience, nor did we in fact do so, and therefore there is a very important part of the job which I am not competent to testify about, namely, the part that was played by

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American industry in creating these atomic weapons. I think it essential to emphasize this, because I deplore the tendency of myself and my colleagues to pretend that with our own hands we actually did this job. We had something to do with it. If it had not been for scientists, there would have been no atomic bomb; but if there had been only scientists, there also would be no atomic bomb.

I have an extremely brief prepared statement. May I read it, sir?

The CHAIRMAN. Certainly.

Dr. OPPENHEIMER. This committee has been created to deal with problems of more than ordinary gravity. It is proper that those of us who have had technical knowledge and responsibility in the work on atomic energy should attempt, in every way we appropriately can, to be helpful. Perhaps I can do that most effectively by answering your questions. I should be reluctant to take your time with a long statement of facts and arguments with which you are well acquainted. It may be that you will wish to ask me of things that cannot be adequately discussed at this hearing, because they are secret. I shall be glad, insofar as I am competent, to go into these matters with you at another time.

I may interpolate here and say that it is my view that this committee should have any information which in its opinion is required for the carrying out of its grave responsibilities, and if I can help get that information to you I should be glad to do so.

In the all-important problems that are not primarily technical it is my conviction, as it is of the great majority of my colleagues, that we must speak, if at all, not as scientists but as American citizens. For in these questions the welfare of science is inseparable from the welfare of the American people, whom you represent.

Let me explain this as I see it. Science has flourished because, in the long term, its works were good for mankind. It has often happened in the past that the progress of science has turned up some development that was hard for society to digest; at such times we have learned not to repudiate science but to accept it and to use it to reshape our ways of life. Last summer the progress of science turned up something very indigestible: the atomic bomb. As a culmination and a complement to a long series of technical advances in the arts of war, atomic weapons have made it necessary to examine with a new earnestness and a new courage the steps by which peace could be established, maintained, and made permanent. Only insofar as this is successful will science itself survive and flourish. In the world of atomic war it will not be true that the works of science are good for mankind. A world fearful of cyclotrons is a world fearful of knowledge. It is not a world in which science can survive. In this issue of peace our interest is the interest of America, the interest, I think, of all the people of the world.

Scientists have spoken very much of atomic energy. Undoubtedly this will have been construed as expressing a desire on their part to assume the responsibilities of statesmen. I do not believe this. I believe that the solution of the problem created by the development of the atomic bomb does not lie within the field of science—that this is a political problem, a deep problem of human values, and a problem of statesmanship. It is to this end that we have testified, that I

should be glad to add my testimony. Let me restate a few of the points that you may wish to ask me about:

There follows a summary of some of the things which have been testified to by scientists and others.

There are, and there will be, no specific countermeasures to atomic weapons.

The prospects seem poor for any adequately effective military defense.

There can be no long-term security, either in the scientific novelty or in the vast technical complexity, of the project.

There are no ingenious devices whereby one nation could detect or control atomic armament in another nation committed to sovereignty and secrecy in this field.

Atomic weapons can now be, and could increasingly be, cheap instruments of devastation—cheap compared to the costs of war as we have known them.

Atomic weapons are now, and could increasingly be, effective instruments of devastation, so effective that they are unlikely, in a world at war, to be renounced for humane or for tactical reasons.

Scientists may be helpful, in a world desiring fraternity, because there is a sense of fraternity among them in all lands, but in a world of admittedly secret armament, they will not even make good spies.

There are high hopes that atomic reactors can contribute to knowledge, to technology, and to the eventual enrichment of our civilization, but these developments will not avert atomic warfare, nor prosper under the threat of atomic warfare.

We have tried to say these things lest the one great hope, that there be peace on earth, and fraternity among peoples, be subverted by lesser ones, which cannot be realized in fact.

There is one thing that I should add, not as a technical witness, but as a citizen. Today all nations, all peoples, have an overriding community of interest in the prevention of atomic warfare. There would thus seem to be good reason for attempting to establish in the international control of atomic armament those patterns of confidence, collaboration, and good faith which in a wider application must form the basis of peace. There would seem to be some practical reason for undertaking such control, not only as a necessary step, but as the decisive step, on this road, that we, as a nation, have determined to follow. There may not be a comparable opportunity again.

That is my prepared statement, Senator.

Senator HART. Doctor, in your first point you say there are "no specific countermeasures to atomic weapons."

I assume you mean by that that there is no countermeasure which would operate solely by reason of the fact that the explosive in the missile is one of atomic fission?

Dr. OPPENHEIMER. That is precisely what I meant. The problem of countermeasures against an atomic bomb is technically the same problem as that of countermeasures against any other type of bomb. It differs from it only in that the numbers of such missiles may be smaller, and their effect very much greater, and that the requirements of interception may correspondingly be very much higher.

Senator HART. Would you extend that opinion to the detection of the missile in flight also?

Dr. OPPENHEIMER. I would, yes. It seems to me—and on this I will not make quite as categorical a statement, because the future may have something in store—I can see no way by which a bomb can be detected to be an atomic bomb, or detected because it is an atomic bomb, which would not apply equally well to a block buster.

You can learn to recognize its color or its shape, but it will be that kind of thing.

Senator HART. A little further down you say “there can be no long-term security.”

Dr. OPPENHEIMER. Right.

Senator HART. Do you wish to give an estimate as to how long it would take any particular nation—Russia appears very much in the press—starting today with what they now know, to be ready to deliver atomic bombs?

Dr. OPPENHEIMER. Such an estimate would be of no use to the committee. A sound estimate would have to be based on a knowledge of the economy and on the social and military philosophy of the nation, and at least I know nothing about this in the case of any other country.

I would say that I believe I know a little bit about Britain, and if Britain went into it, I think they could be quite far along within 2 years. I do not know anything about the other lands.

I think it is not a predetermined question. What this committee decides, what the Government of this country does, will have more bearing on it than anything else; because if we make it clear that no power can be a first-class power that does not have atomic weapons, we will invite the investment of an enormous effort in other lands.

Senator HART. Do you estimate that the state of industry in Britain right now is such that by going full out they really could accomplish that in 2 years?

Dr. OPPENHEIMER. I would think so. I would think it would be unlikely that they would do that, because they have problems, like building houses, which seem to me more urgent for the welfare of the British people, and which I think will be so judged in Britain.

Senator HART. Another point, Doctor, a technical one in your field: Assuming that the whole world or any nation of the world is entirely open to our inspection, are there ingenious devices, which you mention in your statement, which would be very useful in detecting the up-growth of any industry which might eventually produce atomic bombs?

Dr. OPPENHEIMER. Yes, if everything were wide open, then I think actually the problem would be solved. But if you wish to make doubly sure that the problem is solved, there is equipment with which you would get some idea of what the nature of the water coming out of a plant was, what the nature of the product was, which would supplement the ordinary visual inspection that you might expect to use.

I would put it this way: If this committee wanted to go to Hanford and to Oak Ridge and to Los Alamos, I think we could rig up some gadgets which would start ringing bells at certain points in those plants, and with which you could confirm what you already know; namely, that they were working on atomic energy.

Senator HART. In a system of inspection which would extend over an industrial nation of considerable size, it would be necessary to have a rather large force of men trained in that kind of science to operate those devices, would it not?

Dr. OPPENHEIMER. My view on that is that if you have to inspect every house and every plant as a regular thing, that you have not solved the problem.

If the inspection is used as a complement to the reports which that government will make, and to the facts which will be the common gossip of scientists and common knowledge, if you use it as a spot check to find out whether there is any two-timing by any group within that nation, it is only if you do it that way that it seems to me to have any practical elements.

A thoroughgoing inspection of everything all over the world is such a full-time job that I am afraid we would have very little time left to do any of the useful work of life.

The CHAIRMAN. I don't know; we are talking about taking a million or so boys and putting them in uniform for a year.

Dr. OPPENHEIMER. I do not mean to argue, and should not—

The CHAIRMAN. That is purported to be a protection against war,

Dr. OPPENHEIMER. I don't mean to argue that it is not worth putting a lot of effort into inspection. On the contrary, I believe it is; but I believe that that inspection must be based on a formal and open recognition on the part of the governments that they are not interested in making atomic weapons, that they are not interested in doing any of this work secretly. It will be easy to detect the secrecy, but what will be hard to detect is what is the secret.

If you take our place at Los Alamos, a year ago I think there were no physicists in this country that did not know what we were doing there. They did not talk about it, because it was contrary to the national interest. But this peculiar conglomeration of scientific talent in a very remote place aroused that suspicion, and they made quite a good guess as to what we were actually about.

Now, the fact that there is a secret laboratory there is recognized, but I think you could ask any physicist now what is going on at Los Alamos, and unless he is actually there he would not know. He would not be able to tell you whether we are or are not making bombs. I speak of "we" generically, since I am not there.

This is a good example of the fact that, once secrecy is adopted as a national policy, the problem of finding out what is secret is very tough. When it is not adopted, finding out that something is going on is very easy.

Senator HART. In a country with vast spaces geographically, so great as to make it difficult even to cover it, do you visualize the practicality of such inspection in that type of country?

Dr. OPPENHEIMER. I visualize it with some concern. It seems to me that the way it probably would work is this: At the present time the problem of inspection is rendered almost hopeless by the fact that outside of the United States there just isn't anything to inspect. That is, there is nothing going on, and it is a very abstract problem.

As work on atomic energy starts up in other places, I would think that it would be desirable that these be completely wide open, and that conversations about what was going on and participation in the work be a very public matter.

I think that when a new mining operation is started, it would be reasonable to investigate the nature of that mining operation, the probable output, and to keep books on it, to ask the operators to keep

books and to make audits of these books, and physical audits of the situation from time to time.

I think that inspection should supplement the assumption that we are dealing with honest people whose desire is to prevent atomic armament, and that we should be in a position to detect a change in spirit, if that should ever arise.

It is very much like the laws against murder. Everyone accepts these because he does not expect to be the murderer. I think everyone must accept, and I think with skill everyone can be persuaded to accept, the undesirability of atomic armament.

Then if a situation arises where in some place this decision is reversed, I think it will not be hard to find it out.

Senator MILLIKIN. Doctor, does it follow from what you say that if there is a single nation that does not permit inspection, or does not permit effective inspection, that inspection is useless?

Dr. OPPENHEIMER. I would be singularly unperturbed if Guatemala failed to permit inspection.

Senator MILLIKIN. If Guatemala failed to permit inspection, that might indicate that Guatemala was being used as a stooge by someone that did permit inspection.

Dr. OPPENHEIMER. It might, but they would have to import more than uranium to make atomic bombs.

Senator MILLIKIN. If any important nation refused full and free inspection, then all inspection would be useless, would it not?

Dr. OPPENHEIMER. I think that if one important nation refused, it would be a source of great concern about that nation. I think one would still wish to know and be glad to know what was going on in the rest of the world.

My view of it is this: One of the things which we now realize is that in the 1930's there was a growing and very visible threat of world war in the policies of the Axis nations, and that we in America were both inadequately informed and inadequately convinced by such information as was available that this threat was real.

I think there is no doubt that in the early thirties the military problem presented by the strength of the Axis was not a serious problem. It got to be serious only after many years of armament.

What I think we need is an indication that a threat of war begins to exist, and if you had a group of nations agreeing to atomic inspection and cooperation, of which one or two suddenly started to make barriers or started to two-time so that you were convinced that the information you were getting was unsound, this I believe would be a danger signal and would call for the declaration of an actual emergency.

Senator MILLIKIN. Let me put it to you this way, then: If one important nation refused the right of complete inspection, then the other nations would not be warranted in demobilizing, so far as atomic bombs are concerned?

Dr. OPPENHEIMER. I would think it would be a very serious mistake to allow any nation to fail to cooperate in this point, if we had the power to prevent that.

Senator MILLIKIN. Your first proposition was that there are and will be no specific countermeasures to atomic weapons. Would there be any way of detecting the presence of a planted bomb?

Dr. OPPENHEIMER. It would be most difficult, as I think Admiral Purnell testified before another committee. The design of such a thing is not frozen. The shape is not frozen. The active material which makes it an atomic bomb is usually not near the surface, and I think that just by walking along past a crate you would not be able to tell that in that crate there was an atomic bomb. It wouldn't tick.

Senator MILLIKIN. Would there not be detection devices, the same as the devices that you have in these plants, to indicate radioactivity? Do you not have a detection instrument?

Dr. OPPENHEIMER. The nature of the radioactivity is such that it is not very penetrating, and in many of the designs that I think reasonable the active material would be so thoroughly buried inside a mass of other junk that the evidence coming out of that that there was radioactivity might be very slight.

Senator MILLIKIN. Could that kind of bomb in fact be covered with an insulating material?

Dr. OPPENHEIMER. Well, it generally is covered. I am not supposed to reveal how bombs are designed, but I think I can say this much: The active material in any designs we have been concerned with is like a small diamond in an enormous wad of cotton wool. There is an awful lot of junk outside which is not active, not radioactive, and I believe it would be unsafe to rely on it picking up any activity.

Senator MILLIKIN. I am talking, of course, of the theory we hear expressed frequently that mines could be planted all over the world, and at the crucial moment touched off in one way or another. I am trying to satisfy my own mind as to whether we could set up mine-detecting devices that would give us some measure of protection against buried mines.

Dr. OPPENHEIMER. I understand that. I would recommend that you ask this question of others. I don't want to give categorical answers, but I would not know how to do this.

Senator MILLIKIN. I mean that we in normal warfare, as it is now carried on, have mine-detecting devices which are rather effective if used thoroughly. I was wondering if anything of that kind might be available to use as a defense against that particular type of use of atomic bombs?

Dr. OPPENHEIMER. If you hired me to walk through the cellars of Washington to see whether there were atomic bombs, I think my most important tool would be a screwdriver to open the crates and look. I think that just walking by, swinging a little gadget, would not give me the information.

Senator MILLIKIN. Generally, as science has progressed, at the present time you do not have much confidence in that sort of a defense. Is that correct?

Dr. OPPENHEIMER. That is true of me; I may be wrong in this, but it is true of me.

Senator MILLIKIN. What have been the military defenses proposed aside from shooting V-bombs out of the air?

Dr. OPPENHEIMER. The only defenses I have heard are focused either on preventing anyone from making them, or on intercepting them in flight. I have not heard, and I believe that there are no advanced plans for the interception of the V-2 type rocket. The V-1 turned out to be a soluble problem after a lot of anguish. The V-2 I think

should be worked on. I don't know what the results will be. It is extremely difficult, and as you know it is made particularly difficult by the fact that no defense in fact, whatever we may hope, is ever properly alerted over the years. That is, you do not retain your defense equipment and your personnel at an adequate pitch except when there is a known emergency.

Senator MILLIKIN. May I ask you whether this would be correct—that in your opinion the maintenance of military forces for the purpose of sending them to destroy the possible launching sites of bombs, and to destroy the installations that make them after the use of them had begun, would be far from a complete defense?

Dr. OPPENHEIMER. It looks that way to me. That is, of course, the way in which the V-bombing of England was stopped, but it cost the lives of many men, and it took many, many months, and if those V-bombs had had atomic war heads, it would not have saved England.

Senator MILLIKIN. I am not suggesting by my question that that should not be attempted if we were the victim of an aggression of that weapon.

Dr. OPPENHEIMER. The time scale is wrong. You just do not have the chance.

Senator MILLIKIN. When you speak about effective military defense, I assume you are speaking in the passive sense. Military defense often consists of aggression, of moving first, and I assume that you preclude moving first—that you exclude moving fast—from that proposition?

Dr. OPPENHEIMER. The history of the American people shows that we do not do that, and I am very proud that this is the case; but I think it is one of the facts of life which must be taken into account in planning our future.

Senator HART. That is what is meant by "preventive war," in which America has never participated?

Dr. OPPENHEIMER. Well, we have after considerable persuasion.

Senator HART. Doctor, may I ask you one thing along another line?

All of our talking and thinking thus far has been based on uranium or some other very heavy material as a fissionable material.

Do you visualize science progressing to the point that much more plentiful and more widely distributed materials may become fissionable and not constitute a danger?

Dr. OPPENHEIMER. No; with the exception of the very heavy elements, it will take some very new idea and some new discovery to extract energy from them. My frank opinion is that for all but the very light and the heavy elements, the project will not be successful; that is, I do not think that iron will ever be a source of energy. I say that with the full confidence that I may read in tomorrow morning's paper that somebody has found a way to do something, but I myself will look many times at that note before I believe.

The phenomenon of fission is a very specific phenomenon. It is an accident which this committee has every reason to regret—that uranium and thorium exists in the world at all and that these things can be realized.

As you know, the energy we always use comes from the sun, and solar energy, according to a theory of Dr. Bethe—whom I believe you are to hear later—derives not from a fission process but a series of

reactions upon very light nuclei, primarily involving the conversion of hydrogen to helium in quite a tricky way, which he might describe to you.

In the sun and in other stars, the enormous mass of the star and the effect of gravity play an absolutely decisive part in making this reaction occur, and I will explain that. The reaction generates energy and maintains the material at a high temperature. The reason it doesn't expand and cool off and stop the reactions is that it is held together by gravitational attraction.

It is conceivable that development of this kind might be carried out terrestrially, but I am sure I don't know how, and I do not think it is an immediate prospect nor a very likely one. So my answer—a rather long answer—is, to the best of my knowledge, "No."

Senator MILLIKIN. May I ask you this, Doctor: Roughly speaking, does it come down to this—that unless we can reach a state of complete and honest world cooperation, at least among the powers that are capable of making or causing to be made a bomb, that we should continue to have our fears on the subject and continue to keep our bombs dry.

Dr. OPPENHEIMER. I would like to turn it around and say it comes down to this: that we have got to find a way in which to have a state of honest cooperation. I am afraid of the word "complete," because I am sure that even this country will impose some obstacles to such a complete cooperation, and that it is natural we will; but fundamentally honest cooperation.

Senator MILLIKIN. Unless we have as close an approximation to that type of cooperation as is possible among erring humans, until we do have that type of cooperation among the important nations and the nations that are capable of making bombs or having them made, we have got to have our bombs "dry." Wouldn't you say that is correct?

Dr. OPPENHEIMER. Well, I don't know what we will do with them.

Let us take a concrete example, and suppose we have the very greatest difficulties in negotiations with Power A and that Power A wishes to circumscribe any proposal they can think of, or we can think of, in such a way that we have the most profound doubt that we really will know what is going on. Then, it seems to me, the problem is to question whether we cannot get around this situation.

Let us try to find a minimum basis of agreement, because the building of a stock pile of bombs, when we don't intend to use them, when we certainly would not use them unless we were attacked, would be done with a half-hearted feeling—namely, the feeling that it neither deserves the full support that we would give such a program in an emergency, nor an abandonment of it—and would be one of those half measures which would give us an absolutely illusory security. An atomic bomb which you do not use is of no use to you.

Senator MILLIKIN. To put it another way, you would not advocate that we destroy our stock pile of bombs prior to that state of cooperation which you have described?

Dr. OPPENHEIMER. I think that I would put it this way: This is certainly a problem which goes far beyond what I know about, but my feeling is that our objective is to get started on the control of atomic energy. If we get started, the negotiators who represent this

country must certainly be prepared to make very big concessions about the inspection of our facilities, about the declaration of our stock pile and, if necessary, about the destruction of our stock pile.

I believe that such problems will arise. They should not, in my opinion, be discussed by us alone. They are part of the job of achieving a collective security.

Senator MILLIKIN. I would agree completely with you that we have got to get started, but let us put our minds now solely on the question the inspection of our facilities, about the declaration of our stock pile, of bombs. Let me have your observation on that.

Dr. OPPENHEIMER. I would say that as soon as we have a reasonable degree of conviction that it is not the intention—not the avowed intention—of any nation to manufacture atomic weapons, and as soon as we are convinced that it is the avowed intention of nations to make available to us the evidence that they are not in fact arming atomically, then we should no longer arm atomically ourselves.

Senator MILLIKIN. Don't you think we would have to go further than a reasonable degree of conviction? I think you could take out the "reasonable" angle in connection with the other things that you have said. Should we not have complete conviction?

Dr. OPPENHEIMER. I would like to think that, but I doubt whether it is reasonable to ask it.

The point that I would make is this: The safety which the cooperation of various nations in preventing war can give this country, and the advantages that they can give it in our not having to maintain a military establishment of overwhelming proportions, and the confidence with which we can go ahead with the work of peace are things worth aiming for. The possession of 300 bombs in some vaults around the country is something that I, myself, don't see any good in.

Senator MILLIKIN. You believe that we can take some risk, then, in connection with destroying our stock pile. That is all I am talking about—destroying our stock pile.

Dr. OPPENHEIMER. I believe that we can take great risks if the purpose is the achievement of peace.

Senator MILLIKIN. If there is a doubt or a reasonable doubt that we might not achieve peace by destroying our stock pile, I take it that of course you would not favor destroying our stock pile?

Dr. OPPENHEIMER. I think that this committee should not assume that the stock pile, as at present constituted, is one which would be of any assistance to us in fighting a major war.

Senator MILLIKIN. I wish, as far as you can, or feel that you should, you would elaborate on that a little.

Dr. OPPENHEIMER. This would have to be done under more private circumstances. I would be very glad to.

Senator HART. Doctor, I think perhaps you may be misunderstood at one point on account of brevity. You said that atomic weapons can be cheap instruments of devastation and then explained it briefly. I think it would be better for purposes of the record if you expanded that.

Dr. OPPENHEIMER. Well, I have seen a figure—I don't know whether it is a reliable figure, but it is surely not a crazy one—that it has cost us in this war \$10 a pound to deliver explosive on the enemy. I am unable to give an accurate cost figure on atomic weapons—partly

because I don't know and partly because if I did know it I would be prevented by that knowledge from saying it—but I think that I can say that, even taking account of the in-some-ways diminished effectiveness of concentrated bombing; it is somewhere between 10 and 100 times cheaper to deliver atomic weapons, which is simply in terms of the area destroyed—it is 10 or 100 times cheaper. I don't know if it is 10 times or 30 times, and this will depend on policy, but it is an enormous factor. It is not a trivial change.

Senator HART. Cheaper, for instance, than TNT?

Dr. OPPENHEIMER. That is right; and I am using a figure which may well be criticized, but which is, I believe, the figure used by Army Ordnance for over-all cost of delivering a pound. You can see what that means if you take a round figure of 10,000 tons as a possible effective equivalent for an atomic bomb. That is 20,000,000 pounds, which is \$200,000,000. Now, without revealing any secrets, I can say that an atomic bomb, and the equipment for delivering it, is not going to cost that by an enormous factor.

Senator HART. But those large TNT bombs, which are the usual comparative figure—though the destruction in any one point, any one small area, is by no means as great, it is sufficient and is spread over a wider area, is it not?

Dr. OPPENHEIMER. I used a somewhat conservative figure of the 10,000 tons rather than the actual equivalent in part to take this into account. The actual atomic bomb releases more energy than this.

Senator HART. But it is true that the comparison, as is usually made, is a little faulty because of the respective areas involved?

Dr. OPPENHEIMER. What I would say is this—and I will be somewhat sharper about it, if you wish: For the equivalent tonnage, the factor of cost will be more than 100. For equivalent area, it will be somewhere between 10 and 100, and that is to try to take account of this effect which you mentioned.

Of course, if you want to knock out three houses somewhere, you will not use an atomic bomb.

Senator BYRD. Doctor, when you spoke of destroying the stock pile of bombs, would that mean, too, destroying the organization and the factories that made the bomb?

Dr. OPPENHEIMER. In the first place, I did not speak of destroying it; I was asked about it.

Senator BYRD. I understood you to say that if you had faith in other nations you would then favor the destruction of the bombs we accumulate during this period before we can ascertain what other nations are going to do.

Dr. OPPENHEIMER. I would say this country should do, for the problem of atomic armament, what we expect other nations to do. If we expect them, and are convinced that they wish not to arm atomically, then I think that we should not arm atomically; and if we want to keep the plant some place, I think we should have that plant completely open and should allow the representatives of the powers with whom we are dealing to know as much about what we are doing as we would want to know about their plants.

I do not think that when we get to that point—I don't know that we will but hope that we will—we will treat atomic weapons as an entirely separate problem, because the problem with which we are faced is

not to have wars. It is not to make them pleasanter wars, like this last one; and I think that other weapons will come in for the same kind of discussion as the atomic weapons. We are a long way from that today.

Senator BYRD. Under what situation which you visualize may occur would you keep this present organization for the peacetime development of atomic energy?

Dr. OPPENHEIMER. Some parts of it I think should not only be kept but expanded. My own feeling is that the possibility of maintaining even an effective bomb factory, such as we are supposed to have at Los Alamos, depends on operating there so that there are some peaceful uses of the work, because it is very hard for a group of men to be making bombs which they think (a) will never be used and (b) should never be used. It is very hard for them to do this as their only lifework. Therefore, I have recommended and continue to recommend that as long as that place must be kept in operation, it consider problems of a nonmilitary character as well.

Senator BYRD. Isn't there a very thin line in the manufacture of this atomic energy for peacetime purposes and for the making of bombs?

Dr. OPPENHEIMER. The line is thick with some types of plants and thin with others, and it is perhaps one fortunate thing that for the type of installation which has the greatest use as a research tool and the greatest promise of power development, the line is a little bit thicker. That means it is something of an effort to convert from one to the other; it is not a matter of many years.

Senator BYRD. The material that would be useful for peacetime purposes being available, how long would it then take to use that and convert it into a bomb?

Dr. OPPENHEIMER. If one were completely set up for it—and this Nation now is, on a small scale—it would take a matter of 2 or 3 months to start the various things going that need to be done and to start production; maybe 4 months if one had trouble.

If it were a nation or a group of people that had never had any experience with the job and had to find out how to do it and had to build the installations, I would think 15 or 18 months might be a more reasonable guess.

Senator BYRD. Then, if you permit the use of this material for peacetime purposes, you are just 2 or 3 months behind?

Dr. OPPENHEIMER. For a group of people who know how.

Senator BYRD. We are assuming that sooner or later all the scientists of the world will know the formula and process we have here. You concur with the other scientists who have testified, do you not?

Dr. OPPENHEIMER. I think they would find out quite a lot about it; yes.

Senator BYRD. Let us assume they know as much as we do about 25 years from now, and that then the world organization permits the manufacture of these materials for peacetime purposes. Then, it will only take 3 months to convert that material into bombs for war purposes.

Dr. OPPENHEIMER. I think if you did not have the establishment, if you had to build the place to make this conversion, it would take that much longer; but it is still not a very long time.

Senator BYRD. If we have such a world agreement, the other nations of the world will then permit us, even if we have destroyed the bombs we actually made—are they going to permit us to keep this tremendous plant and organization without having themselves an equivalent plant and organization?

Dr. OPPENHEIMER. I hope that the problem will not appear in this light.

Senator BYRD. Why won't they appear in that light? Every nation is going to say this: "All right, we won't make bombs if America destroys her bombs; and America, then, will also have to destroy the machinery she has established for making the bombs, because that gives her a year or 2 or 3 years advantage over us."

What would be your answer to that situation? Shall we just destroy the organization completely?

I think Dr. Urey, as I recall it, advocated that if such an agreement be reached, we not only destroy the bombs but destroy the machinery and the organization we have set up to make atomic energy.

Dr. OPPENHEIMER. No.

Senator BYRD. Except in very small quantities.

Dr. OPPENHEIMER. I don't know. You see, I don't think you can stop things like this. If atomic energy is good for anything, I think the answer is probably that not only this country but other countries will be using it for anything it is good for.

Senator BYRD. Isn't that a great weakness, though, in the suggestion which has been made that this can be controlled by agreement among nations and by inspection?

Dr. OPPENHEIMER. It is a very great difficulty. It is the reason why everyone is so worried about it.

Senator BYRD. To me it is pretty nearly an insurmountable weakness.

The CHAIRMAN. Do you mind an interruption on that point?

Have you considered the possibility of a United Nations Organization ownership of such power plants as might be developed?

Dr. OPPENHEIMER. I think it would be a very good thing. I think that, for instance, if in China, where I understand we are prepared to help with the generation of power in the Yangtze Valley, it were possible and economically sound to establish atomic power, it would be a very good thing to do that through the United Nations Commission.

Let me answer your question in the following way: We have great factories in Detroit whose purpose is to make automobiles. Everybody knows that within a relatively brief time they can be converted into making tanks. No one argues that for that reason we should stop making automobiles.

Senator BYRD. I don't think that is comparable at all to the situation we have in hand, because nobody wants to stop making automobiles, and the one reason we want to stop making this is because of the terrific destructiveness of its use in a sudden attack.

Dr. OPPENHEIMER. That is right; but as I say, I don't know what the policy of the United States Government is going to be in the conquered nations, but certainly we are going to allow them some industry in spite of the fact that we know that any industry can be converted

in wartime to war making. We are going to do this, taking such other safeguards as we can to be sure that they are not going to make war.

I think that no nation now in the world as it actually is, no major nation, has any interest in making war.

Senator BYRD. That is true. It is just like a man that has been on a drunk and doesn't want to get drunk, maybe, the following day. We don't know that that is going to happen 25 years from now.

Dr. OPPENHEIMER. But that is what the next 25 years must be used for. It must be used to establish such machinery and such human relations between the different nations that this temptation to go on the next binge will be resisted and can be controlled.

Senator BYRD. I have been trying to clear my mind as to this so-called control, to be exercised by the international agreements, of the atomic bomb.

It seems to me that if you have any control that is effective you have simply got to banish the atomic bomb or atomic energy, which I frankly don't think can be done. You cannot do it half way because if you use the same materials for peacetime purposes, the same materials will be used at the beginning for wartime purposes.

Dr. OPPENHEIMER. Right.

Senator BYRD. You have got a time there which you have got down to 3 months. That is, a nation that has the facilities that America now has above every nation in the world, unless we dismantle those facilities, even if we destroy our present stock pile, can make atomic bombs in 3 months.

Dr. OPPENHEIMER. You can start making them. It is a thing that takes time to accumulate.

I would put it this way: If I saw in the abandonment of atomic power as a commercial source of power any real insurance that the world would remain at peace, it would be a very cheap price. You could mine a lot of coal for \$200,000,000.

Senator BYRD. But you are asking something that has never occurred in the history of the world.

Dr. OPPENHEIMER. But I don't think it will occur.

Senator BYRD. It isn't likely that the entire experience of the world for 2,000 years or more is going to be changed.

Dr. OPPENHEIMER. I agree with you.

Senator BYRD. Sooner or later there may be some great dictator of some nation in the world that would take it into his head to conquer the world. That has happened time and again in the history of the world. You cannot depend upon Christianizing and humanizing all the rest of the world within this limited time we have to make a decision as to what to do with the atomic bomb.

Dr. OPPENHEIMER. I think I would put it this way: At the present time the problem does not appear as a problem of preventing the use of atomic power for an energy source, because this is not an existing development and no one knows whether it would or would not be an economical one.

I believe we would have to face that problem later.

I hope when we come to it the situation will have been altered by a history of collaboration.

Senator BYRD. You speak of the inspection. Suppose that government A had an agreement they would not make any atomic bombs.

Suppose we discovered government A was breaking that agreement. What would you do? Would you use bombs we had here to destroy the other nation by bombs, or what will you do about it?

Dr. OPPENHEIMER. I don't know what the word "sanctions" means, but I believe there is such a word and that it means any measures which are necessary in order to cause that power to desist.

Senator BYRD. How would you do it? Suppose within 3 months this nation, which was using atomic energy for peacetime purposes, having the equipment and the plant, had manufactured a bomb and we discovered they were making that bomb.

Dr. OPPENHEIMER. One bomb will not do any harm. I would say that is a case for whatever sanctions were required.

Senator BYRD. What do you mean? If we had no bombs on hand, what could we do? We couldn't invade that country perhaps in 3 months or 6 months or longer.

Dr. OPPENHEIMER. I think if there is such a thing as the United Nations, certainly before atomic bombs were stock-piled to the number of 500, or something like that, they could do an awful lot.

Senator BYRD. But I understood you to say you wanted to destroy the stock pile.

Dr. OPPENHEIMER. I say, before they were stock-piled. It seems to me that the decision to go into this thing may start having some effect within a period of 3 to 6 months. There may be some military weapons made in that time, but it will take a long time to be a real menace, to be a decisive thing, and it seems to me that it is a case where one just must not allow this critical period of armament to occur.

Senator BYRD. If you could explain to me, I would be very much interested to know how you are going to prevent that. If some nation desires to break secretly and surreptitiously the agreement that is made, what are you going to do about it?

We know, and everybody knows, that we talk about a league of 51 nations. We know that the military power rests in three great nations. The others just are not important.

In a warfare which may come as suddenly as the atomic warfare, what are you going to do? Are you going to use the bombs to bomb that nation out of existence, if we have any on hand, because they have broken the agreement and used the materials which they were allowed to use for the making of peacetime energy by converting that into a bomb? What would you do about it?

Dr. OPPENHEIMER. If this situation arose, and it is clear from what I have said that I don't think it needs to arise, I would use military measures of all kinds against the offending country.

Senator BYRD. Then you would want a stock pile of bombs? That is the only effective military measure you could use.

Dr. OPPENHEIMER. I think there you make the thing a little bit too abstract.

Let us put it this way: The United States—and this is a reasonable assumption—starts two-timing on its engagements and starts manufacturing atomic bombs contrary to convention. All right, we start in and we drag off some of the scientists who were down there, and some of the machinists, and we get some new people in and start to get this rusty machinery working, and it is found out by people who are in this country that something odd is going on and an investigation reveals that something odd is going on.

Well, I don't think it is true that this country would have to be bombed atomically, for it would be ganged up on by the whole rest of the world. We would not have any atomic bombs.

If your argument is that any security council, or any United Nations Organization should have available some atomic weapons for reprisal, I will not argue with that. I don't know the answer; that may be a possible answer.

Senator BYRD. It comes down to this, does it not, that if other nations get hold of atomic bombs and these bombs are supposedly under the control of an international organization working through international cooperation, we have got to assume that every nation, not a single nation, is going to abide by the agreement? I mean, that not a single nation is going to take advantage of another one?

Dr. OPPENHEIMER. That is right.

Senator BYRD. The physical means whereby you can prevent that taking advantage seems to be inspection and so forth. That would seem to me to be rather negligible in its efficacy; I do not think that it is going to amount to much.

Take, for example, in regard to this matter of inspection: There are great nations in this world with vast areas. It will be very difficult to find out, unless you can trace the source of the material, that uranium, from which atomic bombs or atomic energy can be manufactured—do you think that would be practical?

Dr. OPPENHEIMER. It is, I believe, a fairly practical thing to do.

You must keep in mind that there are several ingredients going into the production of atomic weapons—at least, there has been in the past.

One ingredient is raw material; one is a whole lot of industrial effort; one is a bunch of technical men who are not, instantly, abundant.

My own feeling is that one of the best leads is to keep some account of what these men are doing, to have some idea of what physicists and engineers are doing. If you see them vanishing into thin air, then you can have reason for becoming worried.

Senator BYRD. This one question has bothered me a great deal. If you permit the use of uranium or any other materials to make atomic energy, allow that material to be put into peacetime uses, the material now in existence, it seems to me to be a most serious barrier if you try to keep that material from a military use.

Dr. OPPENHEIMER. I agree with you entirely, Senator. It bothers us too. That is the reason why we think that, at a time when no other place in the world exists today where atomic energy is being used—although you are speaking of peacetime purposes—we have got to start worrying now about these problems.

Senator HICKENLOOPER. Mr. Chairman, I would like to ask a question.

The CHAIRMAN. Yes, Senator.

Senator HICKENLOOPER. Doctor, does the history of scientific development in the world, at any time, show that the scientists have ever discarded something that opens new ground for scientific investigation?

In other words, can you, by legislation or even by intent of government, stop scientists from investigating or exploring new fields, especially when they have had success in a field, as is the case, the proven case, with atomic energy?

Dr. OPPENHEIMER. Well, enormous discouragements can be proposed and scientific advances can certainly be opposed.

It was not easy, in the days of the Renaissance, for a man to investigate the laws of nature, because he was likely to get himself into extreme personal trouble.

Senator HICKENLOOPER. But scientific development did go on.

Dr. OPPENHEIMER. Yes; but official disapproval is a thing which can discourage it enormously. There are countries in which science at one time flourished and in which the lack of recognition and approval has caused it to languish.

I don't believe that it is going to happen in a permanent way, but I do feel that if the opinion of the American people and of the people of the world is that science is an enormity, that it is synonymous with devastation, then I do feel that the scientists are going to find that they are not going to get support and encouragement and that the next generation of scientists is going to be taught by teachers who have doubts and those scientists are not going to come to it with a deep passion for finding out, which has been one of the qualities characteristic of scientists in the past.

Senator HICKENLOOPER. Well, is it possible or reasonable to think that continued investigation may enable scientists to produce this fissionable material at a far less cost and with a far less or smaller physical development than that with which we have produced it? In other words, we have built great plants to do it.

Dr. OPPENHEIMER. Yes.

Senator HICKENLOOPER. We found it necessary to build great plants to produce this stuff and we had to concentrate scientists in great numbers, spend lots of money and effort.

Is it not possible that, with future experimentation, the size of those plants can be reduced and the amount of effort?

Dr. OPPENHEIMER. I think, in the light of hindsight, all of us would say that some of the plants which we built, although they worked fine, need not have been built. In other words, you don't have to put three bridges or four bridges across a river; one is enough.

Senator HICKENLOOPER. That is right.

Dr. OPPENHEIMER. We only did that so that this program would be insured. Even today we could do it—I won't say at how much less cost—but at a fairly small fraction.

Now, new developments may occur. They have been occurring, and these developments have been watched very carefully by us. We feel that there will be developments in the production of these fissionable materials, that the methods will be improved, but we do not think that it will be possible to install a process, say, in a bathtub. We do not think that you could use a bathtub in a, say, garage, or some place like that.

Senator HICKENLOOPER. Well, let us get a little bigger place than a bathtub. With regard to this question of the size of the plant, we have an installation that required, say, 70,000 or 80,000 people in one area.

Dr. OPPENHEIMER. Yes.

Senator HICKENLOOPER. And we have another installation that requires thousands of people and a tremendous physical plant. The only point I am trying to develop or trying to get information on, your opinion, is this.

Is it reasonable to assume that if experimentation were pursued vigorously, we could very materially reduce the size of the physical plant in order to produce that material and also reduce the number of personnel very materially?

Dr. OPPENHEIMER. Well, let us take, say, one of the plants we have; for instance, the one at Hanford. It certainly is possible to build that today, with less than was put into it and one could change the plans somewhat and make a smaller physical installation.

However, I do think that an enormous production is not feasible. To me it is not. I would not know how to do it and I can only say this, that science always turns up odd things and what they might do in this matter I don't know, but I do not think what you have in mind is very likely.

Senator HICKENLOOPER. I realize that. I am merely wondering if, with vigorous research in the future—it is my opinion, completely unschooled, but it is my opinion that it is reasonable to assume that we may develop less arduous methods of making this.

Dr. OPPENHEIMER. Right.

Senator HICKENLOOPER. And, therefore, that if science continues to investigate a field that they know is successful now and in a field of such magnitude, a field which offers such tremendous scientific possibilities, do you not think that those developments may increase ability to produce these materials, and also increase the difficulty of detection?

Dr. OPPENHEIMER. Absolutely.

Senator HICKENLOOPER. In your prepared statement, in the last paragraph, you say: "Today all nations, all peoples have an overriding community of interest in the prevention of atomic warfare."

It occurs to me that that statement would certainly be true, as far as it concerns people who have any reasonable knowledge of atomic warfare. But I would not assume that it would be true among peoples who have not been privileged to know what atomic warfare is. I have the feeling that it will be only the moral pressure of the people themselves that will give us any hope of control over this thing, and not the opinion or desires of governmental heads, because they are subject to immediate emotions.

Dr. OPPENHEIMER. I quite agree with you, sir.

Senator HICKENLOOPER. If they have a full realization of the powers of this thing and the potentialities of it can be given to all people, the people of all countries, including the powerful countries, it seems to me we might have a better basis upon which to build, perhaps, than in concealment and lack of information.

Dr. OPPENHEIMER. I agree with you entirely. It would seem to me that one of the things that might be useful in this connection is to repeat the sort of demonstration which was made in New Mexico last summer.

That demonstration was performed there really to check up. We were by no means certain that the thing would work as we hoped it would; that was the purpose of it. However, I do think that the explosion of the atomic bombs was partly for the purpose, anyway, of keeping them in the minds of the people of the world, and enabling them to find out what it was really like.

I think that is a very sound thing; and I support you.

Senator HICKENLOOPER. These explosions in New Mexico—the people were told that a munitions plant blew up.

Dr. OPPENHEIMER. Yes; but that did not mean that the people of this country believed that.

Senator HICKENLOOPER. The general proposition I had in mind was that people had knowledge of this power which had been turned loose down there.

I am not criticizing that method of publicity, saying that it was a munitions explosion. At that time it was essential to keep this matter quiet.

I do say, however, that if people of the United States had no other publicity than that a munitions plant blew up, rumors might arise, but the facts would not have been believed by the people.

We would have no appreciation of the power of this thing and its potential dangers.

Therefore, I think one of the first things in attempting to arrive at any control of this is the matter of educating and informing the masses of the people of these other countries.

Dr. OPPENHEIMER. I agree with that. My own impression, and I am not qualified to guarantee this, is that the thing is a fairly spectacular thing, and it has taken great hold of the imagination of the people, even where there has been no systematic effort to publicize it.

The CHAIRMAN. "Fairly spectacular." I think that is a masterpiece of understatement.

Senator HICKENLOOPER. The point that I wanted to try to develop here was I think the suggestion of demonstrations is a good suggestion; it gives a lot of food for thought.

But what good will demonstration be in some area or in some country or some nation where only certain public officials will see it and then retire into a great silence, and the public knows nothing about it?

Dr. OPPENHEIMER. This was not what I had in mind. I was not proposing to convince the Senate of the United States, but to demonstrate it before a somewhat wider audience.

Senator HICKENLOOPER. I am still talking about publicity on a larger scale to a wider audience. Are you in favor of that?

Dr. OPPENHEIMER. Absolutely; I do think that the manner in which my colleagues have handled this—I would not want it indicated that the manner in which the publicity angle of it was handled was due to any lack of zeal.

Senator HICKENLOOPER. Well, I am certainly not criticizing you for lack of zeal. I think their zeal has been proved.

Let me ask you this: Suppose we take an atomic bomb over the ocean and use it to bomb ships. Through publicity and education we could show what the effects would be. Of course, the American people, in my opinion, would not need any further demonstration.

Dr. OPPENHEIMER. Of course.

The CHAIRMAN. Senator, I am not so sure that that is true. I have talked with some people lately. Yesterday I talked with a gentleman who comes in contact with many people in Connecticut. The day before yesterday he spent some time listening to some testimony here and he went back to my office and saw me and he said that people do

not understand what is involved in this thing. I might say that he is a very level-headed observer, by the way.

Senator HICKENLOOPER. I think that is true. I think that probably members of this committee and people who have sat in these hearings know about it.

However, I think that we could go on for literally months and none of us, except the scientists and the engineers who had been present and actually physically examined these things, could fully appreciate it.

But I do believe that the American people are really convinced, the overwhelming bulk of the people, that this is the most ominous and powerful thing ever released and so many more times more powerful than other things when it comes to destruction, that they are fully convinced something has to be done to attempt to put it under control.

I only hope that the rest of the peoples of the world could be informed, at least as much as we have been informed at this point, so that their realization could bring pressure to bear.

Dr. OPPENHEIMER. I agree. However, isn't one reason why the people in this country know something about it is that perhaps there is a certain national pride arising from the fact that it was developed in this country. That works against us everywhere else, but we know we have developed it.

I think that only in the measure in which the people of other nations feel it will be necessary to have power to control the troubles that are in the world—I feel that first they must be aware really of what those troubles are.

Senator HICKENLOOPER. Yes.

Dr. OPPENHEIMER. And the very fact that there are discussions going on about this problem, how it may be met, will enable people to face the fact that it is a tough problem.

Senator HICKENLOOPER. We have quite a free press and quite a free radio in this country; these mediums are free to give the information to the people. If we didn't have them, I doubt whether 1 person out of 10,000 could have any proper conception of this.

The CHAIRMAN. Senator JOHNSON.

Senator JOHNSON. Dr. Oppenheimer, you inferred in your testimony that there was such a thing as compelling cooperation. Is that not a rather strange conception of cooperation—compulsory cooperation?

Dr. OPPENHEIMER. If I so implied, I erred. I did not mean to so imply.

I think that the facts of the world compel us to cooperate.

What I think I said—what I meant to say—was that if there were violations of agreements which would endanger the peace of the world, then it seems to me that one had no other choice but to treat it as a state of war.

Senator JOHNSON. My understanding was that your position is that we should compel nations to cooperate. I gathered, by inference, that you wanted to declare sanctions if the atomic bomb were used, and that you really believe we would be justified in declaring war on a nation that did not cooperate but did go ahead and presumably construct atomic bombs. That is what I understood from your testimony.

Dr. OPPENHEIMER. I thought I said that the necessity has arisen for an overriding community of interest in preventing the atomic war.

Senator JOHNSON. Oh, yes, that is what you said, but I got your position as being that now is the time to bring about cooperation of all nations, the time when we have the atomic bomb and no one else has it.

Certainly, other nations will be very foolish, it would seem to me, if they would not agree at this moment to say, "All right, let us ban the atomic bomb."

Whether they would live up to that agreement or not is another thing; I recognize that. I recall that after the Disarmament Conference we destroyed our battleships and the other nations destroyed their blueprints. The same thing might very well occur again.

It would be very easy to get assurances now, provided we made all the disclosures. That would be simple, because we are the only ones who have any disclosures to make. They will say, "All right, we agree," but tomorrow they might change their minds.

If they change their minds, is it your position that we are justified in immediately declaring war on them? Your testimony would seem to indicate that to me.

Dr. OPPENHEIMER. It is an abstract question and it is certainly a question to which a scientist can give no especially informed answer.

But I think that when Japan started her aggressions in 1931, or when the Germans declared their intention to rearm and started to rearm in the early years of the thirties, if the other countries of the world had said to them that it had to stop, we would have had very much less of a war and very much less misery than in fact we had.

Now, if a situation like that arises in the future—I hope not, I hope we have learned in the last fifteen years that it is better not to let those things get under way—

Senator JOHNSON. Yes, but my understanding of your position is that if a nation denied inspection and if we suspected any nation of accumulating atomic bombs, that we would be justified in doing something about it. Would you deem that a cause of war?

Dr. OPPENHEIMER. I think it probably would be.

Senator JOHNSON. A cause of war?

Dr. OPPENHEIMER. I think it probably would be.

Let me state more clearly what I have in mind.

Let us assume that, taking advantage of the present situation, agreements are entered into in good faith and maintained in good faith for, let us say, 15 years.

Let us further assume that we find out—I don't mean, particularly, this Nation, but whatever agency exists, perhaps a commission of United Nations, as recommended—find out that there is an attempt to get around the agreements by a country, to get around them for the purpose of making atomic weapons.

Atomic weapons are only useful in war. If that were going on in the world, under the circumstances I have stated, it would mean that somebody is planning a war.

I think and I believe that it would be desirable that the rest of the world recognize it and try to keep that war from being fought as this last one has been fought.

The CHAIRMAN. In other words, Doctor, into the agreement you would write a new definition of aggression, based upon the power of the atomic bomb?

Dr. OPPENHEIMER. It seems to me—I don't know that that condition will come about or whether it will exist in the future—but it seems to me that that was the intention disclosed in the Three Power Declaration of Principles, to set up a commission which will, in time, say what is safe to have going on in the world and what is not safe.

I believe that if things which are recognized as not safe do go on, that it is in the intention of the administration that this commission point this out and raise the problem of what steps must be taken. I don't know what those steps will be.

Senator BYRD. Pardon me for interrupting. I believe what you are talking about now would mean a session of the United Nations Organization. As you know, if any one of the United Nations wants to, it can veto any questions relating to matters discussed there.

We tried to change that; we couldn't get it amended to make unanimous consent unnecessary.

Dr. OPPENHEIMER. Certainly. Wiser people than I have pointed out that this veto provision may not be too practical.

Senator BYRD. Well, it is in there and it cannot be gotten out except by unanimous vote of the Big Five.

Dr. OPPENHEIMER. Nevertheless, it is—

Senator JOHNSON. Pardon me for interrupting. I would like to go on.

If I had the planning of that, if I were a world conqueror and had any plans for taking over the world, the first thing I would do would be to build a great power plant, plutonium power plant, and then I would secretly develop atomic energy for atomic bombs from that power plant.

I am quite surprised in your statement here this morning advocating the building of a uranium power plant in China.

It seems to me that that is the most reckless proposal I have ever heard made by anyone, scientist or politician or anyone else, because all of us know that there is only a thin line, as the Senator from Virginia stated, between the development of atomic power, through uranium, and the development of atomic bombs.

Dr. OPPENHEIMER. First I would like to say that I did not advocate that we do it today. I advocated it very conditionally. I mean, only insofar as it would be really useful, a power plant in China.

I don't think we can stop this kind of thing. I don't think we can stop the advance of technology, and I hope by the time these advancements are made and by the time power plants are built in China, or wherever else, wherever it might be, that we will have a machinery for assuring ourselves that they will not be converted into instruments of war.

Senator JOHNSON. Yes, but right in your statement you say that there is no defense against atomic bombs, absolutely no defense.

I agree that it is going to be hard to stop industrial development, and I doubt very much that it can be done.

Dr. OPPENHEIMER. It can't be.

Senator JOHNSON. Or that it should be; I will even go that far.

But, since it is hard to stop it, then I think that our scientists, instead of entering into the political arena and deciding what should be done on this question, as a political gesture, should be devoting their energies to finding out what we should do scientifically. If there is no defense,

they should be developing one, some counteraction against it; that is their job.

I think they ought to keep on trying, or, at least, not advise the political agencies of this Government to scatter plants all over the world, especially in a country as unstable as China is at present.

Dr. OPPENHEIMER. I would like to take that up. I said that I thought that there would be good reasons for putting in a power plant in the Yangtze Valley; that we were thinking of the development of a power project in that valley. I said that that might be a good place, where the economics involved in the use of atomic power for energy would be sound.

I made it very clear that I was not trying to advise political agencies on political matters. I was very clear that my position on that is this: My purpose in coming here was to make available such technical information as I have.

Senator JOHNSON. I appreciate that, but you did advocate—or, at least, I understood you to advocate—that we build a uranium power plant in China instead of a hydroelectric power plant, which has been proposed.

Dr. OPPENHEIMER. I said it might be a better type of plant.

Senator JOHNSON. Well, it might be a better type of plant, but I have this other question that I want to get some information from you about.

You had considerable experience of course, with the bomb and its explosive effectiveness in New Mexico.

What is your opinion of the effectiveness of an atomic bomb exploding in a building in a city, for instance; not in the air, but perhaps in a basement or maybe in the top story of a building.

Dr. OPPENHEIMER. As far as the blast goes, the effectiveness increases as the height of the detonation is increased, up to a certain point. The building wouldn't make any difference.

Senator JOHNSON. The building would not make any difference. You mean that if it were inside a building it would be no more destructive, say, in the city of Washington, if it were exploded in a basement downtown?

Dr. OPPENHEIMER. If it were well underground; but a basement usually is not. It is only 10 feet or so. But if it were well underground, then we would begin to get new effects—earth shocks, and so on. But if it were on the surface or 10 feet under, the 10 feet under is just about the same as being on the surface and you could not note the difference.

The radioactivity would be, if it were well underground, very much decreased; the blast effects would be very much decreased.

Senator JOHNSON. What about the expansion, the radioactive expansion covering the city?

Dr. OPPENHEIMER. I think it would be a very bad mess.

Senator JOHNSON. What about using it as a depth bomb? What are your ideas on that, in the sea?

Dr. OPPENHEIMER. In the sea? I can't tell you quantitatively, because that is one of the things that is secret, but it certainly is effective.

Senator JOHNSON. As effective, you think, as discharged in the air?

Dr. OPPENHEIMER. More so.

Senator JOHNSON. More so.

Senator TYDINGS. Mr. Chairman, may I ask—

The CHAIRMAN. I have been trying to get at him myself, but I will yield to you. Go right ahead.

Senator TYDINGS. Doctor, how large a plant would be the minimum-sized plant, in area, that would be necessary to produce atomic energy?

Dr. OPPENHEIMER. Well, I think the main structure—

Senator TYDINGS. I will qualify that. Looking ahead 10 years, from what you can conceive of the development of atomic energy in the future, what is, in your opinion, the smallest plant of which you can conceive that can efficiently manufacture it?

Dr. OPPENHEIMER. Of course, you are using the word "efficiently."

Senator TYDINGS. Reasonably efficient.

Dr. OPPENHEIMER. Are you talking about large power production?

Senator TYDINGS. My question is directed to this point: Assuming that there is a system of inspection—

Dr. OPPENHEIMER. Yes.

Senator TYDINGS. I want to know, if one nation attempted to cheat inspection, how small a plant could be erected to avoid detection and produce bombs?

Dr. OPPENHEIMER. Oh. I think that the main building, the main reactor, if it were 100 feet square, you would get an awful lot out of it. The building itself would not have to be large; but there would be a lot of auxiliary works.

In other words, atomic bombs could be manufactured in a building or a series of buildings of not more than 100 feet, of which the largest building was perhaps 100 feet.

Senator TYDINGS. 100 feet long and 100 feet wide. And how high?

Dr. OPPENHEIMER. 80 feet high.

Senator TYDINGS. 80 feet high. That would be pretty hard to detect, would it not?

Dr. OPPENHEIMER. Yes.

Senator TYDINGS. Now then, the next question is: Could plants be so diversified in the manufacture of atomic bombs that each of them would be smaller than the ones you have just described, if that was the desire of the country erecting the plants?

Dr. OPPENHEIMER. I think there will be a few buildings—I mean, if they are going into the thing in a practical way and want to make a sizable number of bombs, I think that there will be quite a few buildings not smaller in linear dimensions than 100 feet.

Senator TYDINGS. Now, if they were using a building, if they had a manufacturing process housed in a building which would be limited to not more than 100 feet long to not more than 100 feet wide and 80 feet high, how many bombs do you think it would be possible to make a month?

Dr. OPPENHEIMER. Per building?

Senator TYDINGS. Per building or per combination of buildings scattered in different cities.

Dr. OPPENHEIMER. Well, let me put it in the form of per building.

I don't think that you could make the material for probably more than about five bombs in one such building, maybe as low as one.

Senator TYDINGS. The reason I am asking these questions, Doctor, is that every witness who has appeared before this committee has

stressed the fact that detection is necessary and that that is the only and final hope we have of control.

That being so, I am interested in knowing whether a nation that desires to frustrate inspection might conceivably arrange their atomic machinery and plants so as to avoid detection. Therefore, I have asked you, could plants be so diversified so as not to attract attention?

Dr. OPPENHEIMER. I think it is possible. I certainly do not wish to argue that inspection is easy.

Senator TYDINGS. Well, the reason I asked you is that one of the preceding witnesses on the stand here, in talking about the large and undeveloped areas said it would be necessary, to inspect, to fly back and forth in a plane. He was quite an eminent man and he said that he thought you could detect such a plant.

As a layman I do not believe that that is true. I think that covers a lot of ground, because I think ingenuity would be used. The plants would be either underground or they would be diversified, and would carry the diversification to such an extent as to avoid detection, that kind of detection, from a plane.

Do you agree with that thought or not?

Dr. OPPENHEIMER. I agree that it would be very, very, very tough. I should think that before the process of building the plants is begun would probably be the time when inspection should come in. Inspection would reveal the most about it then.

Senator TYDINGS. But suppose they built a plant 50 miles from any other place in the country?

Dr. OPPENHEIMER. Well, it would need power, it would need water, it would need a lot of stuff.

Let me put it this way: With what we know today, I think atomically to arm a country would involve a general effort and commotion, and if you tride to add, in addition, the fact that you wanted the installations to be invisible, the effort would be very much greater. I think you will notice the size of the strain, even if you did not notice the building itself.

Senator TYDINGS. I admit that there is a good possibility of detection.

But suppose the President of the United States said to you: "We are not permitted to use atomic bombs. However, I have reason to believe, although we haven't been able to detect it, that nation X, nation Y, and nation Z are working on these bombs."

Dr. OPPENHEIMER. Yes.

Senator TYDINGS. Then the President says, "I want you to conceive of a plant where we can manufacture atomic bombs, utilizing diversified operations already in existence in such fashion that nobody making any part of the bomb will realize that the whole thing is to be assembled for that purpose."

What prospect of success could you offer to the President if such a proposition were put to you and supposing you were given a free hand?

Dr. OPPENHEIMER. I would say, "Better ask General Groves to do it." [Laughter].

Senator TYDINGS. Do you think General Groves would have a fair chance of success?

Dr. OPPENHEIMER. No.

Senator TYDINGS. Now, suppose that same proposition were put up to you in one of three, four, or five countries, other than the United States of which you might conceive under existing circumstances, what prospect of success would there be then for this undertaking?

Dr. OPPENHEIMER. When I was running Los Alamos, I had sometimes great difficulties, but I always consoled myself with the thought that any other country would not have done it so well, that it would have been worse.

Senator TYDINGS. I know, but I don't think that answers my question.

Dr. OPPENHEIMER. No? I believe that the more highly industrialized the country is, and the more different are the things going on, and the more complex its organization is, the better chance you would have of doing something, of accomplishing atomic bomb manufacture, and I think that all of these things with reference to complexity, high industrialization, apply to this country, at the present time, more appropriately than to any other country.

Senator TYDINGS. Then, too, General Groves testified that the value of inspection would not be 100 percent, that it would not be naught, that it would be naught plus.

From what you have told me of the difficulties of concealing this operation, I would assume that inspection, in your mind, would be much more successful than was the conception of General Groves. Am I wrong?

Dr. OPPENHEIMER. I think there is a little difference of philosophy. If you are dealing with part of the world, a nation or a group of nations which says, "It is none of your business what we are doing," and if the country or group of countries is full of secret arms plants and you cannot get into it, if they will not let you go into the country but say, "We will let you follow our work on uranium," and do not let you see what is going on—when you come to a country like that you are going to have a terrible time finding out what the plants may or may not be working on.

But if the obstacles are not presented to you in this form and you have people already in the country in the normal way and the government has said, "We are not making or going to make any secret in this field," and does not make a habit of secrecy, then I think you have a chance.

Senator TYDINGS. Don't let us take such an optimistic view. Let us take the world as it is, not the world as it ought to be.

In the case of the world as it is, do you believe it would be possible, assuming that the plant would not have to be more than 100 feet wide and 100 feet long and 80 feet high, do you assume that it would be possible, considering the wide areas that many nations have control over, like Britain as an empire, or like Russia which has one-fifth of the world's land area, or France as an empire, do you believe it would be possible, in any of these countries to make atomic bombs that would have a 50-50 chance of avoiding detection?

Dr. OPPENHEIMER. I don't think it would be possible to get started and make atomic bombs and have a 50-50 chance of avoiding detection.

Senator TYDINGS. Why?

Dr. OPPENHEIMER. Because I think that the effort necessary to do to the job would show up. It would show up.

Senator TYDINGS. To whom?

Dr. OPPENHEIMER. To anyone who lived in those countries.

Senator TYDINGS. Well, suppose they couldn't get out.

Dr. OPPENHEIMER. In that case, it might show up, it might be detected, but the detection would not be valuable; that is, if you don't have freedom of travel, I think the problem is impossible.

Senator TYDINGS. In other words, inspection is not worthy of the name unless it is unimpeded and free?

Dr. OPPENHEIMER. Absolutely.

Senator TYDINGS. And if the country refused to cooperate with inspectors?

Dr. OPPENHEIMER. Absolutely.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. I was very much interested in a part of the discussion between you, Dr. Oppenheimer, and Senator Byrd a while ago.

Let us assume that, instead of the United Nations, that the five or six principal powers of the world should sit down and make an agreement that they will not use atomic energy for warfare.

Let us suppose that this agreement is filled up with all sorts of pious declarations on the subject. Let us suppose that, as time goes on, it is discovered that one of these nations has violated the agreement and has a store of atomic bombs.

I gathered from what you said in answer to one of Senator Byrd's questions, that we then would have to take protective measures, and that we would have to move in on that country.

Would that carry the thought in your mind that we could move in effectively?

Dr. OPPENHEIMER. Well, I don't think that I should be asked, on the one hand, not to discuss political questions, and, on the other hand, approached to answer them.

The CHAIRMAN. Doctor, I want to say this to you: If the political scientists had kept up with the other scientists, there might be some question of complaint or cause for complaint about receiving advice on the subject of political questions.

However, as far as I am concerned personally, the political scientists have made such a mess that I think we would do well to hear such advice. After all, you people have been thinking about this thing for 4 or 5 years, and I, for one, am very glad to hear your advice.

Senator MILLIKIN. What I wanted to find out, Mr. Chairman, was whether the witness' answer carried the implication that, without bombs, one nation could move in and protect itself against a nation with bombs. I think that is a very significant and important question.

Dr. OPPENHEIMER. I will tell you what I thought I said. It is my conviction that the easiest time, and, in fact, the only time when one might hope to discover that there were violations of the convention would be the time when it is started, when you are pulling in your technical people, when you are having the equipment manufactured, when you are building the plants.

During that time, the nation that is doing this is not going to have any atomic bombs.

Senator MILLIKIN. For my purpose, let us assume that that is absolutely correct. Let us take the next step.

Let us envision that situation I portrayed, where one of the principal powers, also having other military resources, confronted us suddenly with the fact that she had a store of atomic bombs.

Could the other four or five principal nations protect themselves against that situation?

Dr. OPPENHEIMER. They could not protect themselves adequately against the atomic bomb, sir.

Senator MILLIKIN. Thank you.

The CHAIRMAN. Doctor, we have spent, and rightly so, I think, a considerable time examining the difficulties of control, international control, the difficulties of having any peacetime development of atomic energy even if we do have control.

Have you thought about the alternative of unlimited atomic armament races between six or seven countries of the world and the possible outcome of that, considering history, if you are to look at history?

Dr. OPPENHEIMER. Yes, of course. That is a problem which I can easily answer.

I believe that if there is atomic armament there will be atomic war. I believe if there is atomic war that the damage which has been pictured to you by many witnesses before me will, in fact, occur.

The CHAIRMAN. Let us assume that all nations—all nations making atomic bombs—have, in a period of time to be denoted as "X," an equal number of bombs. General Groves' estimation of "X" is 20 years, which he admits is a guess; in Dr. Langmuir's mind it could be 3 years or in the case of Russia possibly 5; Winston Churchill's estimate, given, I presume, after talking to English scientists, is 3 years. Now, assuming they all have an equal number of bombs—

The military thinking on it, as I get it, as evidenced by General Groves, is that if you have a great big stock and everybody has a great big stock, no one will use atomic bombs because of the fear of retaliation, and that is that upon which we have got to rely for our defense.

Do you wish to comment on that mental state of mind of the 130,000,000 or 140,000,000 people of this country, as well as the 2,000,000,000 or so of this world, living in an atmosphere where there is the possibility of destruction to come anywhere from the four corners of the globe?

Dr. OPPENHEIMER. You have been so eloquent that I don't need to comment.

The CHAIRMAN. Thank you.

Dr. OPPENHEIMER. I think that that would not be the whole thing. Although the fear of retaliation is a very serious one, the advantages of attack are enormous, the advantages of initiative are enormous.

I believe, when the thing goes far enough and the stock piles get bigger and bigger, that, at least, the advantages, the seeming advantages of the initiative will outweigh any possible disadvantages of having other powers gang up on them.

The CHAIRMAN. Have you thought about the possibility of a nation getting this advantage without even suffering retaliation because the attacked nation would not know where the bombs came from?

Dr. OPPENHEIMER. It is possible. That is not one of the things that keep me awake nights, as the first point you mentioned is. The idea of three or four or five arsenals, each containing 5,000 atomic bombs, that is something to lie awake nights about.

The fact that the weapons might have traveled so many times around the world to their target that you couldn't identify their origin is, I think, a minor worry. I think, as a matter of fact, that technical equipment could be set up so that you would know where they came from, if you were there to read the meters. [Laughter.]

The CHAIRMAN. Well, assuming that you wouldn't be there to read the meters and assuming furthermore that the attack might come from a small country, a nation which might be taken over by fifth column methods, what then?

Dr. OPPENHEIMER. There is certainly danger, there is unquestionably danger. That is why it seems to me worth while to face the terrible problems of inspection and the terrible problems of the situation, because the alternative seems a lot worse.

The CHAIRMAN. Doctor, you made a statement about the effect of the bomb as a depth bomb. I assume that you are able to compute pretty accurately, particularly after these three tests—two of them, of course, were not tests, but use—as to the physical effect.

Assume that there was a fleet of ships in a harbor and that an atomic bomb was dropped in the center; or, perhaps, to put it more realistically, assume that a fleet has been discovered at sea, operating as, say, Admiral Halsey's fleet would be operating.

Dr. OPPENHEIMER. Yes.

The CHAIRMAN. Assume that a bomb such as you know is now capable of being manufactured, be dropped upon such a fleet. What would be the effect of it?

Dr. OPPENHEIMER. Am I allowed to answer that in open session? I think I am not.

Senator TYDINGS. I think you ought to answer that.

The CHAIRMAN. I think that is answerable, Doctor.

Senator TYDINGS. In general terms.

The CHAIRMAN. Yes.

Dr. OPPENHEIMER. I am afraid about that. There is a specific Presidential prohibition on saying anything about the military or naval uses of atomic weapons and saying anything in public.

Senator TYDINGS. I think there is a good point there that should be brought out.

The CHAIRMAN. Frankly, Doctor, it never occurred to me that that could be regarded as a secret.

Dr. OPPENHEIMER. Well, if it does not have to be answered quantitatively, if it can be answered generally—you see, it is obvious, I could say, "It would do great damage." I am willing to say, I am willing to go on the record as saying that it will do great damage. [Laughter.]

But I would like to point out one thing. It is sometimes asked whether a single weapon can destroy this or that by the use of such a weapon.

I would say that that depends upon the details and a lot of things. For example, in the example you cite, it would depend upon how the fleet was disposed of, where the bomb was set off, and so on. That would determine how much of the fleet would be destroyed.

As I see it, the cost of an atomic weapon is going to be so small, compared to the cost of a capital ship, that the problem of the usefulness of capital ships, which is a very serious one in any case—that is, even if you only hit one ship—there you have a big target, you have an expensive target.

Senator TYDINGS. I have one more question.

The CHAIRMAN. All right, Senator.

Senator TYDINGS. I would like to have you give me a comprehensive answer to this if you feel that you can and circumstances will permit you.

Can there be a reasonable separation of the manufacture of atomic energy for peace, as differentiated from its manufacture for war?

Dr. OPPENHEIMER. The manufacture of atomic energy for peace, in any plants that I have heard discussed, would make material latently which could be used for war.

Senator TYDINGS. May I interrupt? Up to that point, the line between the manufacture of atomic energy for peace and using the materials so manufactured for war is a very thin and difficult line to draw?

Dr. OPPENHEIMER. I would put it this way.

If you did this, if you made atomic energy and sold it in kilowatts and so on and definitely made no provision for military inspection of the products which you were making at the same time and did this on a large scale, you would have perhaps solved, let us say, more than 60 percent and less than 90 percent of the problem of making atomic weapons.

Senator TYDINGS. So, by the manufacture of atomic energy for purely peaceful purposes, we have by so doing considerably lightened the manufacture of atomic energy for war purposes from between 60 percent and 90 percent, somewhere around there, of its potential?

Dr. OPPENHEIMER. That is right, and it is a very serious problem and if we do it we would want to have the most rigorous inspection of such a plant.

Senator TYDINGS. Do you believe it is humanly possible to manufacture atomic energy for peacetime purposes in a country that desires to use it for wartime purposes eventually without having to reach, preliminarily, the 90 percent potential to which you have alluded?

Dr. OPPENHEIMER. I don't know.

Senator TYDINGS. I mean if they have the will to do it, you understand.

Dr. OPPENHEIMER. I think—my guess would be that, let us say, if a plant is erected in—if you don't like China, let us say France—

Senator TYDINGS. Or in the United States.

Dr. OPPENHEIMER. Or in the United States. If there is such a power plant and we have any inspectors in this plant, I would say that the part of the job which needs to be done, circumventing these inspectors—and I think that would be very hard to do—is about one-third or one-fourth of the total.

I could also say that you can make power plants, make plants for the creation of atomic power for peaceful uses which do not make materials for military uses; but you can only do this if you have other plants which are making the ingredients of atomic bombs.

Senator TYDINGS. So, you think, with respect to inspection and this question of other countries being permitted the making of atomic power for peacetime purposes, that then we would be, approximately, at that point, within 25 percent of the ultimate goal of starting from scratch and manufacturing atomic power for the atomic bomb?

Dr. OPPENHEIMER. That is my understanding.

Senator TYDINGS. I think that is a fair statement.

Dr. OPPENHEIMER. And I would go further and say that this problem, obviously, is a tough one.

The heads of three states, who have very good advice on it, were not only worried about it but, in their official statement said they were worried about it; namely, they felt that the time was not yet here when it was possible to cultivate the application of atomic energy to peaceful purposes on an international scale. By implication, they said that they thought the time would be here.

Senator TYDINGS. Assuming that 10 years from now atomic energy in many countries has been licensed by the government for peacetime manufacture and uses and that our country was one of them.

What do you think would be the necessary time to construct the remaining 25 percent of the process, for war purposes, of producing atomic bombs?

Dr. OPPENHEIMER. It depends on the scale. If we wanted to have, I will say, 1,000 bombs, 2 years would be a lot of work and the whole country would feel it.

Senator TYDINGS. In other words, it would take 2 years?

Dr. OPPENHEIMER. Yes, to accumulate 1,000 bombs.

Senator TYDINGS. If it were decided to make military bombs from our peacetime atomic energy, how long would it take us to complete 200?

Dr. OPPENHEIMER. Maybe a little over a year.

Senator TYDINGS. How long would it take us to make 50?

Dr. OPPENHEIMER. Maybe a year.

Senator TYDINGS. So that we are faced with the prospect—

Dr. OPPENHEIMER. I think a year is too long; maybe 9 months.

Senator TYDINGS. So, then, we are faced with the prospect, if countries were permitted to manufacture atomic energy for peacetime purposes and 10 years after, if they got the all-out and oriented themselves into production, you say that within 9 months they can make 25 or 50 or 60 bombs thereafter for military purposes, utilizing that peacetime machinery?

Dr. OPPENHEIMER. Not without, I would say, its being known; but it could do it.

Senator TYDINGS. As I say, if they were given a free hand.

Dr. OPPENHEIMER. Yes.

The CHAIRMAN. Doctor, of course any peacetime use of atomic energy presupposes widespread distribution of the power generated by the fissionable materials.

Let us say we have a central heating plant in Chicago that is so devised that it could furnish heat to every house and apartment house in Chicago cheaper than it could be done in any other way.

Now, if it is decided that that fissionable material was going to be used for bombs, somebody would get his heat cut off in Chicago; would he not?

Dr. OPPENHEIMER. It wouldn't have to work that way.

The CHAIRMAN. It wouldn't have to work that way?

Dr. OPPENHEIMER. No. You would need new stocks of uranium, but the normal way you would do the job, you would not have to cut off the power. I think not.

But, that is one of the few problems that I don't see as a serious one.

The CHAIRMAN. I see.

Dr. OPPENHEIMER. It is clear, of course, if you have a lot of power plants and you suddenly change their use, their use for power generation may be impeded, but it would not have to be if you had an adequate supply of materials.

The CHAIRMAN. Senator Johnson.

Senator JOHNSON. Would the water used for heating purposes be radioactively dangerous?

Dr. OPPENHEIMER. The plant could be designed so that that would not be the case.

Senator JOHNSON. It could be so designed?

Dr. OPPENHEIMER. Yes. I ought to say quite clearly that although the generation of power at high temperatures looks to me like a solvable problem, it might be a matter of a couple of years or more than that before a working solution could be arrived at, even if it were decided to be the right thing to do.

Senator JOHNSON. Would the steam coming from such a plant be radioactive?

Dr. OPPENHEIMER. It shouldn't be. It should be done by means of heat exchanges, so that there is no direct contact between the hot fluid going to heat the homes and the radioactive materials.

The CHAIRMAN. Doctor, assuming that you believe that inspection was scientifically feasible—and not injecting into it the political feasibility of control—you have, it seems to me, this result: That nations willing to forego the control of a weapon of warfare such as the atomic bomb would also be willing—if this is a logical situation and it seems to me it might be—would they also be willing to forego other weapons of warfare?

Dr. OPPENHEIMER. That is my hope. You see, I think that the whole situation is completely turned around.

Here is a development which makes it clear that the dangers of warfare are enormously greater than in the past—and they have been terribly great in the past—and I think our thinking and that of every one else has got to be in the direction and will be in the direction not only in this country but everywhere, that no one will be interested in making war.

I think that those steps which you have got to take that may involve the giving up for the time being of a certain technological development in order to control atomic weapons—I think that these are the steps that tie the people of the world together in their determination not to have a major war.

That is my view, but it is a political view and I am quite willing to admit that it might not be well informed.

The CHAIRMAN. It seems to me that if I can induce my neighbor to put away a pistol with which he could blow my brains out, I should also be able to prevail upon him to put away a stick with which he can rap my knuckles or shin.

Dr. OPPENHEIMER. It would be completely logical. I don't think that it will happen in the real world that the major weapon is abandoned and that people will still plan wars.

Senator HICKENLOOPER. May I ask a question?

The CHAIRMAN. Yes.

Senator HICKENLOOPER. Doctor, am I correct in assuming that you believe, assuming freedom of inspection, whether we get the help of other governments or not, that our inspectors have freedom to go into a country if they want to and examine—with that freedom of inspection assumed, do you believe that we can detect the beginning of the manufacture of fissionable material. Is that correct?

Dr. OPPENHEIMER. With the freedom of inspection and with effort.

Senator HICKENLOOPER. Well, that is part of my assumption. I am assuming all of the efforts that are necessary for the inspection and I am also assuming the freedom to do it.

Dr. OPPENHEIMER. That is right.

Senator HICKENLOOPER. Now, if we have that freedom of inspection, including definite agreements, we could, in your opinion, be reasonably sure that we could detect the beginnings of the manufacture of these materials; is that right? And, that later, if we did detect it being manufactured in violation of an agreement, that it would be up to us to determine what to do about it?

Dr. OPPENHEIMER. That is right.

Senator HICKENLOOPER. That would be another problem, what to do about it, political or otherwise.

Now, let us assume that, with that freedom of inspection we, by license or treaty or agreement, or any other means, permit countries to make this material for power and for scientific experiments and for public health and all the rest of the things, the beneficial use of it, with their agreement not to make the material for a bomb or to attempt to make it, at what point, assuming the situation that there were factories making this material and putting it into heating plants, for example, and using it for that purpose—from that point on, at what point or how soon do you think free inspection could detect that they were changing that production or using a part of that production for the manufacture of fissionable materials?

In other words, do you think it would be when they begin to do it or when they had part of the bombs made or in the midst of the process, or when?

Dr. OPPENHEIMER. I think that you would detect it as soon as any material was diverted if you had a good inspection system. My view is that you may or you may not go into every house in the country, but if they really have got a plant that is making these different things you would have a pretty active group of inspectors and I think they could detect that right away.

Senator HICKENLOOPER. In other words, it would be possible to detect any substantial diversion of the original material in the process of manufacture for peacetime purposes?

Dr. OPPENHEIMER. That is right.

Senator HICKENLOOPER. From the beneficial, peaceful use to the manufacture of weapons, this other 25 percent of the process that you are talking about?

Dr. OPPENHEIMER. That is right.

Senator HICKENLOOPER. And that would depend entirely upon adequate and efficient inspection?

Dr. OPPENHEIMER. Yes, sir.

Senator HICKENLOOPER. I presume that there would be some disagreement as to what is adequate and efficient inspection, but assuming that it is, it can be done?

Dr. OPPENHEIMER. I say if you are dealing with open plants, the problem of inspection is not so tough. If there is a power plant some place and we are allowed—we, or the United Nations, or what have you—are allowed to maintain inspectors there, this problem does not look hopeless.

The problem starts looking hopeless if you have a country where you do not know what is going on, a country where there are limitations of freedom and movement.

Senator HICKENLOOPER. Just one more question.

May I ask your opinion on this?

You have been in the scientific end of this and you have been in it, of course, as deeply as anyone and you have had a tremendous responsibility, both as a scientist and as a citizen. At this moment I would like to have your opinion although I realize that at this moment you may not be able to give it.

Would you care to answer this, as to whether or not you believe we should point our efforts towards a suppression of atomic energy and the scientific development or should we point at efforts towards the continuance of atomic investigation and center on the attempted control by inspection and other allied means.

Dr. OPPENHEIMER. That is the easiest question I have been asked this morning.

I believe we must continue with the work and attempt to solve the problems created in the political sphere.

Senator JOHNSON. That is the same question I was trying to get at a while ago. The Senator from Iowa has couched it in much more courteous terms. He is less blunt about it.

What I was trying to say was this: That the scientists have created an instrument, a terrible instrument. Now, they are coming to the politicians to control it. They say that is the only way it can be controlled, that the only answer is political control. They say we must have a political solution and that there is no scientific solution whatsoever.

As I understand your testimony, that is your position.

Dr. OPPENHEIMER. At the moment, as you surely know, every imaginable effort is engaged in the problem of intercepting airplanes, rockets, guided missiles, and I know what is going on. I am sure that progress will be made along these lines. I think the people working on it are doing the best they can do. It may be that such progress will be made that this problem may be solved.

Senator JOHNSON. My question was whether the scientists have given up in their efforts to find a countermeasure or whether they are relying entirely upon the politicians to find the answer to the problem which they have created through their energies.

Dr. OPPENHEIMER. That is really beating your wife. The idea of a specific countermeasure has never had—I myself wrote a memorandum on it, some 5 years ago, which gave a completely impracticable

solution. It could work against some other weapons, that scheme I had, but I would say that it would not work against this weapon.

Senator JOHNSON. But don't you think the scientists ought to continue along the line of discovering physical means of combating atomic bombs, rather than to come in and say that it is just one of those things that cannot be done and we must have a political solution?

Dr. OPPENHEIMER. I honestly believe it can't be done. I realize, in saying that it must have a political answer, we are passing the buck.

Senator JOHNSON. No, it is not a question of passing the buck.

Dr. OPPENHEIMER. I am very much afraid that the buck really is passed; but it is one of those things where we will, 10 or 15 years from now, have reasonable interception methods, but the military people working with them will report back that they are not satisfactory.

Senator JOHNSON. It is not a matter of passing the buck. It is a matter of being very frank with us, because we are trying to find the answer, and if the only answer is political you are rendering a great contribution to the world in positively stating that.

Dr. OPPENHEIMER. That is my conviction. I think you should ask other people who may be better informed on some parts of it than I am. I say not only do we not have now but I don't believe we ever will have anything that will prevent the atomic bomb from working unless you hit the carrier and physically demolish it. It is the same problem that you have with any other bomb.

I might be wrong; but I know of nothing that I could say more confidently than this, that I believe it is a political problem and I believe it is about the toughest one that has been handed to any group to struggle with.

Senator HART. Doctor, we have profited greatly by your observations in the international field concerning Dr. Smyth's report. As I understand it, after that, they issued the Truman, Attlee, and King statement.

Dr. OPPENHEIMER. Right.

Senator HART. As a citizen with a splendid background, what do you think should be the next step?

Dr. OPPENHEIMER. Well, I would answer it this way, that certainly the step proposed in the Truman-Attlee-King memorandum is sound. If there were, on the part of those competent, real doubts as to the willingness of any important group of nations or a nation to participate in the steps that are there proposed, I think this problem should be attacked by direct conversations with such groups of nations, or such nation.

If there are no such doubts, then I think the steps proposed in the memorandum are right and, particularly, the emphasis on the fact that this problem is going to be solved inch by inch, that they should start with a very modest program and would have to take advantage of the war weariness and the absence of atomic bombs to get into a frame of mind in which the major problems might be properly presented.

Senator HART. Specifically, whose move is it next?

Dr. OPPENHEIMER. It is always the move of the United States, because the United States is committed to peace.

The CHAIRMAN. Doctor, there are 2,000,000,000 people on the face of the earth. If they were to be given a chance to vote on the control of this thing, what do you think the results would be?

Dr. OPPENHEIMER. I have no doubt that they would say, "Let us have no wars."

The CHAIRMAN. Doctor, Senator Hart has brought up the declaration made by President Truman and Mr. Atlee and Mr. King. In the eighth paragraph of that declaration there is a statement that we should proceed by steps and stages.

I noticed that the first stage suggested was the exchange of information on scientific data. Does this mean, according to your interpretation, the exchange of information on nuclear energy?

Dr. OPPENHEIMER. I think it mentions the exchange of a good deal of the basic scientific findings of our laboratories and our experience, calculational experience, which are not specific to the making of atomic energy or atomic bombs.

I am sure that those who wrote the statement are better qualified in saying what it means than I am. I think it is purposely vague because it is not clear just to what extent this will proceed.

I think it is the intention of the Government of the United States to release noncritical technical information which has been gathered in the work on this.

The CHAIRMAN. The purpose being, I presume, that that information will have a peacetime value?

Dr. OPPENHEIMER. That it will develop science and industry and technology.

The CHAIRMAN. That is, peacetime use.

Dr. OPPENHEIMER. But not necessarily atomic energy. A lot was discovered that will be useful in other endeavors.

The CHAIRMAN. Have you any comment to make as to proceeding by stages which, I take it, contemplates a period of considerable length of time for the solving of this problem?

Dr. OPPENHEIMER. Well, certainly, no one would argue that it was not desirable to solve the whole problem at once; but I believe that the men who issued this statement must have been aware of the impossibility of so doing and the dangers involved in the setting up of full interchange and full construction programs of atomic reactors all over the world. I think they must be aware of those dangers. I know of nothing which causes me to doubt the soundness of their views. I think it might be dangerous if the steps were too small.

The CHAIRMAN. Doctor, I think there are some more questions that some members of the committee would like to address to you which you can only answer in executive session.

We are going to meet again this afternoon at 2:30, but we have some other witnesses, and I will try to arrange that with you later.

Thank you very much, Doctor.

We will recess now until 2:30.

(Whereupon, at 12:25 p. m., a recess was taken until 2:30 p. m., of the same day.)

AFTERNOON SESSION

The CHAIRMAN. Dr. Bethe, I believe you have a prepared statement. Will you proceed to give it to us, please?

STATEMENT OF DR. HANS A. BETHE, PROFESSOR OF THEORETICAL
PHYSICS, CORNELL UNIVERSITY

Dr. BETHE. I am normally a professor of theoretical physics at Cornell University. During this war, during the last 3 years, I have been working on the atomic bomb project at the Los Alamos Laboratory, the director of which you heard this morning. I was the leader of the theoretical physics division in that laboratory.

I have been asked to testify on the problem of obtaining energy from atomic nuclei other than uranium and plutonium.

The CHAIRMAN. Doctor, for purposes of the record, where were you born?

Dr. BETHE. Strasbourg, Alsace-Lorraine.

The CHAIRMAN. When did you come to this country?

Dr. BETHE. 1935.

The CHAIRMAN. Had you worked in this science in Germany?

Dr. BETHE. Yes.

The CHAIRMAN. When did you begin working on it here?

Dr. BETHE. You mean on nuclear physics?

The CHAIRMAN. Yes.

Dr. BETHE. All the time I have been here.

The CHAIRMAN. Will you go ahead, Doctor?

Dr. BETHE. This is a very difficult subject to discuss because practically all of it is still in the realm of speculation.

It is necessary to make a clear distinction between the theoretical possibility of releasing atomic energy, and the practical feasibility of doing so. Theoretically, on the basis of the energy stored in the atomic nucleus according to Einstein's theory, energy could be obtained from most atomic nuclei. For instance, the splitting of any of the heavy nuclei into two or more parts, such as takes place in the fission process, will release large amounts of energy if the splitting can be accomplished. Likewise, the combination of two or more light nuclei, such as hydrogen into one, will also release considerable energy—in this case the energy release is connected with a building up of nuclei, not with a splitting. Only some medium-weight nuclei such as iron are exceptions—no energy can be obtained from them either by splitting or by building up.

The problem then does not lie in finding great stores of energy in atomic nuclei, but in finding a way to release it. It is common practice in nuclear physics laboratories to produce transformations of atomic nuclei, either splitting them or building them up. In many of these transformations, energy is released. However, these transformations can be induced in only relatively few atoms at one time. The transformations are generally produced by particles accelerated in a cyclotron or similar device; some of these particles hit atomic nuclei and cause them to transform into other species—but this is where the process stops. There is no further transformation after the particles accelerated in the cyclotron are on their course. No amount of atomic energy of any practical importance is released. It is the same situation as when you hold a burning match to a large piece of wood: some of the wood will be charred but the wood does not catch fire; therefore you do not get any appreciable heat out of the wood.

How, then, can we ignite atomic nuclei? In other words, how can we start a nuclear reaction which continues on its own power and which releases energy from the atomic nucleus in practical amounts? There are only two known methods to obtain such a so-called nuclear chain reaction: one of these is the nuclear fission on which the atomic bomb is based. The other involves the nuclear reactions which we believe take place in the interior of stars, and which involve light nuclei.

The chain reaction based on nuclear fission is well known. The principal agent in this chain reaction is the neutron. The neutron, having no electric charge, can approach an atomic nucleus without being repelled from it and can therefore enter the nucleus and cause transformations in it without difficulty. The principal reason for the working of the fission-chain reaction is that in the fission process neutrons are emitted which in turn can cause fission in other nuclei.

The process of atomic fission has so far been observed only with the very heaviest atomic nuclei, plutonium, uranium, thorium, and one or two others of less practical importance. There are good theoretical reasons why the fission process should become less and less likely, the lower the atomic weight. The most important practical question is whether fission could occur in any element which is abundant on the earth. The heaviest abundant element is lead and, somewhat less abundant, bismuth. But these elements are much lighter than uranium, and it is therefore theoretically quite unlikely that they could be made to undergo fission to any useful extent. In fact, up to the present no fission has been observed with either lead or bismuth. From general principles, it is then most improbable that elements still lighter than lead would show this phenomenon. This leaves us with thorium and uranium as the most important raw materials and, of course, with the elements which can be produced from these by nuclear reactions, such as plutonium.

As we go to elements of smaller atomic weight we come into the region where nuclei are even theoretically incapable of releasing energy. If we go to still lighter nuclei, we can get an energy release by building nuclei up rather than by splitting them. It is such a building up of light atomic nuclei which is believed to be the source of the energy in the sun and in the stars.

More precisely, the sun's energy is believed to be due to reactions between hydrogen nuclei on one side and carbon and nitrogen nuclei on the other. Each atomic nucleus has a positive electric charge, therefore they repel each other. It is therefore difficult for two nuclei to get into contact and undergo a nuclear reaction. They can do this only if they move at each other with very high velocity. Then the velocity carries them together in spite of the repulsive forces.

The high velocity is provided in the interior of stars by the very high temperatures existing there. For instance, at the center of the sun the temperature is about $20,000,000^{\circ}$. In our laboratories, the high velocity is given to the nuclei by accelerating devices such as the cyclotron. The velocities involved are about the same in both cases; actually they are somewhat higher in the cyclotron. But the main difference is that in the stars all atoms have the high velocities, in the laboratory only a few do. Also in the laboratory, these few atoms lose their velocity quickly when they traverse matter.

The matter, of course, is at a low temperature, has not high energy, and if you hit an atom which is at rest with an atom which is in motion, then the atom which is in motion will lose most of its velocity and give some of it to the atom at rest. That doesn't do the atom at rest any good, but it does some harm to the power of the atom which used to be in motion.

In the stars, they keep their high velocities forever; therefore the nuclear reaction can go on indefinitely and we have again a self-sustaining reaction: The energy released from the nuclei produces the high temperatures in the stars, and the high temperature in turn enables the nuclei to get together and to release their energy.

You will see that this mechanism of the sustained nuclear reactions in stars is quite different from that in the atomic bomb. In the bomb, neutrons are causing the reactions; they are not repelled by the electric charge of the atomic nuclei, because they are electrically neutral and therefore the reaction can take place irrespective of the temperature of the bomb and of the velocity of the neutron. In the stars, on the other hand, the reaction takes place between two atomic nuclei which repel each other; a sustained reaction is therefore only possible at the high temperatures in the stars.

There are some stars, the red giants, which have lower temperatures in their interior than the sun, namely only about 1,000,000°. They are supposed to derive their energy from a reaction between two nuclei of heavy hydrogen.

It is not impossible that some day in the future we shall be able to release nuclear energy by reactions similar to those taking place in the stars. The difficulty is to obtain a high enough temperature to start such a reaction, and to obtain this temperature in a sufficiently large volume.

This latter is a particularly great difficulty which has already been mentioned by Dr. Oppenheimer this morning, that in the stars you have an enormous region, an enormous mass which is at high temperature, and on earth it is very difficult to imitate these conditions.

In the stars, the temperature of the interior is kept up by the fact that there is almost equally hot material around it which shields the interior from losing too much of its heat, and the fact that there is so much material around is made possible by the gravitational forces in the star which keep the star together and enable the star to have such large amounts of high temperature material.

Senator AUSTIN. Do you consider the star as gaseous, entirely?

Dr. BETHE. Yes. It seems almost impossible to imitate these conditions on earth. Moreover, the reactions taking place in the sun are exceedingly slow; it takes several billions of years to consume the hydrogen nuclei in the interior of the sun. There would be no practical value in producing nuclear reactions at such a slow rate on earth, but we should be interested only in reactions which would take place in a matter of at most a few years or, for bombs, even in a fraction of a second. In order to get the reactions accelerated to this extent, it would be necessary to have even higher temperatures than even in the center of the sun.

At this point I should like to discuss the question of setting the atmosphere or the ocean on fire by atomic bombs. This question has been very much talked about recently, and I think there was very

much loose talk about it. In the atmosphere the only abundant elements are nitrogen and oxygen, in the ocean oxygen and hydrogen. Nuclear reactions between these nuclei are very unlikely and require enormously high temperatures, much higher than the reaction which takes place in the sun. It can be stated with complete assurance that atomic bombs of the present type or of any type that is now in sight will not produce high enough temperatures to cause nuclear chain reactions in either the atmosphere or the ocean. Theoretical arguments which are probably reliable would even indicate that no temperature, however high, would permit the "ignition" of the atmosphere. Only if one had an enormous amount of water or air, about the size of the sun, and if one then raised this large amount all at the same time to a temperature of many millions of degrees, could there be a self-sustaining nuclear reaction in these substances.

The point is, of course, that in that case the temperature does not get lost by radiation, by heat exchange with the surroundings; and if the temperature can get lost by radiation, then the temperatures required are very much higher and the conditions for the nuclear reaction are much more severe. It therefore seems extremely unlikely that there will be any possibility of igniting the atmosphere or the sea by atomic bombs.

To sum up, the reactions between light nuclei are of possible interest for the future development of atomic power, although the difficulties are undoubtedly very great. To produce such reactions the primary problem will be that of obtaining the extremely high temperatures necessary. In addition, of course, the nuclear reactions themselves will have to be studied.

There is, however, another and much more profound reason for studying the reactions between light nuclei. It is hoped that from such reactions, physicists will be able to learn about the nature of the mysterious forces which hold atomic nuclei together. The light nuclei are the only ones from which such information can be expected, because the heavier ones have such a complicated structure that it will be nearly impossible to analyze any experimental information that might be obtained.

The study of nuclear forces is a problem in pure research. It is not possible to predict whether any practical results will be obtained. I can only say that, in the past, progress in pure research in physics has led to practical applications sooner or later. It is in the nature of pure research that it is impossible to say beforehand where it will lead.

It is my belief that everything should be done to encourage and support pure research on light nuclei. The reasons are both the attempt to understand nuclear forces and the possibility of imitating the nuclear reactions of the stars. Like any kind of pure research, the research in this field can only be done successfully if it is free from restrictions on subjects to be investigated and on publication of the results. Because of the possible practical applications, it may be desirable to require that all results obtained must be communicated to the Atomic Energy Commission whether they are otherwise published or not. Apart from this, the research in this field will flourish most if it is unrestricted in any way, but encouraged in every way.

Research in fundamental fields has in the past benefited very greatly from international collaboration between scientists. This will, no doubt, continue to be the case and such collaboration should be encouraged as much as possible. Arranging for the exchange of scientists and for international conferences are some of the best methods for this purpose. The international collaboration of scientists in the field of pure research in nuclear physics may also be one contributing factor to improve collaboration between the nations in the field of atomic energy which is so necessary for the survival of all nations and which has been initiated by the joint statement of President Truman, Prime Minister Atlee, and Prime Minister Mackenzie King.

I have mentioned in this testimony two ways of releasing atomic energy which are known at present. It is always possible that other mechanisms may be found even though at present there is no indication of the possibility of such mechanisms. Only pure research without any definite aims can lead to the discovery of such alternative methods.

I should like to add one point: There is somewhat more to this story which I think I could only mention in an executive session, and which would make the picture more complete.

The CHAIRMAN. Thank you, Doctor.

Are there any questions?

Senator HART. Doctor, may I ask if this is correct? That the reason that these extremely high temperatures in the middle of the sun are effective is because the atoms under those conditions are always moving at such an extremely rapid rate?

Dr. BETHE. Yes; in fact, from the standpoint of physics, the two statements are identical.

Senator HART. One other question, Doctor. You were very encouraging to all of us in the assurance that there is no danger of burning ourselves up by burning the atmosphere or the water, which you mention has been spread around.

It has not been said in here, but a certain number of men of supposedly very good scientific training have given those statements. Have you any idea how they came to do that?

Dr. BETHE. I am afraid I don't know. They were not men who have worked specifically on this problem, and I can only explain it as ignorance.

Senator HART. They are, however, men who have standings before the country by virtue of their educational attainments.

Dr. BETHE. That is true.

Senator HART. Possibly their attainment or production lies elsewhere.

Dr. BETHE. That is quite true. It is a rather complicated problem, and it took us the work of several years to find out about this subject and about the other subjects mentioned in this report.

I think I should say that before we made our first test of the atomic bomb, we were sure on theoretical grounds that we would not set the atmosphere on fire.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. If you wished to render the atmosphere inflammable, what would you do?

Dr. BETHE. I don't think you could do very much. If you had enormous amounts of energy available and could heat, let us say, all the atmosphere covering the city of Washington all at once—

Senator MILLIKIN. I was thinking of in the laboratory, if you wished to make atmosphere rare or inflammable, what would you do?

Dr. BETHE. You cannot do anything. The only thing you can do is char it. That is to disintegrate some of the nuclei. You cannot get a self-sustaining reaction in the atmosphere.

Senator MILLIKIN. I am not speaking of that. What does atmosphere consist of?

Dr. BETHE. Nitrogen and oxygen.

Senator MILLIKIN. If you withdrew one or the other, what would happen?

Dr. BETHE. Nothing. If you added heavy hydrogen, then there would be a slightly better possibility; but still I think it would be very unlikely that you would succeed.

Senator MILLIKIN. I am not thinking in terms of nuclear physics at all.

Dr. BETHE. You mean just chemistry?

Senator MILLIKIN. I am thinking of how to make the atmosphere inflammable. I have a vague idea that if you subtract one or the other of the components of the atmosphere, it becomes highly inflammable.

Dr. BETHE. If there are other substances around. If you have a piece of iron, for instance, it will burn in pure oxygen but it will not burn in ordinary air. That is, if you withdraw the nitrogen, then certain chemical substances such as iron can become inflammable in pure oxygen.

Senator MILLIKIN. That is what I was referring to.

Dr. BETHE. But this, of course, is not nuclear.

Senator MILLIKIN. I understand. Would there be any way of preparing the atmosphere to any large extent by the method you have described, and then subjecting it to nuclear energy?

Dr. BETHE. Yes, but it would still be extremely unlikely that you would succeed in setting it on fire. Also, it would certainly be noticed.

The CHAIRMAN. Dr. Bethe, if you had an air-tight chamber over Washington, you would have to draw it out in order to make it inflammable, wouldn't you?

Dr. BETHE. Just about.

Senator MILLIKIN. What started the stars off on this rampage?

Dr. BETHE. I don't know; I wasn't present.

Senator MILLIKIN. That is one of those "egg or the chicken first" things. Have you any theory on that?

Dr. BETHE. Some theories have been made; none of them are very satisfactory, and all of them are rather complicated.

Senator MILLIKIN. There is no simple explanation?

Dr. BETHE. No simple explanation, as far as I know.

Senator MILLIKIN. No explanation that withstands scientific measurement.

Senator JOHNSON. What is the temperature at the center of the earth?

Dr. BETHE. Probably only about 10,000°, so it is very low.

Senator JOHNSON. Comparatively cold?

Dr. BETHE. Yes; compared with the center of the sun.

Senator JOHNSON. Have the scientists succeeded in controlling the splitting of any atoms other than elements that naturally split themselves, like uranium and plutonium?

Dr. BETHE. Yes, definitely. I think I should mention two different types of splitting. Uranium and plutonium, naturally, that is, if you leave them to themselves, split themselves by emitting so-called alpha particles, which are small particles taking away only 4 units of 200 units of atomic weight.

Distinct from that is the splitting which takes place in the atomic bomb, which is a splitting into two almost equal parts, and which is induced by shooting a neutron at the nucleus of uranium or plutonium. If you shoot a particle, either a neutron or a hydrogen nucleus, or some other nuclear particle, at any nucleus, you will very frequently succeed in causing a nuclear transformation, that is causing the nucleus to transform into a new element.

Now, this has been done with practically all nuclei which exist; that is, with practically all elements that exist. For most of these elements, all you can do is shoot your projectiles in, and let us say 1 in 10,000 will make a lucky hit and will transform one of the nuclei. But this will not start a reaction which then goes on by itself, and if you want to get atomic power you cannot depend on sending a few projectiles in and getting a few lucky hits; you must get the whole piece to ignite. That is, you must get a nuclear reaction which goes on in the substance by itself.

Senator HICKENLOOPER. Doctor, is it the theory of the physicists and scientists that the earth at one time was a tremendous mass of heat with this fission going on, and that our present earth crust is the residue of that or the remainder of the stabilization of those things?

Dr. BETHE. We have no reason to believe that fission was a very important source of energy in any star or in the earth. It is not quite certain in what state the earth was when it first separated from the sun. I think the general belief is that it was hot—perhaps it came from some part of the sun, but that is not certain—and then cooled down very rapidly, because it was a smaller mass and a small mass loses energy or heat very rapidly to the universe which a large mass, like the sun does not.

Senator HICKENLOOPER. Perhaps I did not make my question quite clear. Is it the theory that the solids that we know, the various elements that we see—wood, metal, and so on—represent the results of nuclear transformation until it more or less wears out and stabilizes into these various forms?

Dr. BETHE. That is a fond belief of physicists. However, there is no established theory which permits us to explain that. We just don't know. We know that at present, in most stars, it is only the very lightest nuclei which transform; so the stars must have been in an entirely different condition if they had to produce such elements as iron, let us say.

Senator HICKENLOOPER. Now, is it the theory that the sun is a mass of reacting atoms, or is the sun in theory composed partly of a solid, as we know it?

Dr. BETHE. No; it is supposed to be closest to a gas; but it is a gas at very high density.

Now, by that I mean the following: In a solid, the atoms are carefully arranged to certain patterns, and that is not the case in the sun. In this sense it is a gas. On the other hand, the material is very dense at the center of the sun. It is 10 times denser than iron, which is a fairly heavy stuff.

Senator HICKENLOOPER. Getting back to the theory, whether it is reasonable or not, that the earth may have broken away from the sun, then apparently at the time the earth broke away from the sun it was this dense gaseous formation?

Dr. BETHE. That would be correct.

Senator HICKENLOOPER. Then what would be the generally accepted theory, under that theory, as to how the earth developed its solidification, or produced the solids which we now know, the various elements we find here?

Dr. BETHE. Well, the elements would be the same from the start. The elements in the gases are the same as the elements in the solid. The sun, for instance, contains a very large amount of iron, but this iron is in the gaseous state; and you can heat iron in the laboratory sufficiently high so that it does become gaseous. There is no particular difficulty in that.

Senator HICKENLOOPER. In other words, in cooling it solidifies?

Dr. BETHE. When it cools, it solidifies, and that is the theory.

The CHAIRMAN. Doctor, I take it, to sum up your testimony, that we do not have to anticipate that there will be use in the foreseeable future of any other basic materials than uranium and thorium to make atomic energy?

Dr. BETHE. Certainly not by the fission process. If somebody finds a way how to imitate the reactions in the stars—and that may not take a tremendously long time—then other materials will come into play.

The CHAIRMAN. You mean creating this intense heat?

Dr. BETHE. Creating this intense heat, and thereby igniting substances, igniting nuclear reactions in light nuclei.

The CHAIRMAN. The other day in the paper it was announced that Kapitza, the Russian, had done certain work. Will you fit that, as you read it, into this projection of what might be possible?

Dr. BETHE. I have heard of this, but unfortunately from the newspaper reports it is impossible for me to form a clear picture of what he has done.

It is claimed that he has discovered a negative proton, which is a particle which is similar to the nucleus of hydrogen but has a negative charge instead of a positive charge, and the claim would then be that such a particle will not be repelled by the positive electric charges on nuclei, but will be attracted by them and therefore it will be easy to make such a particle combine with nuclei, with atomic nuclei, and power might be liberated by such a combination.

Senator HICKENLOOPER. That would be the combination of combining rather than fission?

Dr. BETHE. Yes; that is right. Now, I don't know what is behind this story. It seems that the particles which we normally find on earth are all of the opposite nature—namely, of positive particles; so there seem to be two possibilities.

The most likely is that these negative protons come into the atmosphere from other stars, from other galaxies, maybe, with the cos-

mic radiation, and in very small quantities. In this case they will obviously not be of practical importance for making atomic energy.

The other possibility would be that some mechanism could be found by which such particles could be produced in the laboratory. If that is the case, it is likely that you use up as much energy in producing them as you afterward get out in making them combine with other nuclei; so again it is not likely that it will be a practical scheme.

The CHAIRMAN. You would say it was theoretically very interesting, but as far as you can project it, you would not look for any positive results from it?

Dr. BETHE. That is correct.

The CHAIRMAN. In the way of making, we will say, an explosive?

Dr. BETHE. Yes.

Senator HICKENLOOPER. In that connection, does science, so far as you know, know any method now by which either a positive charge can be altered in a nucleus to a negative charge—that is, that the charge can be altered—or that a neutral body, such as a neutron, can acquire either a positive or a negative charge?

Can we put any kind of a charge by any known method of science into a neutron?

Dr. BETHE. Not to my knowledge. There is one process which can go on and which is fairly well known; namely, a neutron in the nucleus can split into a proton, which has a positive charge, and an electron, which is a light particle which has a negative charge. The total charge in this process is always conserved, but you can have a neutral particle split up into a positive and a negative particle.

Senator HICKENLOOPER. Would it be possible that this so-called discovery of a negative proton is merely one of these that is split into the positive and negative?

Dr. BETHE. That is perfectly possible. It is quite possible and has in fact been theoretically predicted that there might exist the possibility for the neutron to also split the other way; namely, into a negative proton and a positive electron. The positive electron has been known for quite a long time. No one has ever seen a neutron split into a negative proton and a positive electron—at least not in this country; but there is nothing in theory which makes that impossible.

Senator HICKENLOOPER. I presume that if a method were discovered to alter these charges, that that would then open up an almost unheard of field of experimentation and activity, would it not?

Dr. BETHE. That is certainly true. The question, however, is whether it would be of any practical importance. It would probably be of this kind: That you can produce some negative protons in the laboratory and they might live for a short time, but you can probably not put them into a bottle. You cannot fill a bottle with hydrogen particles with negative charge, because presumably they would in a short time transform back into a neutron and the negative electron, and therefore I don't think it would have much practical importance.

But as I said, it is very difficult for me to say because I have not read the scientific paper about Kapitza's discovery, but only the newspaper accounts, which are always very uncertain about scientific facts.

The CHAIRMAN. Doctor, we have done a good deal of talking here back and forth about the scientific feasibility of an inspection system world-wide in scope.

Is it your belief, and do I gather correctly from your testimony, that if we were to be able to control uranium and thorium from its source to see that it did not go into bombs, that for the foreseeable future we would be protected?

Dr. BETHE. That is probably true, if we could really control and inspect all the supplies of uranium and thorium.

The CHAIRMAN. I had that as a predicate to my question.

Dr. BETHE. But these are very abundant elements, especially thorium which is found in very many places, and also uranium is found in quite a few places in lower-grade ores than are usually exploited.

If we could control all the supplies of uranium and thorium, then I would say "Yes" to your question.

Senator HICKENLOOPER. Doctor, I assume that you have had some acquaintance with the extent of scientific development and of scientific engineering in foreign countries, in Europe, and areas of that sort.

Considering the condition of the other nations of the world today—that is, their physical devastation or whatever their condition may be—do you believe that any other nation in the world today has the extent of scientific personnel available, plus the scientific engineering, plus the necessary finances, and plus the necessary determination, to start on their own basis, knowing that a bomb can be produced, and produce it within any short number of years?

Dr. BETHE. Yes; I believe so, very definitely. It does not take an enormous number of scientists. Many countries have quite a number of good scientists; Russia has, and France has; and while no other country has industrial facilities comparable with this country, the production of plutonium or uranium-235 is not a very expensive venture.

It cost us \$2,000,000,000, but we used three different methods because we wanted to be sure that one of these methods would be successful.

Now, other countries know that all three have been successful, so they can start on one of them and can choose the cheapest. Probably for half a billion dollars they can produce atomic bombs. Half a billion dollars is a very small amount for a country like Russia or France.

Senator JOHNSON. Doctor, do you think that the Smyth report gave any information to European scientists that they did not already know? How much information did it give?

Dr. BETHE. It is hard to tell, because we don't know how much the Intelligence Service of these countries knew. It gave more information than was known to us in the beginning of 1939.

The three processes which were used and are described in the Smyth report are probably the processes which any nuclear physicist would first investigate before anything else; and these three processes would occur, I think, to all the nuclear physicists in European countries. In that respect, it did not give away anything. It did say something in stating that every one of these three processes was successful. However this would have been very easy to find out even with a minimum of Intelligence Service, because it could not have been concealed that there were three separate industrial plants engaged in the manufacture of materials for this process; and if you know that there are three separate plants looking very differently, so obviously using differ-

ent processes, then it would have been probably the first guess of any scientist in Europe that these three processes are the three that we actually used.

Senator JOHNSON. Would you care to discuss briefly your career as a physicist in this country as compared with your experiences in Europe, as to your liberties and your accomplishments, your assistance or general appreciation by the Government through regimentation, or anything of that kind?

Dr. BETHE. I am very glad to do so.

I was very young when I left Germany, and I left Germany immediately after Hitler came to power, so I did not have much experience with the regimentation of science there. I knew enough in a couple of months so that I knew that I did not want to stay.

I can say that in this country working conditions have been extremely good, and I have liked working here much better than I liked working in Germany, even before Hitler. I think that the spirit of the scientific work here is very excellent, and the collaboration of the scientists in the war effort, which was completely voluntary, at least to start with, and which started sufficiently far ahead of the actual war to do some good, was something which would not have been possible in Germany even before Hitler.

I think this democratic spirit of collaboration is something which I greatly admire, and which I think is an enormous strength of this country.

All the same, I think things can be done in different ways. They can be done by collaboration, or, if one knows the aims, if one has a definite directive, I am sure that research can also be done by directive in a dictatorial country. I would rather work in a democratic country where I can determine myself what I want to work on, and I think in the long run this is somewhat more successful.

Senator JOHNSON. Do you believe that any other country on the face of the earth would have printed the Smyth report, other than the United States?

Dr. BETHE. I don't know. In the old spirit of scientific research, it would certainly have been printed; in fact, more than that would have been printed.

The Smyth report, as you probably know, contained no detailed data. It does not contain any numbers. This is very regrettable for scientists, because numbers is what science consists of.

I think the most relevant information which came out was the fact that the bomb itself was successful. The Smyth report added something to that.

I think that in some European countries, perhaps in Russia, it would not have been published. I think in France it probably would have been.

Senator AUSTIN. There is a report in process now in Great Britain, isn't there?

Dr. BETHE. Yes; some report has come out actually from Great Britain.

Senator HICKENLOOPER. But the point you just mentioned there is one I was going to ask you about when Senator Johnson finished.

One of the greatest aids to other people about this whole situation is the fact that we proved the bomb could be made?

Dr. BETHE. That is exactly so.

Senator HICKENLOOPER. And that is beyond any question of experimentation or research now?

Dr. BETHE. Quite.

Senator HICKENLOOPER. We have proved the fact that fission is possible and the bomb can be made.

Dr. BETHE. Exactly.

Senator HICKENLOOPER. And therefore it only remains for them to work toward the accomplishment of something somebody has already done?

Dr. BETHE. Yes, and they would presumably, if the Smyth Report had not come out; the fact that the bomb could be made would have proved an enormous incentive to them, and they would have started on it just the same, Smyth Report or not, and would probably have used one of the three methods.

Senator HICKENLOOPER. They were almost bound to know it was made by one of these three major methods?

Dr. BETHE. Yes.

Senator HICKENLOOPER. And by the three major methods, you mean the methods of separating U-235?

Dr. BETHE. Separating uranium-235 by the electromagnetic method, or by the diffusion method, and the third is the manufacture of plutonium.

Senator HICKENLOOPER. Isn't there a thermal diffusion method?

Dr. BETHE. The thermal diffusion method could also be mentioned, and then it would be four.

Senator HICKENLOOPER. I didn't know whether you meant those three methods, and then the plutonium as a fourth, or included that among the three you mentioned.

Senator MILLIKIN. Doctor, was the Smyth Report published through the pressure of the scientists or did it come out through the initiative of the Army exclusively?

Dr. BETHE. I don't know. The scientists, I know, would have recommended it. The release, I think, was made by the Army after, I think, the President was consulted.

Senator MILLIKIN. If there was an error in this publication, it would be attributable to the Army, then?

Dr. BETHE. I should think so.

The CHAIRMAN. Any further questions, gentlemen? [No response.] Thank you very much, Doctor.

Do we have any other witness? Apparently there is none.

Senator AUSTIN. Why not have an executive session now?

The CHAIRMAN. I think that is a good idea. The committee will now go into executive session. Dr. Bethe, don't leave.

(Whereupon, at 3:35 p. m. the special committee retired into executive session.)

ATOMIC ENERGY

THURSDAY, DECEMBER 6, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Johnson, Millikin, Hickenlooper, and Hart.

Also present: Representative John R. Murdock; Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. The hearing will come to order. We will hear Dr. Morrison.

STATEMENT OF DR. PHILIP MORRISON, PHYSICIST, LOS ALAMOS LABORATORY

Dr. MORRISON. I have a prepared statement. I believe it is appropriate to indicate my qualifications before I begin.

After the completion of my graduate work at the University of California in Berkeley in 1940, I was for a short time instructor in physics at San Francisco State College and later at the University of Illinois. In December 1942 I began work at the metallurgical laboratory of the University of Chicago. In October 1944 I came to the Los Alamos laboratory. At Chicago, my work consisted of theoretical, experimental, and design work in connection with the plutonium-producing chain reactors. At Los Alamos, it was concerned with the active components of the bomb itself. Following the Trinity test in New Mexico, I went to the Marianas to assist in the final assembly work on the bomb. On September 6, I came to Japan to join General Farrell's party there. I returned to Los Alamos in October.

Senator MILLIKIN. Mr. Chairman, who is General Farrell?

Dr. MORRISON. General Farrell was General Groves' deputy; he was sent overseas to head the military party.

Many Americans have visited the cities, or the ruins, of Japan since the end of war in the Pacific. The reporters and the photographers have made clear for us all the appearance of the war-damaged towns, especially of the cities destroyed by the first atomic bombs, Hiroshima and Nagasaki. But there is more to be learned from those scenes than the newspapers have yet been able to tell. It was my job to visit the damaged cities of Japan, to speak with the people there, and to assist in the carrying out of certain technical studies. You have heard and

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you will hear more expert testimony on the kinds and extent of the damage done by the atomic bomb. I am a nuclear physicist, not a specialist on this or that kind of damage; I wish I knew even less about damage than I do. It is my purpose to tell the committee as clearly as I can what the impressions of an American physicist are when he views the ruins and talks to the survivors of the bombing he and his coworkers spent so much time to make possible.

The atomic bomb is not merely a new weapon: it is a revolution in war. I saw the blackened ruins of Tokyo and Osaka, of Kobe and of Nagoya, and I know that a city cannot live under the fire raids of a thousand B-29's. The destruction of a great city in itself is not the new feature of the atomic bomb. To make clear why the atomic bomb is different one must talk first of the B-29.

We of the Los Alamos project who went overseas in July to prepare the bombs for delivery over the target were stationed on the small island of Tinian, near Saipan in the Marianas chain. Tinian is a miracle. Here, 6,000 miles from San Francisco, the United States armed forces have built the largest airport in the world. A great coral ridge was half-leveled to fill a rough plain, and to build 6 runways, each an excellent 10-lane highway, each almost 2 miles long. Beside these runways stood in long rows the great silvery airplanes. They were there not by the dozen but by the hundred. From the air this island, smaller than Manhattan, looked like a giant aircraft carrier, its deck loaded with bombers. I have flown many times in a B-29, and I doubt that there is a more complex and wonderful machine of any kind. And here, far from the factories in Seattle or Wichita, were several hundred of these million-dollar craft. Here were collected tens of thousands of specialists, trained in the operation and repair of the delicate mechanisms which cram the body of the plane. In the harbor every day rode tankers, laden with thousands of tons of aviation gasoline. A net of pipe lines supplied the airfields with fuel. The radio dial was busy with signals of every kind. And all these gigantic preparations had a grand and terrible outcome. At sunset some day the field would be loud with the roar of the motors. Down the great runways would roll the huge planes, seeming to move slowly because of their size, but far outspeeding the occasional racing jeep. One after another each runway would launch its planes. Once every 15 seconds another B-29 would become air-borne. For an hour and a half this would continue with precision and order. The sun would go below the sea, and the last planes could still be seen in the distance, with running lights still on. Often a plane would fail to make the takeoff, and go skimming horribly into the sea, or into the beach to burn like a huge torch. We came often to sit on the top of the coral ridge and watch the combat strike of the 313th wing in real awe. Most of the planes would return the next morning, standing in a long single line, like beads on a chain, from just overhead to the horizon. You could see 10 or 12 planes at a time, spaced a couple of miles apart. As fast as the near plane would land, another would appear at the edge of the sky. There were always the same number of planes in sight. The empty field would fill up, and in an hour or two all the planes would have come in.

Next day the reconnaissance photographs would come in. They showed a Japanese city, with whole square miles of it wrecked and torn by flame. The fire bombs dropped on wood and paper houses by the thousands of tons had done their work. A thousand B-29's, time and again, burned many square miles of a city in a single raid.

The atomic bomb was something else. There were no shiploads of incendiaries. Instead of all the ordnance men and their bomb dumps, there were about 25 people from Los Alamos, a few Quonset huts transformed into testing laboratories, and a barricaded building. The strike took off after midnight. The field was deserted. Only two or three planes were warming up. A few lights burned around a single hard-stand.

Senator MILLIKIN. What is a hard-stand?

Dr. MORRISON. It is a path on the airfield on which the airplane sits before taking off.

And one plane roared down the runway, took off, and set course for the cities of the enemy. The reconnaissance photos next told the same story. One plane, with one bomb, had destroyed many square miles of a city, destroyed them even more thoroughly and with even less chance for resistance or escape than the 1,000-plane strike.

I can imagine a thousand atomic bombs and an airport like Tinian's to send them off. But not even the United States could prepare a thousand Tinians with ordinary bombs. There are simply not enough people. Destruction has changed qualitatively with this new energy. War can now destroy not cities, but nations.

There is even more to be said. I remember vividly the lunch we had at the prefectural building in Hiroshima. The Japanese officials came there to talk to us and to describe their experiences. I sat at lunch next to and spoke to the chief medical officer of the district. He had been pinned in the wreckage of his house for several days after the explosion. He lived a little more than a mile from the point of impact, and was still wearing splints. His assistant had been killed, and his assistant's assistant. Of 300 registered physicians, more than 260 were unable to aid the injured. Of 2,400 nurses, orderlies, and trained first aid workers, more than 1,800 were made casualties in a single instant. It was the same everywhere. There were about 33 modern fire stations in Hiroshima. Twenty-six were useless after the blast, and three-quarters of the firemen killed or missing. The military organization was destroyed; the commanding general and all his staff were killed, with some 5,000 soldiers of the garrison of 8,000. Not one hospital in the city was left in condition to shelter patients from the rain. The power and the telephone service were both out over the whole central region of the city. Debris filled the streets, and hundreds, even thousands of fires burned unchecked among the injured and the dead. No one was able to fight them.

Senator MILLIKIN. What was the population of Hiroshima?

Dr. MORRISON. About 300,000.

There is a word for this kind of attack; it is described as an attack of saturation. If you strike at a man or a city, your adversary protects himself. If you attack a man, he runs or strikes back at you; if you attack a city, it throws up flak, it musters its firemen, it treats the wounded. But if you strike all at once with overwhelming force, your enemy cannot protect himself. He is stunned. The flak bat-

teries are all shooting as fast as they can; the firemen are all busy throwing water at the flames. Then your strike may grow larger without increased resistance. The defenses are said to be saturated. The atomic bomb is a weapon of saturation. It destroys so quickly and so completely such a large area that defense is hopeless. Leadership and organization are gone. Key personnel are killed. With the fire stations wrecked and firemen burned, how control a thousand fires? With the doctors dead and the hospitals smashed, how treat a quarter of a million injured?

There is one more novelty. A Japanese official stood in the rubble and said to us: "All this from one bomb; it is unendurable." We learned what he meant. The cities of all Japan had been put to flame by the great flights of B-29's from the Marianas. But at least there was warning, and a sense of temporary safety. If the people in Kobe went through a night of inferno, you, living in Nagoya, were going to be all right that night. The thousand-bomber raids were not concealed; they even formed a pattern of action which the war-wise Japanese could count on. But every hour of every day above any Japanese city there might be one American plane. And one bomber could now destroy a city. The alert would be sounded day and night. Even if the raiders were over Fukuoka, you, in Sendai, a thousand miles north, must still fear death from a single plane. This is unendurable.

I should like to interpolate a few remarks on the kind of damage that the bomb does. I think I can describe to you very simply what happens and that will make clearer to you what we saw there.

When the bomb is detonated in the middle of a city, it is as though a small piece of the sun has been instantly created. There is formed what we have called the ball of fire, which is a hot, glowing mass something about one-third of a mile across, with a temperature of about a hundred million degrees Fahrenheit in the center of it.

The effects from this small sun are as you would expect. In the first place, there is a sudden creation and expansion which pushes away, with terrible violence, the air that once occupied this region.

This air, shocked into motion, as we say, moves just like a blast wave from a great explosion of TNT. We often measure the effectiveness of a bomb in tons of TNT equivalent.

This pushing air creates an enormous pressure, even a great distance away. Behind the wave of pressure, which travels rapidly through the air, there come great winds, 500 to 1,000 miles per hour, winds which damage and destroy all structures.

If you stand near this piece of the sun—

Senator MILLIKIN. Those are the winds rushing to fill the vacuum; is that right?

Dr. MORRISON. They are winds which occur partly from that, sir, and also partly because the wave starts in the air. It runs too fast—the air cannot move fast enough to keep up with the wave, so it follows somewhat like a breakwater wave, and this is the great wind.

Senator MILLIKIN. I see.

Dr. MORRISON. If you are near the sun, you must expect to get burned. The people near it are burned on the body; the people and the structures underwent terrific radiant heat.

In New Mexico, where we were 10 miles away, on a cold desert, I felt as though the hot sun had been out for an hour when the explosion occurred. My face was warmed up.

There, in Japan, the same effect happened. Since they were closer there, instantly all organic material was burned up. For some distance it burned up the flesh.

As I shall show later in my prepared statement, for a considerable distance it set fire to piece of wood, curtains, textiles, to anything inflammable in the neighborhood.

There are two more effects. At the instant of the explosion there is emitted from this small sun not only the great push through the air, the violent blast, which is the violent explosion—there is not only the concentrated heat which you would expect from being close to the sun, there was also a great amount of radiation, like the radiation used by doctors, like the X-ray radiation used for the treatment of cancer.

This radiation is very penetrating. There is no protection behind a foot of concrete, for example.

Senator MILLIKIN. How about lead?

Dr. MORRISON. It is possible to have protection. It depends on where you are. You will have no protection unless the material is thick enough. If you have 20 feet of concrete or 5 feet of lead, you are safe enough if it is in front of you.

This radiation produces special physiological effects which I would like to describe.

There is one more effect which may or may not be effective in a military sense, besides the instantaneous burst of these ray-like emanations.

There is left on the ground an enormous amount of radioactivity, corresponding, in the maximum case, to thousands of tons of radium. If this is the case, if this is deposited on the ground, it will be difficult to approach that area, that region, for a long time.

Senator MILLIKIN. Mr. Chairman, I have a question.

Would it disturb your sequence of thought if I would go into the lead matter now?

Dr. MORRISON. No, sir.

Senator MILLIKIN. Are there any other readily available metals that could be used to shield things, that could be used as a defense against the atomic bomb?

Dr. MORRISON. The only point is getting enough material. It doesn't matter what it is if you have enough of it. It may be concrete, dirt, or lead; whichever it is is not very important. Lead, of course, is very heavy and to get a mass of material is convenient with lead.

Senator MILLIKIN. In other words, a thin sheet of lead may be equivalent to 2 or 3 feet of some other material?

Dr. MORRISON. I am afraid not. An inch of lead is equivalent to 10 inches of concrete. The factor of lead to concrete is about 1 to 10. Gold would be twice as good.

Senator MILLIKIN. What does the person wear if he goes into one of these infected areas?

Dr. MORRISON. I don't know. I don't quite understand. There is nothing you wear for protection.

Senator MILLIKIN. I saw a picture in a paper of a tank that moved in there, in New Mexico, and it said that the tank was coated with lead, or something of that kind.

Dr. MORRISON. Yes.

Senator MILLIKIN. Now, when the men get out of that tank, what do they wear?

Dr. MORRISON. They didn't get out. They would have been fried if they had gotten out at that time. They stayed in.

Senator MILLIKIN. Do you see a field of considerable usefulness, where defensive measures are concerned, in lead or any other metals?

Dr. MORRISON. Well, going underground would be helpful. I think that lead is especially valuable, lead is useful, if you have a small room and you want to keep it small. Otherwise, you might as well make it with concrete. We have a similar problem when it comes to sealing in all plutonium reactors. As far as I know, except for instruments, there lead is not employed. These other materials are cheaper. You see, it is much cheaper to use 10 feet of concrete than its equivalent in lead.

Senator MILLIKIN. Thank you.

Dr. MORRISON. As I was saying, there is left on the ground, under some circumstances, this large radioactivity.

In New Mexico, where the explosion was on the surface, this activity was sizable. In both cities of Japan, this activity was negligible, simply because of the tactical choice of the method of employing the bomb.

It has been described in the press. In New Mexico, the bomb was detonated close to the surface; in Japan, a considerable distance above the ground.

In one case the radioactivity was concentrated on the ground; in the other case, in Japan, it was spread over a great area, and so there was not enough of it; it was negligible.

Senator HICKENLOOPER. May I ask a question?

The CHAIRMAN. Yes, Senator.

Senator HICKENLOOPER. How far away did the heat generated from the bomb kill individuals? At say the 100-foot level in New Mexico, as compared to the 1,500- or 1,800-foot level over these Japanese cities, what would be the comparison?

Dr. MORRISON. Would you please wait? I think I have that question covered in my statement.

Senator HICKENLOOPER. Yes. I don't want to disturb your train of thought.

Dr. MORRISON. Yes, sir. I answer that question directly in the statement.

I simply want to give a picture of what the physical effects were and then I have this prepared statement from observations in the area of damage.

Senator JOHNSON. You left out one step.

Could you tell us something about the reaction? I suppose that the air rushes back into the vacuum. That is, you describe the air as being pushed out at the time of the explosion.

Now, there must be the secondary reaction, of air rushing back in and causing damage through that suction that would follow naturally.

Dr. MORRISON. Mostly there is nothing left by that time to damage. If you built one in between the two, it might suffer some damage.

Senator JOHNSON. The buildings are all torn down but that suction is, relatively, something that will not amount to very much because the damage is all done. Is that the theory?

Dr. MORRISON. That is right.

Senator JOHNSON. But is there not a tremendous suction?

Dr. MORRISON. There is; but not too much effect where individual buildings were concerned. We could sometimes see buildings where, at the edge, the air blast had struck from behind, not in the front. That effect would depend upon the shape of the building and such freak effects might happen.

Mostly, the impact, like a hammer, causes the damage, and following this hammer blow is the rapid wind; after that, the suction phase is not very important.

Senator JOHNSON. We have had described to us here cases involving concrete buildings reinforced by steel. We have been told that the interiors of the buildings and the partitions had all been torn out. It just occurred to me that that reaction, perhaps, did that.

Dr. MORRISON. That is quite likely. I was just going to say that in the next sentence.

Senator MILLIKIN. Mr. Chairman, pursuing that same subject a little further, I have seen many pictures of damage over in London during the bombing, which showed that the buildings collapsed towards the location of the bomb. The explanation was that it was caused by the suction rather than by the hammer effect of the blast. Does that prevail also as far as this particular bomb is concerned?

Dr. MORRISON. No, I don't believe it does. It is rather less important in this case than in small explosions.

Senator MILLIKIN. I was curious about that.

Dr. MORRISON. I think that the effect has been exaggerated even in the smaller explosions. If I might put it this way, the bigger the explosion, the more negative the effect of the suction phase, the less important it is.

Senator MILLIKIN. You get the first hammer effect, which does the job, and the second effect has nothing to pull down.

Dr. MORRISON. Yes.

The damage done in the cities struck by the atomic bomb is not easy to realize. Houses and buildings for a mile in all directions are totally destroyed. A good deal of comment has been attracted by the ferro-concrete structures whose walls still stand. These are very strong buildings. But they too are useless. I have been in these buildings. The window casements are gone, the interior walls are down, the roofs are collapsed, the furniture battered, plumbing fixtures and heavy machinery overturned. A great blast wind followed the shock and ripped through the buildings, destroying their interiors. Most of them burned. Brick buildings, and even steel-frame buildings with brick walls, are extremely vulnerable.

Senator MILLIKIN. Did I understand you to say a while ago that this wind you have described reaches a velocity of 500 or 600 miles?

Dr. MORRISON. That is a very conservative figure. A 1,000-miles wind is common.

Senator MILLIKIN. What is a hurricane wind?

Dr. MORRISON. About 120 miles an hour.

Senator MILLIKIN. I wanted that just for a comparison.

Dr. MORRISON. At Nagasaki, the Roman Catholic church was an old and heavy brick-walled building nearly a mile and a half away, and it suffered total destruction. It is likely that an American city would be as badly damaged as a Japanese city, though it would look less wrecked from the air. In Japan the wreckage burned clean; in a

western city, the rubble would still stand in piles in streets. But the city would be just as ruined, and the people of the city as dead.

The action of the blast on steel-frame factory structures is known from the wreckage of the Mitsubishi Torpedo Works in Nagasaki. Japanese homes are lightly built, but their factories are about like ours. And the torpedo works buildings collapsed in a twisted jumble of steel onto the heads of the workmen and the still-turning machines. For a good mile and a half all factory structures were totally destroyed.

For 3 or 4 miles from the point of impact there is heavy damage, making half the buildings unusable. In Hiroshima the fires which began after the blast, some set by overturned stoves and chimneys, some by the heat from the bomb itself, burned for 10 hours. The flames stopped at the edge of the river. Many places were completely destroyed by fire which had only been partly smashed by the blast. It is not hard to understand that fire-fighting was impossible.

Senator MILLIKIN. Mr. Chairman, I hate to interrupt so often.

Dr. MORRISON. That is all right.

Senator MILLIKIN. Yesterday we were questioning a witness as to whether these same effects would occur in a heavily constructed area, like lower Manhattan, for example.

I think I asked the question whether the great bulk of the heavy construction, the buildings, would serve to insulate and confine the effects of the blast. Would you mind giving us your impression on that?

Dr. MORRISON. As the blast wave moves over the face of the city it loses energy by the knocking over of structures, it carries debris around; therefore, I think the more densely the city was built up, the more the number of buildings that would be caught in a given area. Therefore, the extent of the damage would be, or might be, somewhat smaller because there were more buildings.

Senator MILLIKIN. But the effect, in a quantitative way, would be the same?

Dr. MORRISON. Yes, sir.

Senator JOHNSON. What is the direction of this blast? Is it straight down?

Dr. MORRISON. It depends on where you are and where the bomb is set for. I am not sure that I can go into the details, but if it is close, it is straight down; if it is some distance away, it is horizontal.

Senator JOHNSON. Of course, this straight-down blast might raise havoc with the roofs, but it might not raise havoc with the walls of the buildings.

Dr. MORRISON. That is true. For example, in Hiroshima, the walls directly under the impact were intact while the roofs had been driven straight down. The heat and the radiation had killed the people; but the walls and even the telephone poles were still standing up.

The effect, of course, depends very much on how far away it is. At some distances, you have one effect and at some other distances you have another.

Senator MILLIKIN. Is it true that, so far as the bomb is concerned, passing what is below it, as far as the bomb itself, does it throw out energy in equal directions or does it have that energy thrown out directionally?

Dr. MORRISON. If the bomb is released very far above the earth, it would throw out the same energy in all directions. It is not, as a matter of fact, done this way; but I would not like to go into that question.

Even more striking than the damage to buildings is the great number of casualties. Very few people were in shelters, because there was evidently no large bomber raid. Virtually all the people in the streets within almost a mile were instantly and seriously burned by the great heat of the bomb. These burns covered all the exposed flesh, sometimes even clothing caught fire and burned the wearer fatally.

I remember seeing one man, a patient, who had worn a railway worker's uniform. This uniform, in Japan, is a dark serge with an insigne to designate his grade. This man wore, as insigne, a kind of a cross-shaped emblem over the left breast.

His whole body was burned very badly and blackened, with the exception of the region under this cross. That was because the white clothing passed the heat somewhat less than the dark clothing did. The dark clothing absorbed the heat and caught fire and burned him. Of course, the white clothing would ordinarily not do this.

There were reported to me some people who had even been wearing striped clothing upon whom they found the body had been burned in stripes. I did not see that.

People inside buildings were not burned by the flash, but were for the most part killed or seriously injured by falling walls and beams. Caught in the wreckage of their homes, many were burned to death by the secondary fires. Those fires resulted from combustion material set ablaze after hundreds of stoves had been overturned; this was in addition to the fires started by the bomb itself.

Of these people within a thousand yards of the blast, about one in every house or two—perhaps 5 or 10 percent—escaped death from blast or from burn. By chance these people were screened from the heat of the bomb by some object too light or too strong to kill them by falling upon them. Many literally crawled out of the wreck of their homes relatively uninjured. But they died anyway. They died from a further effect, the effects of radiumlike rays emitted in great number from the bomb at the instant of the explosion. This radiation affects the blood-forming tissues in the bone marrow, and the whole function of the blood is impaired. The blood does not coagulate, but oozes in many spots through the unbroken skin, and internally seeps into the cavities of the body.

The CHAIRMAN. Would there be a third-degree burn?

Dr. MORRISON. No; not from radiation; no burns at all. There were some dramatic cases of people who were protected from the burns—

The CHAIRMAN. You mean the skin would be absolutely normal and yet the blood would be coming through?

Dr. MORRISON. Yes. There might be a slight burn on the skin, but it was not essential.

The white corpuscles which fight infection disappear. Infection prospers and the patient dies, usually 2 or 3 weeks after the exposure. I am not a medical man, but like all nuclear physicists I have studied this disease a little. It is a hazard of our profession. With the atomic bomb, it became epidemic.

The facts and figures of this and other related effects of the atomic bomb are still under study, and remain for the time being classified information. I am not a medical expert in these matters, and I have tried to tell you only the things I have seen.

It goes without saying that, like most of the scientists of the project, I am completely convinced that another war cannot be allowed. A working and realistic domestic policy ought to be determined on the premise that some measure of international control of atomic energy will come and come immediately, based on functioning, material agreements among the great and the smaller powers. We have a chance to build a working peace on the novelty and the terror of the atomic bomb.

But I should not be a physicist if I left you with the impression that only in war a revolution has been made by the large-scale release of atomic energy. Man will not live the same again for this advance. I do not think you will soon see atomic automobiles, though you may soon see atomic rockets and atomic power plants. But the changes which will come are sure, and great, and beyond prediction. When science learned to control mechanical and thermal energy, we had the early nineteenth century maturing of the industrial way of life. When science learned control over electrical energy, we had the manifold changes which electricity has brought to daily life and to the structure of nations. When the chemists understood the nature of chemical energy, there was opened the way to new materials, to freedom from the restrictions of mine and farm, to the changes which chemistry is even today still bringing us. Now we have nuclear energy, based on a more profound insight into and control over the fundamental nature of matter itself. We have seen war change only 6 years after the key laboratory discovery in this realm. We physicists are professionals in change and in novelty. That new times will come is our firmest conclusion.

Senator HART. Mr. Chairman.

The CHAIRMAN. Senator Hart.

Senator HART. Doctor, when you compared in your statement an attack by 1,000 B-29's and one B-29, you said there was a great qualitative change in the destruction. Then you followed with your observations on Hiroshima, and about the only thing you said to support that statement was about the damage done by the gamma rays.

We had been led to believe from other testimony that when the bomb explodes well off the earth, as was the case there, that the gamma rays' damage is a very small proportion of the total damage.

Dr. MORRISON. I think I detected two questions in your question. Would you mind if I separated them and tried to answer as I see them, separately?

Senator HART. Yes, sir.

Dr. MORRISON. When you gradually increase something by simply piling on, by quantitative implementation, you come to a point where something new has occurred, and we have a qualitative change.

For instance, if you heat water, you heat it 1° at a time until it boils and there is still a quantitative change going on. But if you keep on heating, you get a qualitative change; it is no longer water, you have something new.

The reason I say that the bomb has made a qualitative change is the manner in which the atomic bomb works. Take the destruction of cities. When you use ordinary bombs to destroy a city, you do it with a great effort, all the resources of a nation.

With the atomic bomb, it is done, more or less, with the left hand. I mean, one bomb, one city.

The whole attitude has been changed. They are not talking about the destruction of one city at a time any more; the new strategy will have to deal with weapons of destruction which will make one city too small a target.

In the future, it will not be the case of a raid against Berlin or against Hiroshima or Nagasaki on separate days, but it will be against all of them on the same day.

Senator HART. It seems to me still that you are terming as qualitative a change which I consider a quantitative change.

Dr. MORRISON. Well, this is a question of philosophy. What I am implying is that, by the piling on quantitatively you have produced a new mode of action which is in nature qualitative.

As you know, you might say an army is a collection of, say, 1,000,000 men. But if you have a collection of 1,000,000 men into an army, you have something different from just a collection of 1,000,000 men. In the same way, when you have a collection of atomic bombs, you have something different, then, which becomes a qualitative difference, because there you have a chance to destroy whole nations.

Senator HART. Well, I will drop that, Doctor, although I still think you mean quantitative rather than qualitative.

Do I understand you to say that the gamma factor in your explosion is not a material part, that mostly it is blast and heat?

Dr. MORRISON. This is correct.

Senator HART. Is that correct?

Dr. MORRISON. This is correct. The gamma radiation is a part of it, or could be; it all depends upon how the bomb is used, as I said. The way the bomb would be normally used, I do not think that the gamma rays would be material.

Of course, I do not know what the statistics are. In the case of Japan, under the conditions that existed there, there are simply no records, no officials, men familiar with the town who could tell us exactly what happened.

It is known that in Hiroshima 40,000 people came into the town the day before the bomb was dropped, to help evacuate it, because the town was on the list, and they felt it would be attacked and they wanted to evacuate it.

They had started work at 7 o'clock in the morning, they were still moving shops and furniture and the contents of warehouses, and so forth, and they were killed by the bomb.

However, no census taker, no statistician, is able to say how many people were killed in that explosion. It is my impression, gained as I walked through the city and the hospitals and talked to the men, that there was one man who escaped immediate death out of every one or two houses that were destroyed. There was always someone who, by chance, escaped the building falling on him and killing him, who, by chance, escaped the burns, even from the direct heat or through the fires that raged throughout the district. There were people who

walked away more or less unharmed, by chance—and even these did not escape death in the end.

Senator HART. Doctor, in the latter part of your statement, when you went into the political field, I believe you used the words that something must immediately be accomplished in our international relations so that atomic bombs would not be used.

What is your thinking around that word “immediately”? Is that altogether a theoretical idea, or have you some practical ideas about that?

Dr. MORRISON. I think, for example, that the implementation of the Three-Power Declaration, if it comes in the near future and if it is extended, will be an immediate step in the right direction.

I did not mean that the problem would be solved immediately; I mean that we should act at once. The reason I think that is this: that one of the great advantages that we have with regard to the control of this decisive weapon which does not adhere to any other weapon is that it is something new.

It is something which is not all over the world. There are no great industries connected with it, it is not filled with a tradition of continuity, it does not have a tradition of money or economics—those interests do not enter into it. There is none of this.

I think that if we catch hold of this opportunity and soon begin control, you will find it to be a much easier situation to handle than if we sit around 1 year, 3 years, 7 years, 10 years, making no progress. Then, when it has come to a full-fledged realization, by that time there will be greater difficulty. It will be widespread; there will be money in it; there will be great industries, and the economy of great regions may be dependent on it. It will be sizable, and it will be great, and it will be difficult to make such changes as should be made, because then, at that time, people will say that it is not practical.

Senator HART. I take it that you did not think that there was an immediate and complete solution practical. Let me ask you one thing.

Your statement has been about the power, the destructive power of the atomic bomb alone. In your thinking, do you place that in a different category than, for instance, an entirely merciless bacteriological form of warfare?

Dr. MORRISON. Yes, sir; I do.

Senator HART. Why?

Dr. MORRISON. I am not a bacteriologist, and perhaps I am wrong, but I have been in Washington on military affairs and on these matters I have spoken to people that know—

The CHAIRMAN. I defer to your greater knowledge, Senator, about the propriety of an open session to a discussion of bacteriological warfare.

Senator HART. I am merely asking a general question. If he is going into anything that he ought not to go into, I will withdraw the question.

The CHAIRMAN. You are acquainted with that?

Dr. MORRISON. Yes, sir; I will not discuss it.

The CHAIRMAN. I just wanted to caution you.

Dr. MORRISON. Yes, sir; thank you very much. I simply wanted to say that the absence of successful bacteriological warfare is not a statement that people do not think about it.

Senator HART. Well, you do; and you do not put it in a different category, as a political matter looking forward to the protection of the world?

Dr. MORRISON. I do put it in a very different category, because it does not exist.

Senator HICKENLOOPER. Would you care to answer my question of a little while ago now, of a bomb set off 100 feet in the air? Will it burn better than a bomb set off 1,500 feet in the air?

Dr. MORRISON. A little further away, because, at a given distance, you are a little closer to the bomb. In other words, if you are right below the bomb and it is 1,000 feet above, you are 1,000 feet away.

Senator HICKENLOOPER. I understand that, but I wondered if the radiation would be conducted along the air or whether it might be dissipated in the air.

Dr. MORRISON. I don't think so; it might be. The reflected heat from the ground might have a small initial effect, but not serious.

Senator HICKENLOOPER. It is all hot enough?

Dr. MORRISON. Yes, sir. In New Mexico, where it did touch the ground, the ground is covered with glass for about 1,000 feet.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. What would be the effect if the bomb exploded in the ground, in terms of radiation, blast, and heat?

Dr. MORRISON. If it exploded at or near the surface of the ground it would be very much the same as high in the air, with the difference that the people would be closer to it and the difference that the radioactive material would then probably be left on the ground in large amounts; and, perhaps, with the other difference that the ground, perhaps, would be glazed and might be untenable for a very long time to come.

If you also wanted to include a situation where it was very far below the earth, 50 or 100 or 500 feet below, then it is clear that the situation would be very much changed here. I don't like to go into detail, but I would say this. It would simply produce not an air blast but an earth blast, a ground shake. There is no doubt but that it would have great military importance. I would rather not discuss it.

Senator MILLIKIN. How would you protect rescue workers and other relief forces that necessarily would have to operate in an area where the bomb had exploded in the ground?

Dr. MORRISON. I would keep them out.

Senator MILLIKIN. Well, there are essential functions, in any large city especially, that have to keep going—rescue functions and utilities and things of that kind—that, unless there was complete destruction, unless there was a determination that this area be forever abandoned, you have got to keep going.

I am curious as to how you would protect people that would have to work in the area as best they could.

Dr. MORRISON. I hope we don't have to face these problems. I would say simply that I imagine they should run in and out quickly, there would be a fringe where they could do that. There would be another fringe where they might send volunteers to do dangerous things, using tanks, and there would be a central region which they could just abandon.

Senator MILLIKIN. Suppose they had to go in, what sort of protective material would you clothe those people with?

Dr. MORRISON. Oh, you would need 50 tons of lead.

Senator MILLIKIN. Lead. I don't want you to think I am fanatic on the subject of lead.

Senator HART. Where is lead mined?

[Laughter.]

Senator MILLIKIN. Coming from the West, we are interested in those things. I want to know about what might be used in a defensive way. I quite agree with you that in most instances, for these stationary objects, for instance, it would be cheaper to get insulation from other materials. Then, you could close in the work with thicknesses of concrete or other materials, but if you have moving objects, people or appliances, perhaps, I take it that you will agree with me that lead and possibly other metals would make a good insulating material.

Dr. MORRISON. I do not want to give you the impression—it is quite wrong, but it is very easy to do it—that it depends on the material. There is really no specific material. It depends on the weight of the material you use.

If you could dress a man in a suit weighing 50 tons of lead or any other material, I don't care what the material might be, you could do that.

Senator MILLIKIN. You can't practically do that. You stated that you could surround it or him with a wall of concrete.

Dr. MORRISON. Yes; or lead.

Senator MILLIKIN. And, of course, there are many places where you could not surround even a stationary object that way. You could not put a wall of concrete around it, due to its placement. From what I have read it seems to me that you do have protection already for the articles of clothing, like shoes and personal equipment of people who have to approach these radiation places, that they may be clothed with protective material.

Dr. MORRISON. No; that is really a misapprehension, Senator, if I may say so. It is not possible to gain any worth-while protection by the amount of material that a man can carry on his own body. It is not possible; you just can't do it.

Senator HICKENLOOPER. That would depend on the degree of contamination.

Dr. MORRISON. But the point is that a man cannot carry enough protection, he cannot increase his weight that much. Also, the time element enters into it; how soon it is after the explosion.

Senator HICKENLOOPER. It depends on whether you want to go into that area in 20 minutes or 2 days.

Dr. MORRISON. It depends on whether you want to go into it in 20 minutes or in 20 minutes and 10 seconds; and most people would rather wait 10 seconds rather than carry the tons of lead they would need for protection.

Senator MILLIKIN. It comes from the degree of harmful radiation that remains, does it not. It loses its strength as time passes, does it not?

Dr. MORRISON. Yes; it does.

Senator MILLIKIN. Therefore, you have a decrease there in terms of time of radiation and, perhaps, some sort of protective material which

might be utterly useless at the moment might be useful a week or two or 10 days from the explosion.

Dr. MORRISON. That is true; but it is not true that anything that a man can carry around will give protection worthy of being called protection.

Senator MILLIKIN. That depends entirely upon the problem of when you have to go into the area. Sometimes you, of necessity, have to go into an area. You are postulating that it would be better to stay out. I suggest it might not be better to stay out. I suggest that it might be essential to get in there. Neither you nor I can sit here now and imagine the particular circumstance that will call for the decision, but I do suggest that there might be a circumstance which will call for a decision.

Dr. MORRISON. This is quite true. I am simply saying that if he must get in there, he will not get the protection with, say, 100 pounds of lead; he can with 10 tons. The additional amount, say about 100 pounds, that he can carry will not protect him sufficiently.

Senator MILLIKIN. That, again, follows that you can theoretically coat a tank with lead.

Dr. MORRISON. Exactly.

Senator MILLIKIN. And so there are circumstances, and one of them was demonstrated by coating the tank with lead. I am not mentioning lead, except that I have heard it mentioned in the press; but it could be coated with some sort of a protective material?

Dr. MORRISON. Yes, but the protective material which is worn on the body of a man is not adequate against radiation.

The only reason that existed for coating the shoes of these men who walked in later and for their wearing special clothing was this: It was simply clothing in the nature of overalls, so that they would not carry away on their person any of the contaminating material. It was not to give protection.

You can get protection from walls. You must use walls, and these walls will be much heavier than anything a man can carry. He could not carry enough to get a worth-while increase in protection.

Senator MILLIKIN. Then, you have a double problem. You have the problem of protecting the man himself against radiation, and you also have the problem of keeping him from carrying out the radiation; is that right?

Dr. MORRISON. That is right.

Senator MILLIKIN. And in the latter instance, there is a definite need for some sort of protective material to cover that man.

Dr. MORRISON. That simply calls for clothing that he can wear and then throw away.

Senator MILLIKIN. Yes.

Dr. MORRISON. That is all the protection you provide there.

The CHAIRMAN. Doctor, the bomb was dropped over Hiroshima at something of a height. That height, I presume, was chosen to get the greatest blast effect that could be gotten. You have testified that many, many people there were killed by the gamma rays. Would that result in a large deposit on the ground?

Dr. MORRISON. It did not.

The CHAIRMAN. It did not?

Dr. MORRISON. It did not. There was no physiological injury to any person in Hiroshima from material deposited on the ground. We did not find any indication of that.

The CHAIRMAN. In other words, the gamma rays went through the body and then were exhausted before they touched the ground; is that the idea?

Dr. MORRISON. Well, the idea is this: the gamma radiation is a ray. Once it is emitted, it is absorbed; that is the end of it. It is energy which turns into heat or chemical energy, or something of that sort.

Therefore, it will not last. It is emitted, and that is the end; it is absorbed.

The things that last are the atoms of new elements which have the property of destroying themselves, giving out radiations, rays, in the process.

Now, this is not true when the bomb is exploded on ground. But these bombs were exploded in the air and the radiation disappeared, the gamma radiation moved through the area and was absorbed.

Senator HICKENLOOPER. I have another question.

Doctor, I would like to have your opinion on this question: Do you think it reasonably possible—we know that it would be theoretically possible—do you think that it is reasonably possible that science will abandon the field of investigation into nuclear research?

Do you think that there can be any law or any other force in the world that can prevent the investigations of science to the fullest possible extent in this new field?

Dr. MORRISON. I do not think that it is in the tradition of science that this has ever been done. Therefore, to secure such a result is evidently a problem of extreme difficulty.

Senator HICKENLOOPER. Science has never abandoned a field of investigation once it has been opened up?

Dr. MORRISON. I think in recent years it is quite right; in the last few hundred years, it has never been done.

Senator MILLIKIN. I mean in a field as successful as has been indicated here.

Dr. MORRISON. I don't know about the future. I hope it will not. I hope in the future they will bring forth new things, in peace as they have done in war.

Senator MILLIKIN. Won't science and education keep searching for more and more light on this subject, and more and more knowledge?

Dr. MORRISON. I believe that will be the case.

Senator MILLIKIN. Isn't that almost inevitable; I mean, isn't that the human inevitability?

Dr. MORRISON. I think on this question you probably have more experience than I.

Senator MILLIKIN. No, I am not a scientist.

Dr. MORRISON. No, but you are a man who knows how people act and organize themselves into states.

Senator MILLIKIN. It seems apparent to me that once there is an area where scientists have discovered something profitable and opened up a further field of investigation, that they will pursue that, the investigation, into natural laws. It never has been abandoned; that is, no major field of investigation of that kind has ever been abandoned because of the ultimate purpose or the ultimate results.

Dr. MORRISON. I believe that is true. I am not saying that you cannot destroy investigation, that it cannot be abandoned, if you insist upon it. I am saying simply that it has never been done.

Senator JOHNSON. Mr. Chairman.

The CHAIRMAN. Senator Johnson.

Senator JOHNSON. I should like to say to the witness, to Mr. Morrison, that he is the most eloquent witness that I have ever heard since I have been around Congress. I am sure that his power of description must be the envy of all reporters here present. I know it is the envy of all the Senators here.

I deem this paper that he has submitted to us a classic in direct statement, and I shall preserve it and I shall use it.

He has made an almost unanswerable argument against TNT, for one thing, and I think he has made some arguments that no military man can escape—much as our military high command are trying to escape, I don't see how they are going to escape the argument he is making.

In listing the choices of death, he tells us that the victims of the bomb had a good many choices. They might be killed by falling brick, or they might be burned to death by the direct blast, or they might be burned to death by secondary fires, and if they escaped all of them, the death ray would probably get them.

I want to ask him about the absence of oxygen caused by this tremendous blast and the wind that he has described, the vacuums, and all. Was it possible for persons to have suffocated for lack of oxygen, and were secondary fires handicapped by a lack of oxygen in the immediate region?

Dr. MORRISON. I do not believe so.

Senator JOHNSON. There is plenty of oxygen left after the wind has sucked them out?

Dr. MORRISON. You see, after the blast has passed you for 10 seconds, then everything is back to normal again. Presumably, if you are still in one piece under all these other conditions, you can presumably do without oxygen for 10 seconds. You cannot do without your head for 10 seconds; that is the trouble.

Senator JOHNSON. You cannot do without that at all, but the interval of the absence of oxygen would be very small?

Dr. MORRISON. Very small.

Senator JOHNSON. Ten seconds?

Dr. MORRISON. Much less, but I said 10 seconds is evidently not serious. I said that because I am sure of that figure. I know it is much less by a factor of a hundred or more.

Senator JOHNSON. So suffocation was not one of the choices?

Dr. MORRISON. Except by having things fall on you and bury you, which was not a very common cause.

The CHAIRMAN. Doctor, have you read General Arnold's report?

Dr. MORRISON. I have.

The CHAIRMAN. Did you by any chance read General Spaatz' story?

Dr. MORRISON. I read that in the train coming to Washington, sir, and was greatly impressed by it.

The CHAIRMAN. Do you think that that portrays what a future war would be?

Dr. MORRISON. I hope that it does not portray what the future circumstances of the world will be. I believe it portrays correctly, perhaps with a natural conservatism on the part of a general, what a future war would be if engaged in by the powers.

Senator JOHNSON. I have one more question, Mr. Chairman.

The CHAIRMAN. Senator Johnson.

Senator JOHNSON. I was intrigued by this statement: "I do not think you will soon see atomic automobiles, though you may see atomic rockets and atomic power plants."

Now, the atomic rocket is the thing I wanted to ask you about. My understanding is that up to the present time this atomic energy that we have is either a tremendous explosion, or else it exists in a minute sort of way. In other words, we either have a terrific explosion, or the atoms split very casually, one at a time, and nothing happens.

Is there any way of controlling that explosion so that you can use it for a continuous flight of a rocket?

Dr. MORRISON. I should like to answer that question, but not in the most direct way you asked it.

I would not like to say you could control the explosion, because that is contradictory. Before we could make a bomb, we had to learn to produce a controlled nuclear reaction. It was not a controlled explosion. I don't know what a controlled explosion means, but it was the release of energy at a uniform rate under conditions where it could be turned on and off. In fact, the great plant at Hanford is exactly this sort of thing.

Senator JOHNSON. But you cannot use the great pile at Hanford in a rocket bomb.

Dr. MORRISON. That is quite right, but you can make smaller piles.

Senator JOHNSON. Small enough to drive a rocket and still small enough to be carried by a rocket?

Dr. MORRISON. I believe so, but I don't think I can go into any more detail.

Senator JOHNSON. It looks to me as if it is the same question of lead pants you were discussing with Senator Milliken a while ago; that your pile would be so heavy that the rocket couldn't travel, that the energy it produced would be less than its weight.

Dr. MORRISON. But who is riding on the rockets, Senator? If there are no people nearby, no crew, you do not need a very heavy shield.

The CHAIRMAN. Senator, isn't that perhaps getting into classified information?

Senator JOHNSON. I think that is as fantastic as Buck Rogers, and I just wanted to challenge the witness on his statement here that we may see atomic rockets. I think that is a statement that ought to be challenged, and I challenge it.

Dr. MORRISON. I certainly will not engage in the manufacture of atomic rockets, because I see no use for them except in war; but I think it is a natural development of the thing we have been working on, and that such a thing could be produced.

Senator MILLIKIN. Mr. Chairman, I would like to ask the witness what he has done in the laboratory to prepare atmosphere so that it may become highly inflammable.

The CHAIRMAN. Isn't that classified?

It looks as though the chairman is getting security conscious.

Dr. MORRISON. These matters were discussed by Dr. Bethe yesterday, I believe.

The CHAIRMAN. Doctor, you have thought a great deal about the future of our defense, I presume?

Dr. MORRISON. Yes.

The CHAIRMAN. What relation has a 10,000,000-man army, every one of them able to shoot the eye out of a squirrel at a thousand yards, every one of them able to salute and come to attention and say, "Yes, sir" and "No, sir"—what relation has that in your mind to the ability or the power compressed in these bombs as a matter of defense?

Dr. MORRISON. Do you really want me to answer that question?

The CHAIRMAN. Yes; I don't know why it shouldn't be answered. It is something that I have thought about a good deal.

Dr. MORRISON. Well, I can say these things.

The CHAIRMAN. Unless you think it is classified information.

Dr. MORRISON. No; I think it is controversial discussion on a subject on which I have no special competence.

The CHAIRMAN. I ask it of you on the theory that has been so often quoted by Clemenceau, who said that war was too important to leave to the generals, with which I am in thorough accord.

Now, on that basis, as one amateur talking to another, tell me what the relation is as you have thought about it.

Dr. MORRISON. I am still working for the War Department. [Laughter.]

The CHAIRMAN. Let the responsibility be mine.

Dr. MORRISON. Let me say that if you have, as you will have in a future war, 1,000 or 5,000 long-range rockets striking our industrial areas, each one loaded with enough atomic explosive to destroy any city district, that is, the central part of Washington, lower Manhattan, or any small city of three or four hundred thousand, you will have an enormous installation which will perhaps intercept half of these, or seven-tenths of them, or something of that sort; but you will lose, as I think has been said before, something like one-third of your population in the first day of the war.

I do not know; I do not like to think about prosecuting a war under these circumstances, and that is why I want to stop there.

How the war would progress after that is a question I hope we will never have to answer. It is clear to me that against such an attack a conventional army is of no value; whether it is of no value in the further prosecution of the war is something I do not know about.

The CHAIRMAN. I assume we have a navy in order to defend the country. I was questioning myself last night and asked, "What good is a navy if you haven't got a country to defend?"

Dr. MORRISON. You are going to always have a navy to defend, Senator. [Laughter.]

The CHAIRMAN. I think I will let that one lie right where it is.

Has anyone else any questions?

Senator HICKENLOOPER. Not unless you want to explore that field a little more. It is a rather interesting field.

The CHAIRMAN. It is; I will let you go forward with it. That last one stopped me, Senator, and in fact I think the whole argument was made in the one sentence.

Senator HICKENLOOPER. I am sorry, Mr. Chairman, but I was engrossed in a maze of figures here so I missed the doctor's argument on this number of men, and so on.

I realize that you are a physicist and not a professional soldier—
Dr. MORRISON. Thank God.

Senator HICKENLOOPER. But let us assume that the United States, or any country, elected to use the atomic bomb, having a sufficient stock of them for either offense or defense.

Roughly, if you have any opinion, about how many people do you think we would need efficiently trained to use that weapon successfully, either in offense or defense?

Dr. MORRISON. I am not quite sure how you successfully use it in defense.

Senator HICKENLOOPER. I realize that the fellow who hits first has a tremendous advantage in this thing.

Let us suppose that we are going to use the bomb and want to use it efficiently, that is, to kill the most people and do the most damage to our enemy.

Dr. MORRISON. Well, let me try to make a guess. I have not thought about this question, and it is useful to think about only to show how expensive the whole proposition will be, I hope.

These bombs will cost, as Dr. Oppenheimer said a couple of times—and I may quote him without any violation of security—in the order of \$1,000,000 apiece.

I think to launch them in some fancy and complicated missile, like a super V-2, would probably not be practical unless the V-2 itself cost only 10 times as much as the bomb, as in the case of the airplane in relation to its bomb load.

Let us say it cost \$10,000,000 to launch an atomic missile. Now, if you have to do this in the number of thousands, and were spending around 10 or 20 billion dollars, you probably have an equal sum for all the administrative and communication problems, so that you will spend in the order of \$50,000,000,000. You can transfer that into the number of people who have to be employed in the enterprise as well as I.

Senator HICKENLOOPER. Could you give an opinion on this? Could we successfully conduct an atomic war, just using some very rough figures now, with, say, a well-trained military land force—let's leave the Navy out of it—of a million men as easily as we could with a trained force of 10 million men on land?

Dr. MORRISON. I really do not know. I would prefer not to discuss those questions.

Senator HICKENLOOPER. Well, my point is as to whether or not 10,000,000 foot soldiers would contribute anything more to the launching of an atomic attack than 1,000,000 foot soldiers, for instance, or whether the 9,000,000 would be surplus?

Dr. MORRISON. I think not one foot soldier will contribute to the launching of an attack, but there are other things to do. I do not want to discuss what other things may be done.

I think that you can see what our point of view is, namely, that to launch an atomic attack you need people to press buttons and make instruments. What else you need is not my province to discuss.

Senator HICKENLOOPER. In other words, I was trying to develop the point whether you believe marching armies would contribute very

much to the effectiveness of the atomic bomb from our standpoint, or whether it is purely or almost exclusively a scientific and engineering problem confining itself to the construction of the materials and the launching of the ships—with the trained personnel, of course.

Dr. MORRISON. I think that the impact of war will be so great in the first day that I do not know what will happen thereafter.

Senator RUSSELL. Mr. Chairman, I regret I was a bit late. I wonder if the doctor has discussed the range of these rockets and these missiles, and whether he thinks there is any limitation on the distances that they can traverse with accuracy.

Dr. MORRISON. I know nothing about rockets or missiles from my own experience. If the Germans were able to make a rocket under their conditions that will travel 300 miles and hit within a couple of miles, if they were able to do that under circumstances in which they could not develop weapons like we were able to develop, such as the atomic bomb, I do not doubt that 10 times this range and equal accuracy is attainable.

I do not know of my own experience, but it seems to me common sense that progress in this range will be made. There is certainly no new physical fact involved, but detailed engineering study.

General Spaatz and General Arnold have spoken about these things and must have received information that these things are practical. I myself see nothing against them.

The CHAIRMAN. Are there any further questions?

Thank you very much, Dr. Morrison.

Senator MILLIKIN. I would like to add my appreciation to that of Senator Johnson of the very graphic and informative descriptions you gave us of the conditions at Hiroshima.

The CHAIRMAN. Dr. Goudsmit.

**STATEMENT OF DR. S. A. GOUDSMIT, PROFESSOR OF PHYSICS,
UNIVERSITY OF MICHIGAN**

The CHAIRMAN. Dr. Goudsmit, have you a prepared statement?

Dr. GOUDSMIT. I have no prepared statement with me, but I may have one later.

I wish to point out first of all that my connection with the atomic bomb is quite different from that of the previous witnesses. I have not worked on the project at all, except in intelligence functions.

I was connected with the War Department mission which was sent overseas in order to find out what the German progress was along the project of the atomic bomb, and that was what we have done, and that is the information which I can give you.

Also, because of that function, I may have a few suggestions which might be useful, even though they are one-sided suggestions, as to control and supervision.

In spite of certain preliminary newspaper reports, we can say that the Germans did not have anything at all. They were way behind. They just did not have the vision which the Allied scientists had, I believe.

I have put down a few points about the German progress.

The German scientists had abandoned the hope of making a bomb during this war, entirely. They used the idea of the bomb to sell it to the Government and to the military officials.

Another point is that as a result they concentrated their efforts on the production of atomic energy, and all the work done was nothing else but trying to build what is called over here a pile, a uranium machine. That is all they worked on, and they had not even succeeded in constructing a pile. They had not a working uranium machine.

At the end of the war they had done just enough experimentation so that they were certain that it could be done, but they had not done it. They had not produced a chain reaction. They had not a uranium machine which they had hoped for.

The total effort expended by the Germans on the project was rather small, but it was among the scientific projects the one of the highest priority; still it was very small compared to our effort.

Senator JOHNSON. In your investigation of the German effort, did you have access to all of the efforts of Germany? Press reports have inferred, or at least I have understood from them, that certain German efforts had been taken over by the Russians, and that such plants as they took over were not open to inspection.

Now, did you have access to all the plants in Germany, and when you speak of what the Germans did, are you speaking of everything that the Germans did in the Russian-occupied zone as well as in the American-occupied zone?

Dr. GOUDSMIT. I speak with confidence of everything the Germans did on the atomic bomb project. I am certain that I have inspected all the papers and have talked to all the key men on the project, and have seen all the documents and most of the laboratories have been visited by me or by men who worked in connection with me.

Senator JOHNSON. In the Russian-occupied as well as in the American- and British-occupied zones? Have you visited any Russian-occupied laboratories?

Dr. GOUDSMIT. I think that is classified information.

Senator JOHNSON. You cannot testify on that?

Dr. GOUDSMIT. I cannot testify in open session as to that.

The remarkable thing about the Germans is that all the time they believed that they were ahead of our effort along those lines. Not until the news broke that the atomic bomb had been dropped did they realize that they were not ahead, but that they were behind. They were absolutely convinced that their work was ahead of ours.

They had no knowledge of our project, none whatsoever, except a few incorrect statements from their intelligence department, and some rumors which they did not take seriously. There was, in 1943, a rumor that in America scientists were working on an atomic bomb, but all details were lacking, and so it was not taken seriously. It was merely used as a means to have the authorities give more help, more men, more space for the laboratories. That was all they used it for.

Senator RUSSELL. You state that their work was very narrow in scope. Do you gather from this that it had not gotten beyond the laboratory stage?

Dr. GOUDSMIT. It had not gotten beyond the laboratory stage.

Senator MILLIKIN. They did not even have a pilot plant?

Dr. GOUDSMIT. They did not have even a pilot plant. The reason for the lack of progress in Germany, as I see it, can be again put down in a number of points.

For instance, as I mentioned before, the German scientists seem to have lacked the vision. They did not believe in its success from the very beginning. They knew its importance, and were convinced that the project was important; but they did not believe that it could be done within a reasonable time, 50 to 100 years.

The CHAIRMAN. Goebbels was talking all the time about a secret weapon. Do you think he had in mind, when he said that, the possibility of the development in German laboratories of this thing?

Dr. GOUDSMIT. He had knowledge of that, and some of the higher officials in Germany, who were utterly incompetent, may have believed that an atomic bomb was possible within a short time.

Senator JOHNSON. Hitler made many statements that he was going to bring the whole world down with him if he fell; in the light of the atomic bomb, it might seem that he had that in mind. Do you think he had that in mind, or was that pure bluff?

Dr. GOUDSMIT. It was pure bluff. They had it in mind, however. For instance, near the end of the war, when the Germans had made a preliminary success, they had really discovered by their experimentation that it might be possible to make a uranium machine.

Himmler's SS men went around and spread the rumor that very soon the Germans were going to use a uranium bomb, scaring the scientists who knew they were 50 or a hundred years away from such a goal.

Other reasons why the Germans did not make any real progress were probably, as I mentioned before, that the key men in administrative positions were utterly incompetent. For instance, Army Ordnance had as its chief adviser on military matters a second-rate physicist named Schumann, like the musician Schumann. In fact, his main interest was the physics of piano strings. He even rose to be the chief adviser of all the German armed forces after a while. That man was the first one who started the project for the German Army. He was the first one who went to France and tried to get the French development out of the hands of the French, and tried to move the French cyclotron, later deciding not to destroy it but to make it work, and sent some Germans down to put it in order and make it work.

That man had a small project going on in one of the Army proving grounds near Berlin, and the scientists he had working with him were definitely inferior compared with the scientists which were available in Germany for such a project; so there was one group working.

There was another group working in the so-called Kaiser-Wilhelm Institute for Physics, where a group of competent scientists by themselves had been working on this project trying to make a pile. Those two groups were always in competition with each other, instead of trying to cooperate with each other.

There were other men who had heard that nuclear physics was important. They tried to convince some other branch of the Government to give them money. They preferred the Air Forces, because in Germany the Air Forces had a lot of money. It was the only organization which was able to support research on a large and lavish scale, so some of them succeeded in talking the Air Forces into the fact that nuclear physics is important, that they should be given money for high tension apparatus, for laboratory equipment, and so on.

Again another man, a great technician and a good businessman, talked the Minister of Post and Telegraph into supporting him. He

had discovered that the Research Department of the Post and Telegraph Services in Germany had a lot of money which was not being used, and that they had research facilities; so he talked him into supporting a project along those lines.

It is clearly understandable that in such a way they could not go very far. It was only later in the history, after the war went badly, that the thing was better coordinated and that one man was put at the head of the whole organization, a competent scientist. He tried to bring some sense into the organization and diminish the competition and make it into cooperation, but that was too late. That was around 1943. I don't know exactly which month it was, but it is in the record somewhere.

Senator RUSSELL. Doctor Goudsmit, you of course are familiar with the Smyth report?

Dr. GOUDSMIT. Yes, sir.

Senator RUSSELL. From your investigations in Germany, do you think that they had knowledge of practically all or all of the facts that are set forth in that report?

Dr. GOUDSMIT. No; definitely not.

Senator RUSSELL. You don't think they knew as much as was contained in the Smyth report?

Dr. GOUDSMIT. They did not know as much as was contained in the Smyth report.

I must modify that statement a little bit. They might have known it, but they did not give the proper importance to the various pieces of knowledge they had. They could have known certain things, and could have thought of the use of plutonium, but it simply did not enter their minds.

One man mentioned it at one time in a short report of his, but it was not taken seriously. I should say the knowledge was there, they could have known it, but they did not grasp the right points in order to further the development.

Senator RUSSELL. Other witnesses have indicated that scientists in Germany, as well in other countries, have for some time had knowledge of the matters and statements in the Smyth report.

Dr. GOUDSMIT. There is indeed, as I say, the possibility that the facts were known; but knowing the facts is not sufficient, definitely not. Knowing that one can make plutonium, which is obvious to any scientist and was in 1939, would not be important; but the German scientists did not go further than that and see in it a realizable possibility of making an atomic bomb, which is something quite different.

Senator MILLIKIN. Did you find any evidence that the Germans had coordinated their individual knowledge and their group knowledge of the subject?

Dr. GOUDSMIT. Yes. They had free exchange of information in the form of reports among the various groups which worked on it. There was no compartmentalization.

Senator MILLIKIN. Then did any group or any top coordinating agency pull this altogether into some sort of definitive statement?

Dr. GOUDSMIT. No.

Senator MILLIKIN. That was not done?

Dr. GOUDSMIT. No; it was simply done in the form of secret publications.

Senator MILLIKIN. In other words, a number of groups of scientists were sort of going along, each one on its own route?

Dr. GOUDSMIT. Yes, sir.

Senator MILLIKIN. They were not working under over-all direction?

Dr. GOUDSMIT. Not until the very end, which was much too late, was there a little bit of coordination, and only a very little.

The CHAIRMAN. Doctor, you tell us that work had not gotten along very far. Now, we didn't know that until after the war, until you could get in there and make an evaluation.

You say that the Germans didn't know much about our situation, and had not learned it. Our information about them was just as poor as theirs about us?

Dr. GOUDSMIT. Yes.

The CHAIRMAN. I can recollect that General Marshall stated that they were in a race with us. That must have been based upon the G-2 reports before the end of the war.

General Eisenhower said, I believe in April, as I recollect it, that barring the bringing into effect of a new weapon, he felt that the war would be over in the spring.

I don't know whether you remember that declaration or not. The fact of the matter is that our intelligence overestimated what they were doing entirely, didn't they?

Dr. GOUDSMIT. It was known. This mission did not wait until the war was over. We have been overseas for quite awhile, and followed the armies.

The first concrete information which was turned over to the War Department, and which definitely indicated that there was no German effort along those lines, complete proof, in fact, occurred in the late winter of '44, around December of '44.

We were absolutely certain that the Germans did not have anything like an atomic bomb.

The CHAIRMAN. So when General Marshall talked about a race, it was the turtle and the hare.

Senator JOHNSON. Were the German scientists and the German efforts handicapped by Hitler's policy of persecution, which included top-notch physicists and scientists as well as other persons?

Dr. GOUDSMIT. They were seriously handicapped by the lack of prestige which science has in Germany. The scientists themselves had gotten together in an informal society, the Uranium Society, just before the war. They had taken it seriously, and had even sent over two of the top scientists to this country to find out what we were doing just before the war started in the summer of 1939.

When the war broke out, all German scientists were drafted. One of the top scientists was a corporal for a while, and stated that his Army experience was like the usual mountaineering, only made difficult by the presence of sergeants. That was the only thing, but the rest was just a mountaineering trip in the Alps.

But pretty soon the key scientists were taken out of the Army and put back in the laboratories; but the bulk of the German scientists remained in the Army for several years, 2 to 3 years. Several were killed in action as soldiers.

Only when the war went bad, especially after the U-boat war went bad, were scientists released from the armed forces and put back

on war work, which on the whole was not very successful, as I said, except for the Air Force.

Senator MILLIKIN. Prior to the war, were the German scientists regimented or were they free to pursue their own work in their own way?

Dr. GOUDSMIT. Also then did they suffer from the lack of prestige, and it was pointed out during the war by one of the key German scientists how German science had declined compared with science in America. He went around the country lecturing for various officials for the Air Forces, using statistics—some of the statistics he had obtained from American journals—to point out that Germany was rapidly declining in the fundamental sciences.

Senator MILLIKIN. What reasons did he attribute to that?

Dr. GOUDSMIT. He attributed it primarily to lack of support for science, to some extent to the loss of scientists because of persecution, and to a greater extent to the replacement of those scientists by incompetent party members instead of good scientists.

Senator JOHNSON. Did Hitler's policy of persecution reach into the scientific groups?

Dr. GOUDSMIT. Not directly, except insofar as several scientists had to leave the country, of course long before the war was started; but the replacement of those men by incompetent scientists was the greatest handicap.

Senator RUSSELL. Doctor Goudsmit, did your investigation indicate whether the rocket bombs or buzz bombs were developed by the Ordnance Corps of the German Army or by civilian scientists, or scientists who were not inducted into the Army?

Dr. GOUDSMIT. The rockets were mainly developed by excellent aeronautical engineers, who worked primarily for Army Ordnance.

Senator MILLIKIN. I thought you made a very interesting statement in recapitulating the reasons for the decline in German science when you said, in effect, that one of the reasons was that they were putting party hacks into positions of authority in science.

Is that not a danger that we must avoid as far as we can avoid it in any governmental agencies of that kind that we may set up in this country?

Dr. GOUDSMIT. Definitely.

Senator MILLIKIN. I will put it this way, that danger cannot be entirely avoided in any kind of a governmental set-up having to do with science. Would you go along with me on that?

Dr. GOUDSMIT. Certainly. We have, for instance, noticed that on this intelligence work, the reason it succeeded at all was I think due to the perfect cooperation between the Army organization and the scientists on these teams. It was really an ideal example of how such a thing can be set up.

The chief of the mission was Col. B. T. Pash, and he understood completely his responsibilities. He never questioned, for instance, the judgment of the scientists about any scientific matter. It was up to the scientists to decide which village in Germany was important; it was up to the scientists to investigate the papers to get all that information; it was up to the scientists to decide who was really an important scientist and who was just a man who had gotten his name in the newspapers.

The military never failed to get us to the places we wanted to go to, to find the man we wanted to find, to get the papers we wanted to read. They never questioned the judgment of the scientists on scientific matters, and that was an ideal cooperation. I think it should be made an example for cooperation not only in wartime, but also in peacetime.

I have been connected with other organizations where civilians and Army people have worked together, and I have been very fortunate that in all cases there was such ideal cooperation.

I was previously overseas for radar work, and there the mingling of the civilians with the Air Forces officials on radar was also really an ideal example of perfect cooperation. That should continue in peacetime.

Senator JOHNSON. I would like to ask Doctor Goudsmit to put something in the record of his personal and professional background.

I understand you are a native of Holland.

Dr. GOUDSMIT. Yes; I am.

Senator JOHNSON. And you are now a professor of physics at the University of Michigan.

Dr. GOUDSMIT. I have been there since 1927.

Senator JOHNSON. Are you a citizen of the United States?

Dr. GOUDSMIT. Yes, I am.

Senator JOHNSON. How long have you been in the United States?

Dr. GOUDSMIT. Since 1927, and I have been at the University of Michigan all that time, except that since the beginning of 1941 I have been on leave for war work.

Senator JOHNSON. How much experience in your profession did you have prior to coming to the United States?

Dr. GOUDSMIT. I had done research work in Holland and Germany and other countries of Europe, and when I came to the United States I was appointed on the faculty of the University of Michigan in 1927.

Senator JOHNSON. How much experience had you had in Europe prior to coming to the United States?

Dr. GOUDSMIT. I don't know how to measure it. - I had already published several papers in physics.

Senator JOHNSON. Had you taught in any university?

Dr. GOUDSMIT. Only as an assistant at the University of Amsterdam, and I had a Rockefeller fellowship in Germany and Denmark. I had mainly done research work, and very little teaching.

Senator MILLIKIN. What schools did you graduate from?

Dr. GOUDSMIT. I got my Ph. D. from the University of Leiden in Holland.

I would like to add a few words about the possibilities of control.

The experience we had in Germany shows clearly that some type of supervision or control is possible. I mentioned before that no knowledge of German development was available here. I can add to that by saying that the security of the Germans was inadequate. They used letterheads and envelopes which clearly stated "Nuclear Physics" on the outside. Nevertheless, we had no knowledge of the work at all over there. The allies did not know what was going on.

As soon as our mission got in touch with the first physicists, the first physics laboratory, the first correspondence and documents on physics which were available on the Continent, we obtained the com-

plete story. From that you see that if there could be free interchange of ideas among the scientists, if they could travel freely, if they were allowed to visit each other's laboratories, if that were possible, then as long as scientists are working or have to be used in work on an atomic bomb or anything of that nature, I don't believe that it can be kept secret. It would be known immediately to their colleagues all over the world without any doubt.

If, however, the art of making atomic bombs will progress so far that they do not need scientists any more, and it can be done by slave labor or prisoners, then of course control will be more difficult. But as long as scientists are needed in the building, construction, or research work on atomic bombs, it cannot be kept a secret from other scientists if they have free access to each other's papers, can talk with each other, can travel and go to meetings together.

Senator RUSSELL. I would like to ask one or two questions, Mr. Chairman.

Dr. Goudsmit, from your investigations in Germany as to the progress which has been made in their research, would you care to venture any opinion as to how long it would take any other country of the world to complete an atomic bomb or to advance to the stake where we are today?

Dr. GOUDSMIT. I can say that the Germans, at the rate at which they were going before they knew about the atomic bomb—

Senator RUSSELL. Of course that made a difference.

Dr. GOUDSMIT. That made an enormous difference, and it makes my estimate valueless. At that time it would have taken them a hundred years, they were going so slowly. You can see the progress in the research reports.

Senator RUSSELL. But you stated they didn't have any faith,

Dr. GOUDSMIT. Now they have.

Senator RUSSELL. But it is an entirely different situation today. The whole world knows the bomb can and has been created and used.

Dr. GOUDSMIT. Yes. Then my estimate must be the same as that of other scientists, and it just depends on getting the men together, getting the industry developed and organized, and I do not see why it should take them any longer than it took us.

Senator RUSSELL. We talked a great deal about rockets during the course of these hearings. Did you make any investigation into the development of the rocket in Germany?

Dr. GOUDSMIT. I did not make any investigation.

Senator RUSSELL. You dealt entirely with atomic energy?

Dr. GOUDSMIT. No; we had some other responsibilities on that mission.

Senator RUSSELL. In other words, you did not have any connection whatever with the investigation on rockets. What member of your group was dealing with the question of rockets?

Dr. GOUDSMIT. We left that entirely to the technical teams of the Army and Navy. There were so many teams over there picking up V-1's and V-2's that we thought our small group could safely stay away from it and leave it to technical teams.

Senator RUSSELL. I gather from that that you would prefer not to express any opinion as to the relative progress which has been made by the Germans and by this country in the development of the rocket as a weapon of war?

Dr. GOUDSMIT. As far as the large rockets are concerned, I do not think that our development went very far because we were not interested in those. As far as the smaller rockets are concerned, I was told by experts that we could not learn much from the German developments.

Senator RUSSELL. I happened to be in the Hague this summer where the Germans launched a great many of these rockets against England, and if they didn't have better luck with them with atomic war-heads than with the bombs they used, it would be bad, because about every other one flew back. They had absolutely no sure sense of direction. About half of them landed in the surrounding countryside, and half over in England.

Unless progress is made in the rocket, it will be some time before any one tries to use rockets extensively with atomic war heads.

Senator JOHNSON. There is room for only one mistake with an atomic bomb.

The CHAIRMAN. Doctor, there has been some comment in the press about the fact that German scientists are finding employment in Russia. Would you care to comment on that?

Dr. GOUDSMIT. I think it is well known that certain German scientists are finding employment in Russia.

The CHAIRMAN. The obvious conclusion is that it will enhance their available resources of scientific development.

Dr. GOUDSMIT. Yes. I think similar German scientists in the French zone are working for the benefit of France, and in the British zone certain factories and laboratories may have been put back to work for British interests.

Senator JOHNSON. Is that true of America also?

Dr. GOUDSMIT. When I left, it was not well coordinated; but let us hope that it will be better coordinated by now.

The CHAIRMAN. Who is Dr. Otto Hahn?

Dr. GOUDSMIT. He is a German chemist who discovered fission, which is the basic process.

The CHAIRMAN. He has just been awarded the Nobel prize.

Dr. GOUDSMIT. Yes.

The CHAIRMAN. Where is he?

Dr. GOUDSMIT. I don't know where he is at the moment.

The CHAIRMAN. You don't think he will be at the Astor Hotel on Monday night when the Nobel prize dinner is held?

Dr. GOUDSMIT. No; I don't think so.

The CHAIRMAN. I am interested, for I am speaking there Monday night.

Are there any further questions?

Thank you very much indeed, Doctor. We appreciate your statement.

(The prepared statement submitted by Dr. Goudsmit reads as follows:)

FOREWORD

The opinions expressed in the following are entirely my own. These opinions represent my subjective reaction to information obtained abroad.

The facts quoted in the following account are derived from evidence collected in the European theater of operations in my function as scientific chief of the Alsos mission. This evidence consists primarily of documents, such as captured

German secret research reports and administrative scientific correspondence. In addition, laboratories were inspected and several scientists interviewed.

State of atomic bomb research in Germany

The progress made by German scientists towards the construction of an atomic bomb was negligibly small. The state of affairs near the end of the war can be summarized as follows:

1. German scientists had abandoned hope of making a bomb for this war.
2. They concentrated their efforts on atomic energy production rather than on an explosive.
3. They had no yet succeeded in constructing a "pile" or self-supporting chain reaction.
4. The total effort expended on the atomic energy project was small, even though it had the highest priority.
5. German scientists had no knowledge of our work.
6. They believed that they were ahead of our developments in atomic energy.

REASONS FOR FAILURE

A careful study of the documents may reveal the causes of the complete German failure in this field. My opinion in this connection can be summarized in the following statements:

1. German scientists lacked the vision which the Allied scientists possess.
2. The Nazi Party and the German military placed incompetent scientists in key administrative positions.
3. Lack of coordination caused competition instead of cooperation among the various groups.
4. German scientists put into this field scarcely more effort than they would have into a peacetime research project, because they felt certain of their superiority.
5. German pure science had no support from nor contact with the military.
6. Allied bombing interfered with German progress.

HISTORY OF GERMAN ATOM BOMB RESEARCH

Early in 1939, as was done everywhere else, several German physicists called to the attention of the military and of other authorities the possibility of making a superexplosive as a result of the discovery of uranium fission. A group of physicists met and formed the Uranium Society (Uran Verein). This was originally an informal group, exchanging information among each other, but keeping such information from outsiders.

German nuclear physicists proceeded with their research independently. Army Ordnance had a scientific group under a second-rate physicist, Schumann, which started work on this problem. The best-qualified groups were the Kaiser-Wilhelm Institute for Physics in Berlin, under Heisenberg, and the physics section of the KWI for Medical Research in Heidelberg, under Bothe. Bothe, as well as Heisenberg, made a survey trip through the United States of America in the summer of 1939, just before the war started, obviously to find out what our plans were for the uranium bomb.

When the war broke out, scientists in Germany were immediately drafted into the Army, but a short while later the key men were deferred and returned to their laboratories. However, the bulk of the lesser academic scientists remained in the field (where several were killed in action), until about two or three years later when the military authorities finally agreed to release them for war work.

At the beginning of the war, each academic research group had to find its own sponsor. The German Air Forces had the best and most liberal set-up for research, and some nuclear physicists were fortunate enough to get support from them. A private scientist, Baron von Ardenne, a clever technician and businessman, got the Minister of Post and Telegraph, Ohnesorge, interested in his research. Ohnesorge was near to Hitler and kept the Fuehrer informed about the importance of the project. For awhile, Von Ardenne was considered by the German authorities to be the expert on the uranium problem, much to the dismay of the really competent scientists.

The various groups worked in competition with each other. The sabotage and bombing of the Norwegian heavy water plant had cut their supply so that it was barely enough for one group to make important experiments. As a result, disagreements arose concerning its use.

The bulk of German scientific research was under the Ministry of Education (Minister Rust). It was governed by a Research Council under an incompetent administrator and second-rate chemist named Rudolph Mentzel, a brigadier in Himmler's SS.

Early in 1942 the members of the Uranium Society thought it necessary to call the project to the attention of the highest members of Government and military organizations. A special secret meeting was called by Minister Rust and General Leeb, Chief of Army Ordnance, to which all top-ranking officials were invited. However, most of them declined or sent minor representatives. The program consisted of a number of talks and a scientific luncheon prepared with synthetic fats. The introductory talk was by Professor Schumann about Nuclear Physics as a Weapon. Then followed popular technical lectures by Hahn, Heisenberg, Bothe, and a few others, and finally a lecture by Professor Esau, Director of the German Bureau of Standards, on the Expansion of Nuclear Physics Research Through the Participation of Other Government and Industrial Departments. It is doubtful whether this meeting had any success.

A few months later, the Research Council was taken out of the Ministry of Education and, by "Hitler decree," placed under Goering. It was hoped that this change would bring research on other subjects up to the same high level as that of the air forces, but matters did not turn out that way. The incompetent Professor Mentzel remained the active head of the Research Council.

Professor Esau, of the Bureau of Standards, was put in charge of uranium research. Later, sometime in 1943, he was replaced by physicist Walther Gerlach, of the University of Munich, a really first-class experimental scientist and organizer. At the same time, Army Ordnance seemed to have gotten tired of this apparently hopeless research and turned the facilities and men over to the Research Council. Upon Gerlach's shoulders fell the difficult task of reconciling the two principal groups working on uranium—the Kaiser-Wilhelm Institutes and the former Ordnance Group.

In the meantime, Allied bombing had forced the scientists to evacuate their well-equipped laboratories in the cities and to seek shelter in rather primitive quarters in various small villages spread all over Germany.

In studying the Research Reports, one is, first of all, impressed with the slowness of the progress. At the beginning of 1945, most of the research was still in practically the same state as it had been in 1943. Isotope separation had been tried on a very small scale only by means of a centrifuge. It had been discovered that the Clusius method did not work. Research on several other methods had been dragging on for a few years without much progress.

Some of the key scientists worked only part time on this important research and the rest of the time did routine teaching or administrative work. The lack of proper large-scale facilities necessary for this kind of work was, of course, another reason for the lack of success.

At the slow pace at which they were progressing, it is obvious that German scientists did not believe a bomb would be constructed within the course of the war. They were confident that perhaps a uranium machine, or at least its basic principles, could be obtained within a reasonable length of time. It is remarkable, however, how incomplete their knowledge was. They were, according to their research reports, scarcely aware of some of the basic difficulties which they were likely to encounter in their efforts. Most surprising is the fact that not even their best scientists had given any thought to the use of plutonium.

Attempts were made to have German chemical industry produce heavy water because the Norwegian plant had been destroyed. However, not much progress was made with this plan either. Uranium metal was produced in quantities sufficient for small-scale experiments, and the stock of heavy water seemed to be just enough for that.

The effort was small, though it had the highest priority among all scientific research projects in Germany. The total expenditure was about 15,000,000 marks, which is perhaps equivalent to some \$10,000,000. The appropriation for 1944-45 was 3¼ million marks with a subsequent supplement of 1,000,000.

It is estimated that approximately 100 scientists were active on this project. They were divided into several rather small groups working on different phases of the problem and were spread all over Germany.

Security

Almost nothing was known about the German project before the invasion of continental Europe in spite of the fact that the security was not of a very high standard. Letterheads and envelopes were used which clearly indicated the

prominence given to nuclear physics, reading "The Marshal of the German Reich, President of the State Research Council, the Plenipotentiary for Nuclear Physics," or "The Plenipotentiary of the Reichsmarshal for Nuclear Physics," which gave Gerlach the nickname of "Reichsmarshal for Nuclear Physics." In draft deferment requests, the reason was clearly stated as "Working on Energy Production from Uranium." There were some weak protests against this lack of security but to no avail. However, this stationery was never used for correspondence with neutral countries. The locations to which the laboratories had been evacuated were kept very secret.

German scientists knew practically nothing about Allied developments, aside from what they picked up the summer of 1939. They received some utterly wrong and useless information from the German intelligence, information largely obtained from travelers or other unreliable sources. There was a rumor in 1943 that the German intelligence had information about atomic bomb-work being performed in the United States. This apparently was not taken seriously, as further details were lacking.

Results

Toward the end of the war, the German experiments had indicated that it was possible to obtain an increase in the number of neutrons, but no self-sustaining neutron source had been constructed as yet. The German scientists considered this achievement of great importance. They were convinced that they were far ahead of the Allies. They believed that this success might play an important role in the settlement of the peace terms, for they understood correctly the immense implications of the uranium-energy project. Even if the peace terms might not be influenced by them, this achievement would at least insure for German science a leading role in the world and save Germany in that way. These thoughts were, indeed, the driving force behind the German scientific efforts. Gerlach was greatly excited when he learned about the favorable result of the preliminary experiment. He immediately informed Bormann, the head of the Nazi Party, reassuring him of German supremacy in this field. Gerlach was quite upset when, shortly afterward, the S. S. spread rumors that the Germans were soon going to use a uranium bomb. The scientists knew that they were still a hundred years away from that goal.

Himmler's S. S. had begun to take an active interest in research and especially in the uranium project. This organization had threatened to evacuate key scientists and their equipment to the Bavarian redoubt where they would be forced to complete the work under pressure. To the relief of the frightened German scientists, this plan failed, probably because of the rapidity of the German collapse. Only one group was actually kidnaped by the S. S. and let loose in Bavaria.

But, the German scientists believed in their superiority. They attempted to hide their research reports and all information about their work from Allied investigators—of course, in vain.

Not until they learned about the use of the atomic bomb by the Allies did they realize how far behind they were. They had lost not only the military war, but also the war of science.

Control

In my opinion, a survey of the German work on uranium energy leads to certain recommendations for eventual control of uranium research.

It has become evident that such supervision can only be had with the help of qualified scientists. The present military methods of intelligence or of occupation are totally inadequate for the control of scientific research. These merely lead to such utterly useless extremes as the destruction of the cyclotrons in Japan.

It is not only the destruction itself which is objectionable. So much has been ruined in this war that a few expensive scientific instruments are insignificant by comparison. The destruction of the cyclotrons is bad because it indicates that those who are responsible for this deed are totally unfamiliar with the real significance of these instruments in the atomic-energy problem. Blowing up cyclotrons is almost equivalent to the attempted cutting down of the Japanese cherry trees here in Washington shortly after Pearl Harbor.

It shows that sound and competent scientific advice is essential in dealing with this matter and those related to it. In this war, there have been several examples of very close and successful cooperation in the field between the military and scientists. I am fortunate to know this from personal experience. Such coordination and supplementation should exist not merely in the laboratory but in all phases of the atomic-energy problem.

The War Department mission, which, among other functions, collected the material mentioned before, can be taken as an ideal example of such cooperation. The chief of mission, Col. B. T. Pash, never failed to execute the operations, often difficult ones, requested by the scientific chief and his staff of scientists. The military were in charge of and took full responsibility for security and for other purely military matters. The scientists were responsible for judging matters concerning enemy scientists, instruments, laboratories, and documents.

Finally, I wish to point out the scientific cooperation which exists among scientists all over the world. This cooperation overcomes the barriers of war and differences of political opinion. I feel certain that, if all countries grant complete scientific freedom to their research workers, no dangerous activity will, or can, be kept secret as long as scientists are involved. By "scientific freedom" I mean the scientists' free choice of research problems and freedom of publication.

The CHAIRMAN. The hearing is adjourned.

(Whereupon at 12:05 p. m., the committee recessed until Monday, December 10, at 10 a. m.)

ATOMIC ENERGY

MONDAY, DECEMBER 10, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Johnson, Tydings, Austin, Millikin, Hickenlooper, and Hart.

Also present: Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. Dr. Szilard.

We have prepared a short biographical sketch on Dr. Szilard and what he has done. He is one of the most eminent of the pioneers in the science of uranium fission.

Doctor, would you proceed, please?

STATEMENT OF DR. LEO SZILARD, STAFF MEMBER, METALLURGICAL LABORATORY, UNIVERSITY OF CHICAGO

Dr. SZILARD. I have a prepared statement in various sections. It may be too long to read all of it, and I will skip a number of paragraphs. I will skip some sections, but I will submit for the record those sections which I skip.

With your permission, I should like to begin by quoting some facts and figures and by presenting some simple considerations which may serve as a starting point. In this way it will be easier to draw a picture of the role which peacetime application of atomic energy might play in the next 10 or 15 years in our power economy.

We are at present producing in factories that were built during the war two substances which are in many respects rather similar. One of them is Uranium-235, or light uranium. This substance is not so much manufactured as it is merely extracted, by means of a rather laborious process, from natural uranium. Light uranium accounts for less than 1 percent of natural uranium and accordingly its quantity is essentially limited by the quantity of natural uranium which can be made available.

In one of the prewar years we imported, for instance, 400 tons of uranium. If we worked every year such a quantity of uranium, and if we managed to extract all the light uranium contained in it, we would obtain every year 3 tons of light uranium. We would do pretty well, however, in extracting two-thirds of this quantity and obtaining 2 tons of light uranium every year.

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If we wanted to use up 2 tons of light uranium per year by allowing it to disintegrate, or let us simply say by "burning" it, and if we used the heat which is generated for the production of steam and steam for the production of electrical power, how much electrical power could we generate?

If we "burn" 2 tons of light uranium per year, we can produce electrical power at the rate of 1.25 million kilowatts, or about as much as the average production rate of TVA in 1944.

If this amount represented the limit of electrical power which atomic energy could be expected to provide for us, I would not take your time by discussing this question.

You obtain a very different picture, however, if you think of a fissionable substance, like, for instance, plutonium, which could be manufactured in large quantities. Plutonium can be manufactured from a component of natural uranium which accounts not for 1 percent, but for more than 99 percent, of natural uranium. If plutonium is allowed to disintegrate, or let us again say if it is "burned," heat is produced in just the same way as in the case of light uranium.

Heat is, however, also produced in the manufacture of such a fissionable substance.

Senator HICKENLOOPER. Let me ask you, Doctor, this question: Heat is produced when you produce the plutonium, and in turn the plutonium also produces heat?

Dr. SZILARD. Yes, when you burn it. You see, you first produce plutonium, and when you do that, as a byproduct you produce heat, and then you store it. If you later decide to burn it, you again produce heat.

When you make 1 pound of plutonium, you produce as much or more heat than when you "burn" 1 pound of plutonium. So you see that heat is produced twice, once as a byproduct of the manufacture of the fissionable substance and once when you "burn" the fissionable substance.

Senator HICKENLOOPER. Excuse me for interrupting you ahead of time, Doctor, as I see you answered my question later.

Dr. SZILARD. This does not hold, of course, for Uranium-235, which is not manufactured, but merely extracted.

With your permission, I will assume that the quantity of the fissionable substances which can be produced might be expected to increase from year to year in geometrical progression.

Senator HICKENLOOPER. May I interrupt you right there?

You mentioned light uranium. In the production of light uranium, you have to first produce the heat or the power that separates the light uranium, so you have to produce that in producing the light uranium; and in the production of plutonium, it creates its own heat?

Dr. SZILARD. Exactly. In the manufacture of light uranium, you use the electrical power available from existing power plants for operating your factories.

Let me now explain what I mean by geometrical progression. For instance, if you start with 1-ton production per year, say in 1946, you might produce 2 tons in 1947, 4 tons in 1948, 8 tons in 1949, and 16 tons in 1950. It might, however, be that the geometrical progression will be slower, and that the quantity which you can produce will double only every 3 years. This would mean that if you produce

1 ton in 1946, you produce 2 tons in 1949, 4 tons in 1952, 8 tons in 1955, and 16 tons in 1958.

Just how fast the geometrical progression might proceed will depend almost entirely on the inventive ingenuity of those who will collaborate in our research and development program. The time in which the production would double might be less than 1 year and might be more than 3 years. The years from 1946 to 1949 or from 1946 to 1958 ought to be considered as "the building-up period." During such a period it might not be advisable to divert any substantial quantities of the fissionable substances for the purpose of being "burned" in order to produce electrical power. After such a "building-up period," however, there is no reason why we should not "burn" up some 20 tons of fissionable material per year and produce electrical power at the rate of about 15,000,000 kilowatts.

Senator HICKENLOOPER. May I interrupt you again?

You said there is no reason to divert for a period of time this fissionable material to industrial uses, as I understand it. Now, why did you say that?

Dr. SZILARD. I said it might not be advisable to divert, and I am afraid that this leads me into a question which I would rather answer in executive session.

Senator HICKENLOOPER. All right.

Senator TYDINGS. How does that amount of power, 15,000,000 kilowatts, compare with the total amount of power generated in 1944 by TVA?

Dr. SZILARD. TVA generated $1\frac{1}{4}$ million kilowatts.

Senator TYDINGS. And you say 15,000,000 a year?

Dr. SZILARD. At the rate of 15,000,000 kilowatts.

Senator TYDINGS. A year?

Dr. SZILARD. No; kilowatts relates to rate of production. You would have to multiply this figure by the number of hours in the day and the number of days in the year.

Senator TYDINGS. As I understood your analysis of the comparison, the amount of kilowatts produced would be 10 times as great as that now produced by TVA?

Dr. SZILARD. Yes; and I could express it in a different way. This amount that would be produced by burning 20 tons per year is equal to the total electrical-power production produced by utilities in the United States before the war. Now, after the war, the value is not 15, but 25 million kilowatts. It has increased.

Senator MILLIKIN. How many tons would you burn?

Dr. SZILARD. Twenty tons. The 20 tons per year mentioned above represent by no means an upper limit and we might produce very much larger quantities if we can find customers for the electrical power produced.

Senator TYDINGS. Let me interrupt you again. At some point in your testimony are you going to bring out the relative costs of producing the 20 tons of fissionable material as compared with the relative cost of producing the electric power as it is now produced for the whole country?

Dr. SZILARD. I am afraid that in order to make substantiated statements we will have to do it in executive session.

Senator TYDINGS. You do not have to give me your answer. You can come along in executive session and answer it.

Dr. SZILARD. Clearly I would not talk about it if I did not think it possible that 10 years from now it will be much cheaper, that uranium as a fuel will be much cheaper than coal; so in a sense that must be a possibility, otherwise I wouldn't talk about it.

Senator TYDINGS. In 10 years it is possible?

Dr. SZILARD. Well, I mentioned 10 years because we have to accumulate these substances first.

Senator TYDINGS. If we could accumulate it more rapidly, the time limit would be correspondingly decreased.

Dr. SZILARD. The uranium deposits of which we know at present will not represent a limiting factor for a long time to come and the quantity of uranium contained in as-yet-undiscovered very low-grade ores might be very large. The rate of growth of the atomic energy industry will be essentially controlled by two factors: the rate at which the production of fissionable substances will increase and by the rate at which we are willing to expand our electrical power installations.

During the "building up" period, or say in the next 10 years, it might be desirable to throw away the heat which is generated as a byproduct. By doing this we would reduce the amount of the necessary investment, because the cost of a steam plant and the cost of the electrical distribution system could be saved. Moreover, the fastest ways of producing fissionable material might not necessarily be those which permit the utilization of heat for steam production.

Senator HICKENLOOPER. Mr. Chairman.

The CHAIRMAN. Senator Hickenlooper.

Senator HICKENLOOPER. Your statement there that it might be well to throw away this heat for a period of time is made, as I understand it, because you think that we might not be ready to use the electrical power during that period, and therefore the construction of the plants necessary to use the power would be, at least for a period of time, a comparative waste of money?

Dr. SZILARD. Yes. If large stocks of plutonium are to be built up, we should not be slowed down by the large investments required in the utilization of the power. Also there may be engineering reasons why production might be faster if we don't insist on making steam.

Senator MILLIKIN. There is also a political situation involved there. In the production of coal we employ vast numbers of people. We employ many people that make dynamite and make the tools of the business. Many of our railroads are heavily dependent upon transportation of coal, and so we cannot have an overnight revolution.

Dr. SZILARD. Exactly. If the output of fissionable substances will increase in a geometrical progression as I have assumed it will, atomic power will not be an important factor in our power economy for perhaps 10 years. Then, rather suddenly—that is, within a few years—it might become a very important factor affecting our economic and monetary policy.

We might then make use of the building of atomic power installations for stabilizing our system of economy. In times when a depression threatens, electrification of our railways, based on atomic power plants, may be pushed with the support of the Federal Government, whereas in boom periods an expansion of atomic energy power projects might be discouraged by the Federal Government.

Senator MILLIKIN. Do you happen to have at hand the cost per capita of electrical energy in the United States at the present time?

Dr. SZILARD. No, I do not have. I know the total power production, and you could assume a price.

Senator MILLIKIN. That would be an interesting figure in order to determine how much of an effect it would have on our whole economy.

Dr. SZILARD. This might give you perhaps an idea. About 600,000 men are employed in mining coal. Therefore you see that if we could produce a substitute for coal—and atomic energy is no full substitute, because coal is used for other purposes also—we could not save more than the labor of 600,000 miners and the cost of transportation.

Senator MILLIKIN. It has been testified that to use this energy for peacetime use takes us about three-quarters of the way along the road to its use for wartime purposes. Therefore we have a balancing problem, it seems to me, here in the committee that goes far beyond whether the production of atomic energy for peacetime purposes is desirable in and of itself, considered simply in a vacuum. We have to consider that in relation to many other things, and therefore I should like to know how much we could save through the peacetime use of this atomic energy over our present methods of producing energy, for that obviously would be one of the balancing factors that we would have to keep in mind.

Dr. SZILARD. My next paragraph makes a comment on that question to some extent.

Dr. Urey and Dr. Langmuir have pointed out to you that inspection, as it might be set up under some international arrangement, might be more difficult if atomic power plants were built on the territory of various sovereign nations. I believe it may be possible to overcome such objections. There is however, a more serious objection which will have to be scrutinized. It relates to the situation that the United States and other nations would face if, after a number of years—during which inspection may have been successfully practiced—one of the major powers suddenly abrogated the arrangement under which the inspection system had been operating.

Considerations of this sort induce me to raise the question whether we shouldn't contemplate the concentration of all manufacture of fissionable materials during the next 10 or 15 years on some internationalized territory. Since there would presumably be no market in such territory for the vast amounts of electrical power that would be generated, most of the heat that appears as a byproduct of the manufacture would have to be thrown away. I wish to point out, however, that this might not be such a very great sacrifice, and perhaps it would be no sacrifice at all, in the light of remarks made earlier in my statement.

In building such factories in an internationalized territory, we would look toward the time when the fissionable substances accumulated in the next 10 or 15 years could be made available. In 10 or 15 years, if the international situation permits, they might safely be distributed to be burned in electrical power plants located in the United States and in other countries.

This terminates the first section.

The CHAIRMAN. Dr. Szilard has said that his statement is divided into sections, and he informed me that he would like to have questions on each section as he finished it rather than go through to the end.

Senator Hart.

Senator HART. Doctor, you have given us some figures which I assume have to do with the theoretical possibility of development of power.

How far have you yourself, or those with whom you have been associated, thought through as to the practical means of using this power which you say is theoretically possible?

Dr. SZILARD. Well, this is again a question which I would much prefer to answer in executive session, because I cannot substantiate anything I say here.

There is this unfortunate situation, and I am glad to have an opportunity to say it. We have two kinds of secrecy: Information relating to technical details, engineering details—

Senator HART. That is not my question. I am asking you if you have thought it through and are ready to present something which is anywhere near as specific as the theoretical possibility you have given us?

Dr. SZILARD. I have thought it through much further than would appear from my testimony given in open hearing.

Senator TYDINGS. I would like to ask a question, either now or in executive session, as you prefer.

Are you in a position to give us your opinion, weighing the advantages of the peacetime use of atomic energy as against the disadvantages of the wartime use of atomic energy, as to whether or not it is desirable to take the risk of using it for peacetime purposes, assuming that you have—by using it in peacetime—gone 75 percent of the way toward manufacturing the atomic bomb?

Dr. SZILARD. I feel about this exactly as Dr. Urey and Dr. Langmuir feel about it. If, by giving up peacetime applications, we can appreciably facilitate the setting up of a peace system for the sake of security, I would very gladly renounce the use of that atomic power in the next 10 or 15 years.

Senator TYDINGS. In other words, I take it from your answer that, assuming that the international situation as projected in the future does not lend itself to the control of atomic energy for wartime uses on what might be called a satisfactory basis, you would prefer that the whole thing be prohibited if possible?

Dr. SZILARD. Yes.

Senator TYDINGS. To the end that the liabilities might be greater than the assets?

Dr. SZILARD. Yes.

Senator HICKENLOOPER. As a step in that direction, Doctor, as a scientist and with what knowledge you have of the history and present activities of international science, do you believe that science or even countries will stop the examination and exploration into the atomic energy field by any treaties or agreements?

In other words, will science stop investigating this great new field that has opened up here, or will they continue in spite of anything with that as a natural field of scientific investigation?

Dr. SZILARD. I believe that it would be very difficult and would be undesirable to stop scientists from further acquiring knowledge, but the direction in which science goes may be influenced by the political situation. For instance, I do not believe that good scientists in

the United States would, under favorable conditions, work on that phase of the scientific problems which relate to the making of bigger and more destructive bombs. That line would not be pursued because it is not very interesting from a scientific point of view and will be pursued only if it is necessary for political reasons.

Senator MILLIKIN. The bombs already made are big enough, aren't they?

Mr. SZILARD. They are big enough for my taste.

Senator HICKENLOOPER. The point I am trying to ask about is this: Even granted that it might eventually be desirable to try to eliminate all of this production of fissionable materials, do you think that in the face of prohibition science will stop investigating it?

Dr. SZILARD. No. I do not envisage control, which has been discussed, as control of knowledge. I envisage control as control of manufacture. I do not believe that control of knowledge is desirable.

Senator HICKENLOOPER. You get down to this point: Your answer to Senator Tydings, as I interpret it, indicates that you advocate the control of the volume production or the abandonment of volume production; but in your answer to me you state that it is your opinion that science will go on investigating the scientific possibilities of this thing; so the two answers, as I understand it, would mean that about all we could do would be to try to abolish the physical production, but the scientific investigation and enlargement of this field from the standpoint of science would go on in spite of anything we can do.

Dr. SZILARD. I think so.

Senator TYDINGS. I take it that your answer to my question comes from the knowledge that no solution is likely to be 100 percent or perfect, that no solution is likely to come for our protection from the use in war which will be watertight, which will be perfect, and your quest is to find, of the many avenues we might explore, which one seems to offer the most promise for a continuance of civilization?

Senator TYDINGS. Therefore, I take it that your answer meant that unless there was an international climate created which would make the control of the bomb or the elimination of the bomb, whichever it might be, reasonably feasible with a promise of safety that, as an alternative, it would be better if we could have an agreement that nobody would manufacture atomic energy even for peacetime purposes, because it would be so easy to slip over into the field of war purposes. Am I correct in what I have said?

Dr. SZILARD. Yes; precisely.

The CHAIRMAN. I take it that your testimony in this first section, together with a couple of other lines of testimony that you indicated you would rather give in executive session, is designed to inform the committee what we would be giving up if we made such an arrangement?

Dr. SZILARD. Yes.

The CHAIRMAN. In other words, before we can determine whether or not we are, as far as we are concerned, going to give up this use, we ought to know what we are giving up in the way of peacetime use?

Dr. SZILARD. Precisely.

The CHAIRMAN. Which will also inform us better as to the chances of other countries giving it up that might need power a great deal more than we might need it?

Dr. SZILARD. Yes.

Senator HICKENLOOPER. We learned about 3 years ago definitely that fission was possible, I believe. I think that it was somewhere in that neighborhood. In other words, as I recall it from the testimony in open hearing, it was only a step of approximately 2 years, or maybe less, from the theoretical or experimental proof that fission was possible until we began to produce the material in volume, that is, in amounts practical for war purposes.

I don't know the exact time, but I think the testimony showed that early in 1940 we confirmed the fact that it was possible, and the bomb was dropped in the summer of 1945, so that sometime between that time from experiment to production was a period of 2 or 3 years at the outside.

Therefore, if experimentation goes on, it is reasonable to assume, is it not, that we may discover ways of making this material much more quickly and much more efficiently; that is, the bomb material? Therefore, if experimentation goes on in the world and we attempt to control the physical production of it, and some nation wanted to abrogate its agreement and make the material in secret, it is entirely possible that in 10 or 15 years they could make that actual material, set up the plants and make it in a far shorter time than we did from the time we started in this war?

Dr. SZILARD. Yes; particularly if atomic power installations are in existence in that country at that time. Particularly, if there is an existing atomic energy industry utilizing uranium, then the time from abrogation to production of bombs will be even shorter.

Senator HICKENLOOPER. Let's assume that we try to outlaw, or agree among nations not to make this fissionable material in any quantity at all. If any nation wanted to abrogate that agreement, it still would only be a matter of a year or two during which they could build plants and actually make it in violation of their agreement. Wouldn't that be true?

Dr. SZILARD. If any of the major powers would abrogate an agreement, this would be true. I think a minor power would take longer.

Senator HICKENLOOPER. Therefore, as long as experimentation and scientific delving into this field goes on, we run the possible danger that some country may abrogate and in a short time actually make the fissionable material based upon their scientific advancement and investigation. I say we run that chance.

Dr. SZILARD. If the country abrogated and made these materials, of course we would know of it and make it also; and then we would be in an arms race.

Senator HICKENLOOPER. Now, then, if we permit the manufacture of this fissionable material for power purposes in the future and try to limit it to that, there still is about a 25-percent, I believe, greater step beyond the production of that until we make the bomb. I believe that has been testified to here.

Dr. SZILARD. Well, I would not call it 25 percent. I would simply say that if such power plants exist, the time lag between abrogation and production of bombs is very much shorter.

Senator HICKENLOOPER. It is very much shorter, but it couldn't in any event be much more than half; let us say we halved it, let us say a year shorter.

Dr. SZILARD. It could be even shorter than that; it might be 6 months or 9 months.

Senator HICKENLOOPER. Anyway, what we are dealing with between the end of scientific investigation and the production of material would reasonably be, say, 2 or 3 years. In other words, we did it.

Dr. SZILARD. Yes.

Senator HICKENLOOPER. The time between the production of fissionable material for power purposes and the production of a bomb would be a substantially shorter time than that?

Dr. SZILARD. Yes.

Senator HICKENLOOPER. Therefore, we are only dealing with a matter of a couple of years at the outside.

Dr. SZILARD. I would not accept that analysis for reasons which are contained in another section. I don't know whether you want me to pursue it now.

Senator HICKENLOOPER. I am not trying to get you to pursue any technical things of that kind. I am trying to get from your testimony that what we are dealing with is only a matter of 2 or 3 years in any event if any nation wants to abrogate, and a much shorter time if they have the uranium already made.

Senator TYDINGS. He said possibly 9 months.

Senator HICKENLOOPER. If they don't have the material, don't use it for power but still go into the experimental field, perhaps 2 or 3 years, somewhere along in there?

Dr. SZILARD. Precisely.

Senator HICKENLOOPER. The time from the scientific investigation on the production of a bomb either way would be a maximum, let us say, of 2 or 3 years; considering advancements, at a minimum of say 6 to 9 months.

Dr. SZILARD. I would agree.

The CHAIRMAN. Which means, in order to get 2½ years of time in which to try to settle any international difficulty that might come up, in order to get that time you would be willing to forswear any peacetime application of it?

Dr. SZILARD. Yes. I think there is a very great difference between 6 months and 2½ years, in case of an actual abrogation. If such a situation arose, the difference between 6 months and 2½ years is precisely this: If we have 2½ years, we can relocate some of our industries; we can disperse some of our population. You cannot do that in 6 months' time, and that is a very great difference.

The CHAIRMAN. Doctor, this may get you into the next part of your statement, and if so I will wait.

Assuming that an inspection system was provided and an agreement went with it that any violation of the inspection system was an act of aggression and that when that act of aggression occurs the nations of the world would have to move to protect themselves against the offender, would you not think then that 6 months or 9 months, which is the time it takes to convert from a fissionable material to a bomb, was sufficient?

Dr. SZILARD. That depends on how much stronger the nations of the world together are than the offender.

The CHAIRMAN. And also it would depend upon the nations of the world being willing to act immediately when an act of aggression, as defined under the treaty, was committed, does it not?

Dr. SZILARD. Yes, but let us assume a very unlikely case just for the sake of argument. Let's assume the United States would be the offender. I believe that the United States could be stronger than all of the nations of the world together in such a case. I am not even sure that Russia couldn't be stronger than the other nations of the world together, assuming at the time of abrogation a high standard of atomic power industry. . . Therefore that solution which you outlined is not so simply achieved.

The CHAIRMAN. You see, Doctor, I am struggling for some way out of the burying, for the first time in man's history, of something that promises an increase in the wealth and productivity of mankind. Do you see my difficulty?

Dr. SZILARD. I am aware of the difficulty.

Senator HART. Doctor, to clear up one thing for the record, in your answers to Senator Hickenlooper I think as the record now stands you are understood as saying that some other nations, some nation other than us, could, if they started now, have atomic bomb armaments within 2 or 3 years.

Other scientists in open hearings have given much greater figures. Is that the way you wish your answer to stand?

Dr. SZILARD. No, I haven't understood the Senator's question that way.

Senator HICKENLOOPER. I tried to preface my question on the advancements of science in the next 10 years in these countries so that they might get to the point where they could do it.

Dr. SZILARD. I understood him to ask what would be the situation if 6 or 10 years from now a country abrogated, assuming knowledge of this field is widespread, and started making atomic bombs, how long it would take them; and there I agreed with an estimate of 2 to 3 years.

Senator HART. But you assume no particular difficulties in their acquiring the industrial capacity to do the work which the scientists laid out?

Dr. SZILARD. No, I don't assume any such difficulty, and I am going to talk about that in another section.

Senator TYDINGS. Doctor, I hope you will do that, because a great many men, better informed in science and industry than I ever hope to be, in my humble judgment in the light of the achievement of some countries during the recent war, have woefully underestimated their potential capacity for the development of this instrument, and I don't believe any of those gentlemen who have testified are reasonably familiar with some of the conditions that exist in some of the countries. Many of them have never been there. They have certainly failed in my judgment to evaluate what has occurred in the last 20 years in some of these countries, and I am left a little cold by the fact that it is going to take as long as many of the people who have testified in open hearings think it will take to achieve a degree of efficiency which is necessary in the manufacture of this instrument.

Dr. SZILARD. If I may be allowed to read section 4 [referring to prepared statement] which relates to this question, that will contain my answer.

The CHAIRMAN. Before you go into that, Doctor, I would like to ask you one more question. You stated that one of the methods that might be suggested would be to have this manufacture of fissionable material in an international territory, in some desert part of the world, where no heat would be even useful.

Assume that that was done, and then assume an abrogation of the treaty under which it was set up. Can't you foresee the greatest Storm of Gethaim that ever was in the nations trying to get at that site first?

Dr. SZILARD. Yes, but that site might be exceedingly vulnerable to bombing attacks from the air, and could be destroyed by any one nation, by any of the major powers. It could be mined in advance and blown up.

Every power that has a veto right could have the right to blow it up at any moment after giving half an hour's notice for everyone to get out. I think it is entirely feasible to make the site so vulnerable that any of the major powers who wanted to destroy the site could destroy it.

The CHAIRMAN. You say if they gave half an hour's notice. The very giving of the notice by country A, if country B were suspected, would give country B time to marshal its forces and see that it wasn't blown up and grab control of it.

Dr. SZILARD. If every factory is mined, and if every major power has a key to the button or number of buttons to blow up those mines, it would be very difficult to save the factories.

Furthermore, you might not provide in that site for any facilities which are needed for the chemical work on uranium. You might have two sites, one in which you manufacture it and another to which you transport it, chemically work it, and transport it back again, so that the possession of that site alone would be of little value.

You see, in a sense plutonium protects itself against aggression by becoming exceedingly radioactive. No one could just go there and get it. It takes elaborate equipment, and that equipment need not necessarily be on the same site.

I have not thought through this proposal very carefully. I just wanted to indicate that we ought to think somewhat along that line, and see if that is not a possible solution in order to get a compromise between, say, Dr. Langmuir or Dr. Urey, who would be willing to give up atomic power, and those who would not like to do anything now which will deprive us from atomic power 10 years from now.

Senator TYDINGS. Let's assume that we do not give up atomic power, or that we cannot give it up, either way; and let's assume that, 10 years from now, after we have used every reasonable precaution, that the atomic bomb will neither be made nor used, but we have under certain international agreements tried to permit and control the use of atomic power for peacetime purposes; at the end of the 10-year period, some nation abrogates its agreement and decides upon war.

In your opinion, would we have not been better off to have tried to eliminate the peacetime use of atomic power as against that future contingency?

Dr. SZILARD. Yes; we would have been better off.

Senator HICKENLOOPER. Mr. Chairman, may I ask the doctor this question, which is political?

Let us assume that we have agreements not to make the fissionable material into bombs. Let's assume that has gone on for some years, and let's assume that an association of nations has a stock of these bombs, and this morning that association of nations finds out that some nation is actually in the process of making this material for bombs.

Just as an individual now, and not necessarily as a scientist, would you say we should send a cablegram to them and say, "You will either let us in there to destroy this material that you have made by noon today or by tomorrow morning, or we will drop an atomic bomb on you," or what would be your proceedings there? How fast should we act? How fast should we use the complete force of the atomic bomb to stop someone else from violating the agreement?

Dr. SZILARD. Under the assumption you made that we have a stock pile of such bombs in the hands of the international agency, there would be no sense in having the stock pile unless the intention was to use it. In that case it should be used as fast as necessary.

But I would not go so far as to say that I favor your assumption, namely to have such a stock pile.

Senator HICKENLOOPER. I wasn't asking you whether you favored it or not. I was assuming that was the condition. Then what would be our step?

Dr. SZILARD. I think that it should be used as fast as necessary because otherwise there would be just no point in having it. Certainly there would be no better case for using it than a violation of such an agreement.

Senator TYDINGS. Doctor, in the event that all the world is disarmed except the international police force, which is under the direction of the UNO, and in the event that army is equipped with such battle-ships and field pieces and airplanes and atomic bombs as evolution decides is wise, and in the event that international police force is composed of component parts of the United States, Britain, France, Russia, and so on, if you had the atomic bomb, what would stop that segment of the international police force which comes from the country to be attacked from trying to seize the atomic bombs first so that they couldn't be used by the international police force?

Dr. SZILARD. I do not know what would stop it. It depends very much on how the whole thing is set up and organized; without knowing, so to speak, the blueprint of the organization I couldn't answer that question.

Senator TYDINGS. Eliminating the atomic bomb, of course, they could not seize enough airplanes or field guns or anything else to make it decisive. The atomic bomb weapon would be the one weapon that would be more decisive, let us say, than all of the others put together if they were in quantity.

If you do have this international police force, you have almost got to have another one to watch the international police force to keep them from trying to steal these few bombs that are actually in existence in the event of any international emergency, haven't you?

Dr. SZILARD. There are difficulties of this sort. I am not sure that you cannot overcome them, but I, too, am somewhat disinclined to see a weapon, which is clearly a weapon primarily designed for the destruction of cities, used as a police weapon. It is not a police weapon.

Senator TYDINGS. I don't want to interject any political note in this, and I have no idea of doing it, because every suggested solution ought to be weighed carefully.

I understand that Captain Stassen has advocated in general terms that all atomic plants and bombs be more or less eliminated, except for five that would be stationed at five different places on the face of the earth, with supplies of bombs for use of an international force. Implied in his statement is, of course, the thought that all other nations would disarm so they would be inferior to the international force; otherwise there would be no point in having it.

Now, if disarmament is to take place all over the earth and the only real strong force is to be the international police force, why is it necessary for the international police force to have any bombs at all? Why can't they retain order with such battleships, cruisers, airplanes, and demolition bombs, and so on, as they would have without the atomic bomb?

Dr. SZILARD. Well, I believe the thought behind the Stassen plan is this: In spite of inspection, perhaps a country might be able to secure a small number of bombs. They wouldn't be able to make many bombs under inspection, but they might make 10 or perhaps 20.

If the international authority has also a small number, those 20 bombs which the aggressor has will not be of very great use.

Senator TYDINGS. So you would need a supply of atomic bombs, just in case some other nation attempted to make them, so you would be on equal or better terms with the nation who had violated the international agreement, so to speak?

Dr. SZILARD. I believe that is the thought behind the plan. My feeling is that none of these plans sound very good, but none of them ought to be discarded until we find a better one.

Senator TYDINGS. That is my attitude. I didn't say what I said in any criticism, but simply to help my own thinking.

Senator MILLIKIN. Mr. Chairman, may I ask: Have we anyone on the agenda to tell us of the possible medical contributions?

The CHAIRMAN. Yes, we do. We have Colonel Warren, who is supposed to be the outstanding authority on radioactive materials in their relation to the field of medicine.

Senator MILLIKIN. That, of course, would fit in perfectly with what I thought you were expressing very well, as to what we are giving up if we were to put a freeze on all of these operations, Mr. Chairman.

The CHAIRMAN. Exactly. That is to come later, Senator.

All right, Doctor.

Dr. SZILARD. In answer to the question of how long it would take other countries to make bombs, perhaps I can read a short section, section 4 [referring to prepared statement].

What are the essential factors which enter into the consideration of this question?

As far as the production of plutonium is concerned, which is described in the Smyth report, any competent mechanical or chemical engineer who spends some time thinking about the problem can see that no precision work is involved in the manufacture of plutonium.

The CHAIRMAN. No mechanical precision work?

Dr. SZILARD. No mechanical precision work is involved.

The design which we actually used did require rather narrow tolerances and high-class workmanship. This we could afford because we have this kind of workmanship in abundance.

Naturally, a country like Russia need not choose just this kind of design, but might prefer a design which does not require high precision work. The statement has been made before this committee by another witness that it requires high precision workmanship, such as can be provided only by a few countries, including Switzerland, to make atomic bombs. As far as the production of plutonium is concerned such a statement would have no basis in fact.

Senator TYDINGS. What do you mean by that? Do you mean that the production of plutonium in itself is not a difficult problem, and therefore the people who say that plutonium cannot be manufactured by this or that country are not guided by the facts in this case?

Dr. SZILARD. That is my view. I am not making any statement about the separation of light uranium, but only about the making of plutonium, and I am not making any statement about the construction of the bomb; but it was indicated here in earlier testimony that it was not the bomb but the production of the fissionable material which is difficult. I flatly contradict that statement as far as plutonium is concerned.

Senator TYDINGS. That is very important, that the raw material, as I shall call it, the plutonium, can be manufactured by any competent scientist and mechanical engineer working together with others without any very great or what you might call insurmountable difficulty.

The CHAIRMAN. Doctor, before you go on, the plutonium is made at Hanford, I believe.

Dr. SZILARD. That is right.

The CHAIRMAN. Under the graphite piles as described in the Smyth report?

Dr. SZILARD. That is right.

The CHAIRMAN. And that process you say is not mechanically difficult?

Dr. SZILARD. That is right.

The CHAIRMAN. Now, that is quite a different thing from the separation of 238 and 235 that goes on in the diffusion process, the thermal process, and the spectograph process at Oak Ridge?

Dr. SZILARD. It is.

The CHAIRMAN. They are mechanically much more difficult than the pile process at Hanford?

Dr. SZILARD. Some of them are, but the others may or may not be. I do not want to make any statement about any of them, because my knowledge is not sufficient to take the responsibility for making a statement about them.

Senator TYDINGS. But you do leave your original statement stand as to plutonium?

Dr. SZILARD. Yes.

Senator MILLIKIN. Are you going to develop that theme now, Doctor?

Dr. SZILARD. Yes, a little.

As far as the production of plutonium is concerned, I see no reason why any country that is capable of industrial development should not be able to build plutonium factories. It is true, though, that a

certain amount of uranium is required for such factories, and the question therefore arises whether or not Russia has available uranium ores.

This question has been discussed at a previous hearing. The deposits in Czechoslovakia which might supply ore to Russia I would not class as important deposits, nor do I believe that any of the Russian deposits of which there is public knowledge in this country can be considered as important. However, it would be exceedingly foolhardy to assume that in the vast territory which is accessible to Russia no adequate deposits of low grade ores could be found if prospecting for such ores is carried out in earnest.

How long would it take the Russians to produce plutonium in substantial quantities?

When Germany attacked Russia I thought that Russian resistance would collapse within 3 months. With such a past record as a prophet with respect to Russia, I think I ought to disqualify myself from answering this question.

The CHAIRMAN. I might interrupt you to say that certain other people ought to disqualify themselves on the same basis.

Dr. SZILARD. If any of your other witnesses have a better record in this respect, let them disclose their record together with their forecast.

Senator TYDINGS. If you don't mind my interrupting you again, because I do think it is important, I think pretty nearly everybody is in the same class with your prophecy. When Germany attacked Russia, most everybody that I had any contact with, all of the press and all of the seers, thought that Russia would go down in about 3 months, and that is one of the reasons why I think they are still underestimating a country which has demonstrated its tremendous ability to coalesce with tenacious will, to keep on with whatever it wants to do.

I am awfully glad you brought that point out, because I do not think we have been cured of that disease yet in this country and all over the world.

Dr. SZILARD. It is a natural tendency to overestimate our own achievement, both as individuals and as a nation, but it would be very unfortunate, indeed, if by underestimating what others can do the people of this country were lulled into a false sense of security.

I may give you, perhaps, an example of the ease with which we can underestimate others.

In the production of plutonium there is another process involved beyond mere manufacture. Plutonium has to be chemically separated from the uranium in which it is produced. You might think that it is very difficult chemically to separate an element if you do not know well the chemistry of that element, and plutonium is a new element. The Manhattan district was apparently of this opinion.

Interpreting very narrowly the directive of the President, the Manhattan district gave us orders not to discuss with the joint British and Canadian project set up in Canada the chemical separation of plutonium. We had a good method, of which we were very proud, and we were not supposed to explain this method to the Canadian project.

This annoyed our British friends, because it compelled them to duplicate our work, which they thought was an unnecessary waste of their time.

The result, however, was, as I have been told by two reliable scientists, that they have worked out a method for separating plutonium which is superior to the one which we are using. It is both much simpler and more complete.

You see, there is an example of how easy it is to believe that what we have done and what seems so difficult to us is something that others cannot do or cannot improve upon.

Senator MILLIKIN. Mr. Chairman, I may say that the witness' testimony so far has reversed a number of tentative conclusions that I had reached, and I hope if there is any rebuttal to what he said it will be brought before us promptly, because it seems to me that he has struck right at the heart of a number of our problems.

The CHAIRMAN. That is right.

Senator TYDINGS. There is no doubt about it.

Senator MILLIKIN. Don't you think we ought to get somebody in here and get an answer, if there is one?

The CHAIRMAN. I suggest to the War Department representative who is present that he get a transcript of this testimony as quickly as he can and submit it to General Groves for such observations as General Groves cares to make on it.

Dr. SZILARD. I do not know how much more time I shall take. I have three more sections which I might read.

The CHAIRMAN. I think you had better go right ahead, Doctor.

Dr. SZILARD. With your permission, I would like to make a few remarks on preparedness, what this word means if we take the word seriously. Those who believe that we have practically no chance of arriving at an international solution are naturally led to think of a solution either in terms of "preparedness" or else in terms of a preventive war.

As far as "preparedness" is concerned, just what is it that we have to be prepared for? If preparedness is necessary, it is necessary because we consider Russia as a potential enemy and for no other reason.

The CHAIRMAN. We are thinking of her as potential friends, and not potential enemies.

Senator TYDINGS. You are just investigating, without throwing any reflection on any country, different contingencies that might happen in the future?

Dr. SZILARD. If we want to be prepared, we have got to know what we want to be prepared for. We want to be prepared for a potential enemy, and in our computations at least we should consider who that potential enemy might be; otherwise, we don't know what the measures are.

This does not imply on my part that Russia might attack us. I am simply analyzing what "preparedness" on our part might mean. We are afraid of Russia, not because she has atomic bombs; we are afraid of Russia because we have atomic bombs.

It is a very peculiar situation.

If we assume that Russia will be building up a stock pile of atomic bombs just as we are at present building up a stock pile of atomic bombs, we assume an arms race. It might, perhaps, be possible for us to have at any time ten times as many bombs as Russia and possibly also to have larger bombs than Russia, but in spite of this we would lose ground steadily in such an arms race on account of the

fact that we have very large concentrations of population located as easy targets for attack by atomic bombs. Moreover, Russia could, and I believe she would, if such an arms race got seriously under way, relocate within a few years the population of her large industrial centers.

Let us, therefore, be quite clear as to what the term "preparedness" means. It means a stock pile of atomic bombs. It also means a large navy and a strong army. These are important, because a war that starts with attacks on our cities by means of atomic bombs will have to be ended, assuming that we are going to win it, by invading the territory of the enemy. But if atomic bombs must be expected to be available in quantity in the hands of the enemy at the outbreak of the war—and no country is going to attack us unless she has such a stock pile of atomic bombs—getting prepared means also the relocation, in time of peace, of 30 to 60 million people, together with the industries which they serve and which serve them.

The CHAIRMAN. You are talking about digging holes now for people to go down into holes?

Dr. SZILARD. Not quite. I think I will be more specific about it, and give you some figures of cost which we have studied.

The CHAIRMAN. I hope you will leave us above ground; that is all.

Dr. SZILARD. I leave the houses above ground, but I am afraid I will have to put some factories and some railroads underground.

I, for one, do not contemplate with equanimity the death of possibly 40,000,000 people in the United States at the outbreak of war. Senator Tydings asked Dr. Bush to comment upon the possibility of such a contingency and was told that this sounded like a story by Buck Rogers or Jules Verne. Maybe this is a Jules Verne story, but by the same token you might call the story of Hiroshima an H. G. Wells story, and, as a matter of fact, Wells wrote a story about atomic bombs and their use in 1914.

There is one significant difference, however, between these two stories. It took man's ingenuity and imagination to translate the story of H. G. Wells into reality, whereas it will take only man's lack of imagination to make this Jules Verne story come true.

However distasteful it may be to us to contemplate such a large-scale relocation of population, we have to face the fact that without it there can be no policy of "preparedness" which makes any sense at all.

I quoted a figure of 30,000,000 to 60,000,000 because about 30,000,000 people live in cities of over 250,000 and because 63,000,000 people lived in metropolitan areas before the war.

If we had enough time, say 10 years, to bring about this relocation, it would be a very expensive proposition, but at least it would be a feasible one. Dr. J. Marschak, of the Cowles Commission at the University of Chicago, jointly with Dr. Klein, also of the Cowles Commission, estimates that with a yearly expenditure of \$20,000,000,000 we could relocate 60,000,000 people in 10 years and make this country considerably less vulnerable.

Senator MILLIKIN. Would that be a figure for the actual relocation, or would it also include the losses from the relocation?

Dr. SZILARD. What kind of losses, sir?

Senator MILLIKIN. Well, if I have a factory in Senator McMahon's State, it might cost me \$100,000 to move that factory out into a less

populated district. That is one feature of cost, but it also results in a capital cost, and many other factors in moving. Is this a mere moving figure, or does it include compensation for the other losses involved?

Dr. SZILARD. I would put it this way. If your old factories and houses were all dynamited, except for the equipment and the machinery, then \$20,000,000,000 per year spent for 10 years would build up all these factories and houses again in the new location.

Senator MILLIKIN. That is a moving and reconstruction cost?

Dr. SZILARD. Moving and reconstruction. They say that our economy could stand this expenditure without any appreciable reduction in the standard of living during the transition period, and they also say that the volume of the construction industry would have to be expanded only slightly above its peak volume in the year 1942, so you will see that you cannot say it is just physically not possible. Physically, it is possible.

It seems to me that those who think in terms of preparedness and talk in terms of preparedness to the American people ought to talk in terms of a peacetime expenditure for preparedness of more than \$20,000,000,000 per year. This amount may be not enough since we may not have 10 years in which to prepare.

Senator TYDINGS. Before you leave that subject, is the transmission of an atomic bomb by an individual by hand feasible?

Dr. SZILARD. You mean moving an atomic bomb from one place to another?

Senator TYDINGS. Carrying it from one place to another.

Dr. SZILARD. It would have to be dismantled if you wanted to take it in a suitcase. The amount of fissionable material could be easily transported in a suitcase.

Senator TYDINGS. How long would it take to dismantle it and reassemble it again?

Dr. SZILARD. One could do it by making several trips.

Senator TYDINGS. Or six men in one trip?

Dr. SZILARD. Using a truck they could do it.

Senator TYDINGS. You don't rule out the possibility of surreptitiously using the atomic bomb if people have the ingredients and the "know how" to put it together?

Dr. SZILARD. Yes; if the organization of a nation is put behind it. I do not believe bootleggers could do it.

Senator TYDINGS. You don't think that is Jules Verne at all?

Dr. SZILARD. No.

Senator TYDINGS. You think that is well within the realm of possibility?

Dr. SZILARD. Yes.

The CHAIRMAN. Doctor, you made an observation about putting certain railroads underground. In view of your answer to Senator Tydings, the possibilities of sabotage below ground would be even more drastic than if the same railroad were on top of the ground, it seems to me.

Dr. SZILARD. Relocation would not help at all, as far as sabotage is concerned.

The CHAIRMAN. In fact, my point is it would be easier to sabotage underground installations than it would on top of the ground, because you would have, we will say, 500 miles of railroad underground, and

if you brought down 100,000 tons of dirt along 10 miles of it, it would be harder to repair than if you blew up the same mileage above ground where you could possibly track around it.

Dr. SZILARD. I was not thinking of putting railroads generally underground; I was thinking primarily of putting certain city railroads underground.

I think the destruction of a city or the destruction of a railroad would be equally easy if you assume sabotage.

Senator TYDINGS. Doctor, as I listen to your testimony as a layman in the field of psychology, I am impressed with the fact that what those concerned with this need more than anything else is, as you have termed it, more imagination; that the avenues of possibility of this are so numerous and the development of it is so full of potentials that one must more or less use his imagination to the *n*th degree in order to comprehend what might be involved.

Is that an erroneous statement?

Dr. SZILARD. No; I think it is correct.

Senator TYDINGS. The one thing we need to understand is the ultimate possibility of this new instrument.

Dr. SZILARD. I think so.

Since time is getting short, perhaps I may read just a part of section 5.

Senator HICKENLOOPER. I understand that your entire statement will be made a part of the record?

Dr. SZILARD. Yes, I will hand in the entire statement.

In thinking about an international solution of our problem, we may take encouragement from the fact that at least as far as the United States is concerned, this question has not become a political question in the ordinary sense of the word. It seems to me that the essential difference is not between Democrats and Republicans, or Progressives and Conservatives, but rather between two schools of thought.

According to one school of thought, two powerful countries, like, for instance, Russia and the United States, could both have a large stock pile of atomic bombs and have the means to deliver these bombs to their distant targets and yet a durable peace could exist on the basis of fear of retaliation.

According to the other school of thought, such a situation would inevitably lead to war and war would break out even if neither of the two countries wanted it, more or less automatically as a result of the arms race. I myself believe this to be true. Perhaps, if through some freak accident both countries were exactly equally strongly armed with bombs and equally vulnerable to bombs, peace could be maintained since in that case the bombs which would fall on the cities of both nations at the outbreak of the war would not materially shift the balance of power of two such countries. Conditions of this sort, however, can hardly be expected actually to arise. In most cases which we can envisage, the balance of power will be considerably shifted during the first days of the war either because one of the countries has a much larger supply of bombs or more likely because one of the two countries is much more vulnerable to attack than the other.

In the conditions which actually exist, the greatest danger which faces us is a war arising out of such a situation between the United States and Russia. What can we do to avert this danger?

It seems to me that if the United States and Russia would set up an arrangement in which there would be no stock piles of atomic bombs in either country and no manufacture of atomic bombs on the territory of either country, such an arrangement could be extended without much difficulty to all major powers, as a matter of fact to all nations whose voluntary collaboration is necessary.

Let me be quite specific in the assumption which I am going to make. I am assuming that there is no essential change in the present set-up of the United Nations Organization, that the veto right of the great powers has not been abolished, but that Russia, the United States, and other nations have concluded an arrangement of the type outlined above and that they have reserved the right to abrogate that arrangement at any time.

Under these specific assumptions, we may scrutinize the following specific question: Could Russia and the United States within the framework of such an arrangement create conditions by means of which they could convince each other, and other nations, that secret violations in their territory would be detected and would become instantly known to the world?

I am giving an affirmative answer to that, and I am not going into any detail at this time. I am saying "Yes"; with some imagination, some experimentation, we could make reasonably sure that no secret violations would remain undetected.

The CHAIRMAN. Doctor, that is a subject in which I personally am deeply interested, namely, the scientific feasibility of control. Do you have a full statement on that?

Dr. SZILARD. I have a full statement which I would prefer to put in for the record rather than read it here now.

The CHAIRMAN. I just wanted to make sure we got that, because that is a very vital part of our inquiry, it seems to me.

Dr. SZILARD. May I read to you something appraising such an arrangement, assuming that we could detect secret violations?

What would be the good of an arrangement which could be abrogated?

Senator TYDINGS. Suppose you put in a provision that you could not abrogate it except on 5 years' prior notice so to do?

Dr. SZILARD. For certain reasons, I would prefer to give the large countries who have the physical power to abrogate also the legal right to abrogate in order not to have a discrepancy between legal abrogations and de facto abrogations. I believe it would be better not to have this distinction. I think as long as we have no enforcement, we should legally permit abrogation.

But what is the use of an arrangement that can be abrogated?

Well, this is my view on it: Clearly, in the absence of machinery for enforcement, an arrangement providing for adequate inspection cannot rule out the possibility of war, and, in case of war, sooner or later atomic bombs can be expected to drop from the sky. Yet such an arrangement, assuming that the inspection system functions satisfactorily as long as it lasts, in my opinion would be a long step forward because under such an arrangement war need break only if one of the parties to the arrangement actually decided to risk a war by abrogating the arrangement.

There are two questions which have not been touched yet which will require further examination: (1) What incentives would, under such an arrangement, Russia and the United States have for abrogating the arrangement after it had been in operation for a number of years, by invoking their legal right to abrogate which we have postulated they have retained? How could we diminish those incentives, if they existed? If there is no enforcement, our aim should be to remove incentives which would lead a large power to abrogation.

Another question which must be considered, and which I would prefer to discuss in executive session, is what would be the situation facing the United States if an abrogation occurred say 5 or 7 years from now, what restrictions should be imposed on atomic power and installations in order to make the time lag between abrogation and the production of bombs a long time lag?

At the time of abrogation, always assuming that inspection was reliable as long as it lasted, there will be, of course, no bombs available, but the question is how long would it take until bombs would be manufactured, and at what rate they would come out of the factories. The answer to this question depends to a large extent on whether or not electrical power installations based on atomic energy have in the meantime been erected on the territory of the United States, and on the territory of Russia. And if they have been erected, whether or not certain specific limitations have been imposed upon them which will make their conversion more difficult.

This brings me to the last section which, with your permission, I should like to read.

Senator HART. If that is the end of a section, may I ask one question, Mr. Chairman?

The CHAIRMAN. Certainly.

Senator HART. You mentioned when you began that there were two schools of thought. I personally have not heard any expression from the one school of thought which is contemplating both nations, ourselves or any other nation, not confining it to Russia, in an armament race where both sides possessed atomic bombs.

Have you heard any expression from that school of thought, Doctor?

Dr. SZILARD. Yes. In the transcript of Dr. Bush's statement, which I have not heard but which I read, Dr. Bush expressed the view that fear of retaliation would prevent the outbreak of war if two countries were equipped with atomic bombs.

Senator HART. And that is what you were particularly referring to in that?

Dr. SZILARD. The only testimony before this committee where this school of thought found expression was Dr. Bush's testimony; but I have heard that view expressed by other distinguished men, such as Professor Viner, of the University of Chicago, who thinks that two large countries both having atomic bombs could remain at peace because the fear of retaliation would prevent the outbreak of a war. This thought is prevalent, and very distinguished men belonged to this school of thought; but only Dr. Bush expressed that view before this committee.

Senator TYDINGS. This accounts largely for the view that the nation which takes the initiative and springs the surprise would have an advantage that is almost inestimable, assuming that their surprise attack was successful.

Dr. SZILARD. I am not sure that that advantage is not somewhat overestimated. Clearly, they would have this advantage, that they would not only destroy the cities but also kill the men in the cities. But after such an attack, retaliation would come, because we would launch our atomic bombs not from the cities, but from sites which are very well protected, so the cities of the aggressor would also be destroyed.

Senator TYDINGS. I don't take issue with what you are saying, but I am just expressing the fact that if you had 6 hours' advance to do your bombing as against the enemy, as against bombing the enemy, that the side which has the initiative, which does the bombing first when they are not looking for this attack to come would have a decided advantage over the retaliation, where they would know in advance that the retaliatory attack was coming and would be presumably prepared to interdict as many planes as possible, and other conveyances of the bomb.

Dr. SZILARD. That is certainly true as long as these large concentrations of population exist. It will no longer be true if the relocation and dispersal has occurred.

The CHAIRMAN. The aggressor nation would catch twenty or thirty million people in the cities that were attacked, and they would have their population pretty well dispersed and out of their centers of population.

Dr. SZILARD. Yes, that is right, and may I have permission to withdraw the answer which I gave to Senator Tydings. I think you are right and I was wrong. I think the aggressor would still have a great advantage even if dispersal were carried out.

Senator TYDINGS. And particularly if simultaneously with that visible attack there had been a preliminary campaign to smuggle, if that is possible, other atomic bombs that would even after that attack continue to wreak devastation here, there, and wherever it was appropriate throughout the country.

Dr. SZILARD. That would make it worse, but without it it would still be very bad.

Senator TYDINGS. You are keeping in mind always that the supposition exists in this country, and I believe it is reasonably predicated on fact, that because of a borderline of 3,000 miles to our north, another borderline of large dimensions to our south, with the fact that we are completely surrounded by water in all other respects, that there always has been a great deal more illegal immigration into the United States than perhaps into all of the other countries of the world combined?

Dr. SZILARD. Yes.

Senator TYDINGS. And that therefore the avenues by which the United States can be entered are 100 times more promising than would be the case in almost any other country of which you can conceive, and therefore the means of getting the materials into the country are correspondingly improved?

Dr. SZILARD. Yes.

Senator MILLIKIN. If I may add an additional observation, Senator: you might get across some border of a foreign country, but at once your movements become regulated. Once a man gets into this country, we don't have any of the precautionary devices which foreign

countries have to observe the movements of foreigners and their own people.

Senator TYDINGS. For example, as you probably know, and as I know Senator Millikin has in mind, if you go to Britain you are immediately given a question, no matter if you are a United States Senator: Why did you come to the country? Where are you going to stay? How long do you propose to stay? Where will you go? And so on. You are given a little interview besides.

If you go to France and want to go to a hotel, you fill out a paper, and so on; and that is sent to the chief of police every night. So it is all over the other countries; but when you come over our border, there is nobody here that knows whether they are Americans or foreigners, or what they are. There is no check-up at all; so that we have a country to which more people want to come than want to come to any other country in the world, and with less precaution against their coming than to any other country in the world.

The CHAIRMAN. Go ahead, Doctor.

Dr. SZILARD. [referring to printed statement]. This is Section VI, Remarks on Secrecy.

In the past, secrecy fulfilled an exceedingly important function and we might have lost the war if it hadn't been for the secrecy which the scientists imposed upon themselves in the early stages of the war. If the Germans had known in 1940 that a chain reaction can be maintained in a mass composed of graphite and uranium and if they had known a second fact, namely, that the plutonium produced in such a chain reaction is likely to be a fissionable substance similar to light uranium, they might very well have started an atomic bomb project in 1940; and, with their eyes on the ball, they might very well have brought it to a successful conclusion by the spring of 1944. They might have won the war before we had a chance to invade Europe.

The first of these two pertinent facts which I mentioned was contained in a paper which I sent to the Physical Review in February 1940, with the request that its publication be withheld. The second fact was emphasized in a paper which Prof. L. A. Turner, of Princeton University, sent to the Physical Review a few months later, and which he decided to withhold from publication.

Neither of these facts was known to the Germans at the time when the war ended, though they are public knowledge at present through the Smyth report.

Senator MILLIKIN. Do you agree with the conclusion of a witness that was here the other day that by the end of the war the Germans had not any organized program for making an atomic bomb?

Dr. SZILARD. Yes. The witness who was here was Dr. Goudsmit; and no one is as competent as he is to state that, because he was in charge of the group which went into Germany and collected all the information on atomic energy work.

Senator MILLIKIN. From which it follows that had our intelligence been better as to what was going on in Germany, we might not have evolved an atomic bomb at least during this war. It was sponsored and pushed on the theory that we were in a race with Germany to complete an atomic bomb.

Dr. SZILARD. I agree entirely with that conclusion.

Senator TYDINGS. Doctor, if in 1939 we had been conducting a hearing like we are conducting today, and men like yourself had come before our committee and projected the possible development of the bomb up to now with reasonable accuracy, I imagine they would have been called a lot of crackpots and a lot of visionaries who were playing with theories. I certainly would have not had the receptivity that I have today, to say the least.

So using that experience of the past, I take it that many people who hear the possibilities of this bomb described for the future are just about in the same position that we were all in in 1939 if we had had hearings on it then. Is that a fair assumption?

Dr. SZILARD. Yes, they would be incredulous, but with less justification.

Senator TYDINGS. Some people have to get burned twice in order to understand they have been burned once.

Dr. SZILARD. The point I am trying to bring out is that secrecy has been maintained by the voluntary cooperation of the scientists in 1940 when it was most important that secrecy should be maintained, and that if secrecy should again become important in the future, it can again be maintained by the voluntary cooperation of the scientists. To my mind willing cooperation on the part of the scientists is the only satisfactory and really effective way of maintaining secrecy both in the field of fundamental scientific information and basic engineering principles which are involved in the manufacture of fissionable substances.

I would like to make a few remarks on the compartmentalization of information.

Compartmentalization of information to which the scientists were and are still subjected was mentioned in Dr. Urey's testimony. It is a special technique which is used in the services for keeping secret military operations, and applied in its proper sphere it is an effective method for keeping secrets. Both its meaning and its effectiveness undergo a profound change when it is attempted to apply this special technique to research and development work.

As applied to scientific work, you may justify compartmentalization of information by pointing out that if a scientist knows not only how to extract light uranium from natural uranium, but also knows how to manufacture plutonium and if such a scientist is a traitor, then he can teach the enemy how to make both kinds of bombs instead of teaching him only how to make one kind of bomb. Or even better, if he knows only part of the story of how to make light uranium and nothing about how to make plutonium, he can give the enemy information, but that information alone is not sufficient to enable the enemy to make any kind of bombs.

Compartmentalization of information was practiced in the atomic energy project from the very first day on; that is, from November 1940 on, or before the Army was in the picture. The situation was not better when we had to deal with the NDRC, which had "to play ball" with the Army and Navy, than later on, when we had to deal with the Army direct. If anything, dealing with the Army direct appears to be preferable, since the Army is afraid only of Congress, while agencies like the NDRC are afraid of both Congress and the Army.

I shall be glad to demonstrate, if required, that compartmentalization of information was the cause for our failure to realize that light uranium might be produced in quantities sufficient to make atomic bombs. We should have known that in the fall of 1940. We might have failed to realize this altogether, just as the Germans failed to realize it, if we hadn't had the good fortune that the British scientists were not compartmentalized. They were able to put two and two together and communicated their conclusions to the United States Government in the middle of 1941. Had we in the United States reached these conclusions in the fall of 1940, we most likely would have had bombs ready before the invasion of Europe.

Senator TYDINGS. Doctor, if I am not interrupting you, I would like to ask you a question right there.

Suppose Hitler had assumed that this thing might reasonably be invented. Suppose that assumption had first come to him in 1939, and that he had then assembled all the available scientists and engineers that he had and said: "I want you to do everything possible to develop an atomic bomb, or an instrument of death more deadly than any you have with atomic energy. We will put at your facility every asset of this Government, every resource of this Government."

If that had happened in 1939, with the engineers, the scientists, and the materials and the industrial plants then available in Germany, would it have been possible under reasonably human conceptions for Hitler to have had the bomb preceding our own having it?

Dr. SZILARD. I am quite convinced he would have had it about 18 months before we had it.

Senator TYDINGS. He would have had it 18 months before us?

Dr. SZILARD. We could have had it 18 months earlier, and with their chemical industry they could have moved equally fast.

Senator TYDINGS. Why do you suppose that the scientists of Germany who were then loyal to the Hitler concept failed to impress this fact on Hitler's mind, that it was a possibility and that its devastating effects might decide the war?

Dr. SZILARD. They slipped up on one point, on which we slipped up also. They did not put two and two together. We did not put two and two together because the two two's were in a different compartment; they were not together. That is, the men working on that property of uranium from which they could deduce how much was needed for the bomb had no idea that you can extract light uranium in appreciable quantities.

Senator TYDINGS. How do you account for that break-down of putting two and two together?

Dr. SZILARD. In Germany I cannot account for it. It is true that they were split up in small groups, but they were not compartmentalized.

Senator TYDINGS. Do you think the very Nazi system itself might have destroyed the free interchange of ideas?

Dr. SZILARD. It might have been, but I have no really good explanation for it. I think it was largely a matter of chance.

Senator TYDINGS. Just luck?

Dr. SZILARD. It was luck. Well, the only man who thought fairly early that plutonium might be fissionable was a man who was an immigrant in Germany. He wrote a number of memoranda, but nobody paid any attention to it. He was an Austrian who spent a great deal

of time in Russia, and finally landed in Germany. He was the only man who proposed such a plan, and we know from the record that he proposed it.

The CHAIRMAN. Who was that?

Dr. SZILARD. Houtermans.

The CHAIRMAN. Do you know his first name?

Dr. SZILARD. I do not know his first name.

The CHAIRMAN. Do you know where he is now?

Dr. SZILARD. In Germany.

Senator TYDINGS. What part of Germany?

Dr. SZILARD. In the American section.

The CHAIRMAN. Doctor, you remember one bombing raid that the American Air Force conducted which killed 400 German scientists. Do you think that had any bearing upon their lack of expedition?

Dr. SZILARD. No; and I am not sure it did kill 400 German scientists.

The CHAIRMAN. That is what I read at the time.

Dr. SZILARD. That is what I read too, but I do not believe it.

Senator TYDINGS. Furthermore, they were supposed to be working on something else than the project we are now discussing.

The CHAIRMAN. You had something to do with getting some of the scientists out of continental Europe, didn't you?

Dr. SZILARD. To England, yes.

The CHAIRMAN. When did you start?

Dr. SZILARD. In '33.

The CHAIRMAN. And you made quite a project of that of your own in inducing people to get out of there, didn't you?

Dr. SZILARD. It did not take much inducement.

The CHAIRMAN. But at any rate, whatever it took, you offered, didn't you?

Dr. SZILARD. I wouldn't say that my role was to induce them. I was in England at that time, and I tried to do my best to find temporary positions for younger men in England who wanted to leave Germany. Many of those later came to America.

The CHAIRMAN. Why did you take it upon yourself to engage in this matter at that time?

Dr. SZILARD. I had no thought of atomic bombs in 1933 in my head. I did not think of the possibility of atomic bombs until 1934 or 1935, and it was simply a matter of helping those who needed help and who wanted to leave Germany. I mean men who had been connected with various German universities.

The CHAIRMAN. It did pay dividends, though, your getting some of these men out, didn't it?

Dr. SZILARD. It did pay dividends; yes.

Senator TYDINGS. What would have happened if they had stayed behind, in your opinion?

Dr. SZILARD. I do not know. It is difficult to know what would have happened.

Senator TYDINGS. It might have conceivably, as a matter of deduction, changed the whole atomic bomb development in Germany from what it was to what it might have been.

Dr. SZILARD. I might say that the three men in England who were instrumental in reaching the conclusion that atomic bombs could be made came out of Germany in 1933. At that time in England, in 1941,

most English physicists were engaged in radar work and other types of work, and these refugees who were not taken into that work, which was considered of very great importance for the war, had more leisure than their English colleagues to think of such remote possibilities as atomic bombs.

The CHAIRMAN. Who were those three fellows you got out?

Dr. SZILARD. Peierls, Frisch, and Simon. I did not get them out; they got out on their own initiative.

Senator MILLIKIN. Who was left, Doctor, that envisaged the possibility?

Dr. SZILARD. A great many excellent people were left in Germany. Heisenberg, for instance, is one of the greatest physicists.

Senator TYDINGS. I think that ought to be left off the record unless we know where they are.

Dr. SZILARD. I can limit my statement to those who are in the American sector, if you wish.

Looking back, we now know that full secrecy would have been maintained if compartmentalization had not been imposed upon us because we know that there was not a single scientist through whom information of any kind reached the enemy. There were many compartments, but there was no traitor in any of them, and the Germans had no information whatsoever about us.

Senator TYDINGS. But on the other hand, if instead of 3 or 4 or 5 men, to take an assumption, knowing about the whole process more or less, had there been 300 or 400 men who had learned about it, from now on our secret would be less safe, wouldn't it, unless some of them directly or inadvertently released that information to sources that might find it valuable?

Dr. SZILARD. May I disagree in the following sense, that having access to all the information does not mean you are in possession of all the information. Few scientists would waste their time trying to learn all of the information.

Senator TYDINGS. The more people who know about a thing, the more difficult it is to keep a secret.

Dr. SZILARD. That is true.

Senator TYDINGS. That applies even to Senators, and it is no reflection on scientists.

Dr. SZILARD. At first, we all observed rules on compartmentalization because we did not realize ourselves how damaging it was. Later on, the rules were purposely violated, because we would rather violate rules than slow down our work. Men coming from different sites would drop into my office and they would tell me things which I was not supposed to know, but which they felt that I ought to know. They usually told me that they did not expect me to conceal the fact that I was in possession of this information. All they asked me to do was not reveal to the Army that they had given me the information.

Some of you saw at Oakridge a certain installation and were told by a representative of the Army that it shortened the war by 1 week. That installation was based on a pilot plant which was built by the Navy. The installation was erected at the recommendation of Dr. Oppenheimer after an interview he had with Dr. Bush. But if you investigated how Dr. Oppenheimer got the idea of recommending this to Dr. Bush, you would find that at least two patriotic scientists delib-

erately violated the rules and broke through compartments. Afterward, everything was covered up nicely. Dr Oppenheimer's projects officially asked for the information which was already unofficially in their possession, and made an official study of what they already knew, and then finally Dr. Oppenheimer approached Dr. Bush and wrote to General Groves.

I am very sorry to say that I had nothing to do with this chain of events. As a matter of fact, I should have done something about it, because one of the men came to me six months earlier and complained that nothing was done along that line and asked me if I knew what could be done to get some action along that line.

Compartmentalization of information was very irritating to scientists and as a result of this many of them go much further in their opposition to all secrecy than they otherwise might do. Clearly compartmentalization is only a special technique and in my opinion an inadequate technique for maintaining secrecy. The question of secrecy is in reality an entirely different issue and ought to be judged on its merits in the light of the international situation to which we shall have to adjust ourselves.

This concludes my statement.

Senator HART. Doctor, who would you consider was the agency or the man who carried the full responsibility for our maintenance of necessary secrecy?

Dr. SZILARD. I would say after the fall of '42 it was General Groves. Up to that time, I would say it was either Dr. Conant or Dr. Bush.

Senator HART. Had you been the responsible party yourself, do you think that possibly you would view it differently now?

Dr. SZILARD. I would view it differently perhaps from the way I view it. I would also undoubtedly view it differently from General Groves or Dr. Bush.

Senator JOHNSON. Was there any delay in the creation of the atomic bombs caused by the imposition of the secrecy arrangement?

Dr. SZILARD. Very great delay, primarily due to this reason: Compartmentalization of information could be used without much delay if you had had at the center an omniscient man who could foresee everything. But the way the delay comes about is this: The most important answers are answers to unrecognized questions.

Senator JOHNSON. When would the bomb have been dropped, or when could a bomb have been dropped had the secrecy arrangements not been imposed?

Dr. SZILARD. About the spring of '44 would be my best guess, because the big delay arose from the fact that our work did not have a clear goal until the end of '41, because we did not know that amounts of fissionable material which we could produce were sufficient to make bombs.

Senator JOHNSON. That is a delay of 18 months?

Dr. SZILARD. That is a delay of 18 months, yes; and that is the 18 months that was the chief loss of time.

Senator JOHNSON. One war was finished and the other was toward its end?

Dr. SZILARD. That is so.

Senator HART. May I interject just one thing there?

I think it is in the record possibly from Dr. Bush, or it may be from Dr. Smyth's book, that there was a center for the necessary interchange

of secret information set up in the Manhattan district which was headed by one of the scientists, and I believe Dr. Tollman's name was mentioned in that respect.

Dr. SZILARD. I do not believe it would have been very difficult to get any specific information for which you asked, provided you knew that kind of information existed.

Senator HARR. I think it was represented that that was the duty of that center, to see that those who needed the information in their own work were given such as was necessary.

Dr. SZILARD. You see, it is a duty which no one can perform, because how can you tell what ideas a man would get if he had two different kinds of information? The man doesn't know he needs it.

Senator TYDINGS. Facing the contingency which the Army and the Navy always had to face, that if this were not compartmentalized, as they call it, that the information might inadvertently or directly, one of the two, leak to the enemy which it is assumed was likewise working on atomic bombs, wouldn't you say that even though the precautions taken were now in the light of subsequent knowledge unnecessary that as of the time they were taken they were at least understandable and meant to serve rather than hinder the country's ultimate welfare?

Dr. SZILARD. I am not blaming the Army for using the routine methods in the field of development and research which they used in military operations. That is what you would expect from the Army.

But from January '42 on, we did not cease to protest against it, and those in direct charge of our work knew it was damaging.

A. H. Compton was in charge of the work at the University of Chicago. In 1942, before the Army was in the picture, we received rules relating to compartmentalization. We had a meeting and all scientists protested against it and said it would slow down our work.

Senator TYDINGS. If I do not divert you and the chairman doesn't object and the committee doesn't feel I am taking you too far afield in the time that might be left, would you care to picture, from your imagination and your knowledge of the atomic bomb, what would occur in a war in which the atomic bombs were used by the nations arrayed on different sides?

Dr. SZILARD. Well, I do not know that I can give you a good picture, because I am trying to steer my imagination away from that contingency rather than to concentrate on it. But I believe—and I believe that I am quoting Dr. Oppenheimer, not from his testimony but from a statement he made elsewhere—that 40,000,000 dead during the first few hours, or, if you wish, during the first few minutes in the United States—

Senator TYDINGS. Let us say the first few months.

Dr. SZILARD. There is no reason why bombs should come staggered during a period of a few months. It is equally easy and much more profitable to deliver them within a very short period of time, so 40,000,000 dead, if the war comes without warning and if we don't relocate our population, and if there is a large stock pile of atomic bombs in enemy hands, would be a thing which we would have to count on.

Senator TYDINGS. That would likewise happen, according to the industrial density of the enemy nation.

Dr. SZILARD. It might not be determined so much by how many bombs we have or they have, as it might be determined by how concentrated their population is in cities. Our relative strength might be determined by our relative vulnerability if the war came 10 years from now.

Senator TYDINGS. I think it has been testified in open hearings that the possibility of use of the atomic bomb not only on land but on water is within the field of operations.

Do you agree with that viewpoint?

Dr. SZILARD. Certainly, the use under water may be a very important use.

Senator TYDINGS. How about surface vessels?

Dr. SZILARD. Well, still the bombs might be exploded under water in order to sink surface vessels. I do not know much about it.

Senator TYDINGS. I will not question you on that.

Dr. SZILARD. I am certainly not an expert on this question.

Senator TYDINGS. Your testimony at the conclusion of this hearing, boiled down, is simply this—as we already know, but I want it in the record: If we have a future war fought with atomic bombs, it is likely to be many, many times more devastating not only in the amount of property destroyed but in the amount of both military and civilian casualties of all kinds?

Dr. SZILARD. Well, the war against Germany caused great devastation without atomic bombs; but I think there is a qualitative difference as well as quantitative.

Senator MILLIKIN. The syllabus that we have before us, Doctor, that shows something of your record, states that you helped prepare the Smyth report. Can you tell us the reasons why the Smyth report was prepared and published?

Dr. SZILARD. I am afraid I did not help to prepare the Smyth report.

Senator MILLIKIN. It says that you assisted in the preparation of the Smyth report.

Dr. SZILARD. All I did was read the proofs of certain chapters, which I returned together with my recommendation that it should not be made public, but that was too late. It was just a proofreading, and I had no prior knowledge of the Smyth report.

Senator MILLIKIN. I should like to suggest to you, Doctor, that in the light of hindsight, I believe the Army can make a very strong case for its compartmentalizing theory for the simple reason that Germany was astonished that we had developed an atomic bomb at the end of the war, and so secrecy was preserved.

In the light of hindsight, I say that the Army can make a very good case for having done it the way it did do it.

Dr. SZILARD. Secrecy was preserved not on account of the compartmentalization, because any man from any compartment could have told the Germans what we were doing.

You see, compartmentalization was not effective in the sense that it prevented the men from knowing what was going on—that they found out; but they did not know the details. The Germans did not know even that we were working on an atomic bomb.

The CHAIRMAN. This thought occurs to me, Doctor, that if foreign agents were to kidnap, if German agents were to kidnap a scientist

who had been compartmentalized, they could torture him and get only that which he knew. He would be just as available for kidnapping if he knew it all, and he would be able to give up that much more. Have you thought of that possibility?

Dr. SZILARD. Yes; but my point is that there is a natural limitation to what a scientist knows. He knows what he is interested in, and that is usually a very small fraction of the picture. The scientists would not know everything just because they have access to all the information. General Groves has access to all of the information, but that doesn't mean he knows everything.

Senator MILLIKIN. Would you say that because of the reticence of the scientist and the security measures of the Army the enemy did not learn about our atomic bomb?

Dr. SZILARD. Our enemies did not know that Hanford existed and made fissionable materials. They did not know that in the Tennessee Valley we had plants making fissionable materials, and they did not know that work on uranium was going on at the University of Chicago. I believe that this is due to the inability of the average military intelligence man employed by Germany to grasp things which have anything to do with science. They failed as to intelligence about us just as we failed about intelligence in Germany, and that was not due to our security measures or the security measures of the Germans. It was simply due to the incompetence of military intelligence when it had to deal not with military operations but with science development and a type of industry of which they did not know the existence.

Senator JOHNSON. Doctor, Senator Millikin suggests that the Germans were astounded in August of 1945 when they heard about an atomic bomb.

Don't you think they would have been even more astounded if they had heard it early in the spring of 1944?

Dr. SZILARD. Some would be dead and not astounded, but the rest would be astounded; yes.

Senator JOHNSON. Mr. Chairman, is this witness going to come before us in executive session?

The CHAIRMAN. He has indicated in his statement that he would like to tell us some things in executive session that he has not been able to mention in public session.

Senator JOHNSON. I had two or three kindergarten questions that I would like to ask him about plutonium, because I understand he is especially expert in the manufacture of plutonium.

I don't think these kindergarten questions of mine border on secrecy at all, or would require an executive session.

If I may ask him, and if they do border on what should be confined to executive session, I hope that he won't answer them.

The first question is: As I understand it, the light uranium, the 235, comprises seven-tenths of 1 percent of uranium.

Dr. SZILARD. That is correct.

Senator JOHNSON. Now, when you put that uranium in a pile and this light uranium starts a chain reaction, you create plutonium, which is, as I understand it, 239. When you create that plutonium, do you create more than seven-tenths of 1 percent?

In other words, can you step up the production of fissionable material through the plutonium process?

Dr. SZILARD. If you do it the way it is done at Hanford, you create very much less plutonium than you use up light uranium.

The CHAIRMAN. I just want to make sure that the Doctor knows the limitations, Senator. I agree with you; I cannot see anything in it, but I just want to make sure that he understands.

Dr. SZILARD. Yes.

Senator JOHNSON. If it is anything bordering on the executive session, skip my question, please.

Dr. SZILARD. May I put it this way: As far as the Hanford process goes, we cannot make more plutonium than there is light uranium in the natural material, and we make very much less. But this answer does not do justice to your question, and anything else I would prefer not to say in open session.

Senator JOHNSON. Then, my second question is something like my first question.

In the use of plutonium or a pile process for industrial purposes, does that chain reaction continue for a long period of time? In other words, you put uranium in, and when the light uranium is used up, the U-235 is used up, you have to replace it with new plutonium. Is that a reasonably short period of time, or does that heat reaction continue for a long period of time?

Dr. SZILARD. Could I answer your question this way: I would not think of using for industrial purposes anything that would even remotely resemble that graphite-uranium pile which is described in the Smyth report for making plutonium. I think that is quite useless for any industrial purposes.

Senator JOHNSON. You think it is useless, but do you think that there is a process that is useful for industrial purposes?

Dr. SZILARD. Well, what I think I would like to defer saying.

Senator JOHNSON. All right; I won't press you; but those are two things that have been bothering me.

Senator MILLIKIN. Mr. Chairman, I should like to suggest that I do not know whether the industrial witnesses that we are going to have before us are qualified to deal with this specific matter that I should suggest, but I do believe that someone qualified to deal with it should come before us. I would like to get into the question of dispersal, the practicability of dispersal.

The CHAIRMAN. You mean the dispersal of the population?

Senator MILLIKIN. And of industry.

The CHAIRMAN. I presume, Senator, that the War Department might have some views on that. I had planned to ask the Chief of Staff, the Secretary of War, the Secretary of Navy and the Chief of Naval Operations to come either in open or closed session, at their election, to talk to us about those matters.

Senator MILLIKIN. I think it would be important that we know of that, because the boil-down of considerable testimony is that that is our best protection.

Senator JOHNSON. I would like to ask a question on that, because this witness has testified in some detail on the matter of the relocation of industry. It has occurred to me that if you should move an industry from Connecticut to Colorado—which I would think would be a very smart thing to do on general principles—you would have to take the workers along. They would have to live in a city, and you would

have to build a new city in Colorado that would compare to your dense population in Connecticut.

I noticed that when they built Oak Ridge down in Tennessee the first thing they did was build a city, and I do not know of any industry that is located out on the plains far from population.

The CHAIRMAN. Let us get away from the horrible hypothesis that you propose, Senator.

Senator JOHNSON. It is horrible, I suppose—horribly good.

The CHAIRMAN. Let us take Pittsburgh. As I interpret what the witness is saying, you have, for instance, the United States Steel; you also have Republic Steel, we will say, and Inland Steel. Let's put them at Gary, because that is where they are, and you and I have seen them many times.

The thought would be, instead of having three side by side along the waterfront there, that there would only be one, and then 50 miles away, or on the lake, that would be another; or 100 miles away there would be another. I think that is what he means by dispersal.

Senator TYDINGS. I think it has got to mean that not only would you disperse, but going with your dispersal after it is accomplished you would have to have a limitation on what other industries could come to that city.

Senator MILLIKIN. If you multiply the number of targets, it obviously multiplies the difficulty of the enemy.

Senator TYDINGS. After you have located one industry, we will say, in X, you would provide that no other industries could be located at X, but that the next industry would have to be located at Y; and you would have an over-all point that when industry grew so large that it reached 250,000 or 500,000 population, or so many acres of ground, or whatever the ingredients were, that from that point on nobody else would be allowed to live in that city or to open up any new industry. It seems to me that would follow.

Dr. SZILARD. It is not only the size of the city but the shape of the city that is important.

Senator JOHNSON. But the difficulty in locating industry is that it is not done by the eenie-meenie-minie-moe arrangement. You place industry for very definite reasons, most of them being the availability of transportation, the availability of workmen, and the cheapness and availability of energy.

Now, you just cannot go out and locate a plant where you want to. You have got to take into consideration the things that cause industrial centers to grow.

Then there is one other thing that keeps coming up in my mind, and that is that we know that following the eruption of Vesuvius and other volcanoes that destroyed human life, that the lava had hardly cooled until the people were back there building houses on top of the lava. Even though Senator Tydings says you have to burn them two or three times before they know they are burned, that is a trait in human nature that you have to contend with.

Senator MILLIKIN. I would like to suggest that China moved her entire industry inland to Chungking as a measure of military protection, and the Russians moved their whole industry to the interior of the country.

Senator JOHNSON. That is true, it transported what few machines the coolies could carry on their backs; but that is a vast difference comparing the Chinese industry with American industry.

The CHAIRMAN. Doctor, I assume that if you had a voice in the election you would view the dispersal of our cities with the consequent cost and general transferring from one part of the United States to another of thirty or forty million people to be far less preferable than some sensible international agreement, for the control of this thing, on which we can rely?

Dr. SZILARD. It is certainly less sensible; yes; provided we can get the arrangement. I am not advocating dispersal, but it is a necessary step within the framework of a policy which is merely based on "preparedness." No preparedness makes any sense without it. If we have to anticipate an attack of this sort, we have to disperse.

Senator TYDINGS. If we get into a war of that type, just having a big Navy, Army or Air Force, while they are essential, as compared to previous wars, without the ability to carry on and supply them by the dispersal of plants all over the country, preparedness is only an illusion?

Dr. SZILARD. Exactly.

The CHAIRMAN. The committee will meet in executive session at 2:30.

(Whereupon, at 12:30 p. m., the committee recessed.)

ATOMIC ENERGY

WEDNESDAY, DECEMBER 12, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Tydings, Austin, Millikin, Hickenlooper, and Hart.

Also present: Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. The committee will be in order.

Dr. Simpson, it is my understanding that you, Dr. Williams, and Dr. Weinberg have more or less collaborated on this presentation this morning.

Dr. SIMPSON. We prepared our testimony separately but have worked it together so that it presents complementary material, and there might be some advantage in hearing all three together before questioning us; but that is up to the committee to decide.

The CHAIRMAN. In other words, what you prefer is that we hear the three of you and then line you up and ask you all three questions; is that the idea?

Dr. SIMPSON. Yes; that would be preferable.

The CHAIRMAN. I think, unless the committee has some objection, it would be practical.

Now, will you proceed, Doctor, and tell us who you are and why you are here.

STATEMENT OF DR. JOHN A. SIMPSON

Dr. SIMPSON. My name is John A. Simpson, an experimental physicist associated with the atomic-bomb project for almost 4 years. I am working at the metallurgical laboratory plutonium project and am a member of the Nuclear Studies Institute at the University of Chicago. I am chairman of the executive committee of the Atomic Scientists of Chicago, and a member of the Federation of Atomic Scientists.

Senator AUSTIN. How old are you?

Dr. SIMPSON. Twenty-nine, sir.

The CHAIRMAN. How old were you when you went to work on this project?

Dr. SIMPSON. About 25, between 25 and 26.

The CHAIRMAN. Thank you.

Dr. SIMPSON. The nature of the problems which lie before this committee is in many respects unique in our history. The issues are of great complexity due to the intertwining of a difficult scientific and engineering field with a political problem of the highest order. It is the obligation of all scientists and engineers to offer their aid in the scientific and technical aspects of these problems.

I have come here today to represent the common opinion of the overwhelming majority of scientists and engineers who have had the privilege of sharing in the development of the atomic bomb.

One of the unexpected byproducts resulting from the development of atomic energy is the changed attitude we scientists have toward the social implications of our latest efforts.

Senator AUSTIN. Do you mind stating when that crystallized so you would be able to say, "I now speak the sentiment of the profession"?

Dr. SIMPSON. Yes, I would, sir. In the next two or three pages [consulting prepared statement] I have brought this out rather carefully.

Senator AUSTIN. Go ahead.

Dr. SIMPSON. I should like to discuss briefly this attitude and the evolution of our thinking about the bomb. These ideas are common to almost 2,000 men, who have, as individuals, widely varying scientific and political backgrounds.

It is startling even to those of us who have shared in this thinking to realize the existence of this unanimity of opinion on both the facts of the bomb and their inescapable social and political implications.

As scientists, we have always preferred to see the results of our studies used for constructive rather than destructive purposes. We have been aware, as many others have been, that man's control of the forces of nature, if rationally exploited, could provide all nations with ample livelihood. However, we have not heretofore felt it our responsibility to strive for this rational use of the fruits of our labor. This responsibility we willingly left to the people and government of our Nation.

There are two reasons for the marked change in our attitude. Never before have we been so clearly and directly responsible for new forces of destruction unleashed upon the world. The development of the atomic bomb was the result of the initiative of certain prominent scientists who succeeded in persuading the authorities that nuclear physics contained undreamed-of military potentialities. Had they not been successful in so persuading our Government, we would still be living in the quaint old world of blockbusters and rocket bombs.

Another reason for the change in our attitude is that the advance embodied in the atomic bomb goes far beyond the discoveries of gunpowder, dynamite, poison gas, or radar. Atomic energy goes far beyond the realm of burning coal and falling water and exploding dynamite; it lies in the realm of the forces which power the sun. These forces are now in the hands of men and, unless men can control them, the end of our civilization may not be far distant.

Our ideas about the meaning of the atomic bomb to our Nation and to the world did not develop overnight—they are the result of a considerable period of evolution. During the early days of the project we spent little time thinking about the possible effects of the bomb we were trying to make. What little thought we did give to this problem

involved discussions only with a few friends within the project. In the latter part of 1944, however, it became increasingly evident that we had made great strides in our program and that there was every likelihood of reaching our goal. It was then that the scientists became increasingly interested in considering the possible consequences of success. What would happen if the atomic bomb worked?

Within but a few months, in early 1945, this increased interest expressed itself in the form of discussions among small groups within the laboratory. These discussions were crystallized in short memos, which became the basis for further discussions throughout the laboratory. As was only natural, some men were more actively interested than others; Dr. Szilard, for instance, proposed some particularly interesting possibilities.

During the meeting of the United Nations at San Francisco, many of us hoped that the necessity of controlling possible weapons of an importance comparable with that of the atomic bomb would be taken into consideration in setting up the structure of the UNO. Despite the fact that great strides had been made in bringing the nations together, we could not help but fear that these steps might still not prove sufficient to control the bomb. By May and June, more and more people were becoming excited about the problem, and larger discussion groups were meeting in the laboratory, always remaining well within the security regulations.

What were these discussions all about? They centered not only upon the effect of the bomb upon the security of this Nation and the world, but also upon the possible ways in which the bomb might be used initially to create the most favorable conditions for lasting peace. In fact, a poll was taken in the laboratories to determine how the scientists felt about the first use of the bomb; how it might be used mostly wisely to end this war and to prevent another one in the future.

As a result of these discussions, there developed among the many men of all the laboratories a strong sense of responsibility—a responsibility which in many respects is unique in history, because, for the first time in history, a new age lay in the hands of a relatively few men unknown to the rest of the world. The developments resulting in the atomic bomb were in many respects strange and new. It was evident that only with the greatest difficulty could our present society assimilate the facts and act upon the implications which this new age brings forth. Could such a group of men thrust upon the world such new developments, without assuming the obligation of informing our people concerning the changes they must face if they are to survive?

That obligation is being assumed by the overwhelming majority of scientists. For, after the bombs were dropped on Hiroshima and Nagasaki, and after the wave of wonderment and confusion which followed, there arose a rising tide of thought among the men in the laboratory which showed an astonishing unanimity of opinion. Men who were isolationist in spirit, men who were convinced that war had a place in society, men of every shade of political thought, were all brought together. And this union of thoughts and ideas resulted not only from the all-compelling facts, but also from the fear that a completely uninformed and unprepared people might not recognize the problems which beset the whole world as well as our own country. This unanimity of opinion was remarkable in that documents inde-

pendently prepared by at least three of the project sites showed precisely the same views and recognized exactly the same set of facts.

Thus, a few weeks after the bomb was dropped there spontaneously developed loose organizations at Los Alamos, Chicago, and Oak Ridge, formed by the research men who had been considering the social implications of the bomb. These organizations were formed because the need for them had become apparent to us. From the reaction of the public to the news of the bomb and to the announcement that a new age was close at hand, we saw that the people of this country had completely failed to understand what atomic energy would mean to them in the very near future. We felt very strongly that we would have to start an effective educational program to correct this lack of understanding, and we felt that some sort of organization would be necessary. So we appointed committees for writing factual articles, for preparing speeches, for studying possible legislation, and for considering peacetime applications. And as these developed, it was only natural that the sites began to exchange information about their activities. New York soon joined, and, in recent weeks, scientists and engineers from the gaseous-diffusion project and the electromagnetic project joined with the existing groups.

All of us, at the various sites, felt that it was essential to start a program of giving to the people of this country the facts about the atomic bomb, and the meaning of these facts as they affected the future peace and security of the world. It was obvious, too, that this program of education would have to be on a national level. With such a program in mind, the associations from the six sites met in Washington to help alleviate the present lack of general education on the atomic bomb. But ever-increasing numbers of scientists outside the atomic-bomb projects have been organizing around this problem all over the country—in Cambridge, in Pasadena, in Philadelphia, and elsewhere. They are men of science in all fields of specialization, and they have been getting together in making the educational program more effective and of greater aid to our Nation. They are scientific men with special training, but they are also citizens. It is in this dual capacity that they come together at this time to offer their services to the Nation. As citizens it is our responsibility to see that our people and our Government are fully aware of the social implications of the atomic bomb.

But what are the facts that have convinced all of the scientists and what do they imply for all men who are willing to reason from these facts? They have all been brought before you in previous testimony by J. R. Oppenheimer, H. C. Urey, L. Szilard, H. A. Bethe, and P. Morrison, all of whom are members of this new federation. Let us review a few of these facts:

1. Atomic weapons are effective weapons for warfare. Their effectiveness can be increased to the point where any nation can destroy any other nation with atomic bombs.
2. In the business of warfare, atomic weapons are cheap to use against an enemy.
3. The distribution of uranium and thorium over the earth shows no possibility of complete control of raw material supplies by the United States.

4. There is no lasting security in attempts to keep the sole possession either of the science from which the bomb was created, or the unique technical developments of the project.

5. Other nations can also make useful atomic bombs after a relatively short period of development.

6. We do not foresee in the future any countermeasures or military defense against the atomic bomb.

From these facts and from other facts as yet secret we derive the following inescapable implications:

1. In a world of nations having atomic bombs, the advantage of an undeclared war to an aggressor nation is enormous.

2. The weapon is so effective against concentrations of people and industry that no fear of reprisals will be sufficient to prevent its use.

3. No nation under present conditions can maintain its pride and place in the world until it too has atomic energy and has atomic bombs.

4. Once a nation builds an atomic bomb stock pile large enough to demolish the major cities of potential enemies, no more military advantages result from larger stock piles. As time goes on, all nations possessing bombs will tend to become military equals.

5. In any atomic armament race, the United States in the long run will find itself in a very unfavorable position, due to highly concentrated population and industry.

6. No nation can withstand a large-scale atomic-bomb attack. It may lose a sizable portion of its population in a few hours of warfare.

7. In the immediate future, before other countries also have bombs, the United States must always take the lead in reshaping international affairs to obtain world security.

These facts and implications bring into sharp focus the alternatives which face us today. We have only the two choices—either the eventual destruction of a large portion of the population, or the chance for survival. To follow the latter course appears obvious. But, we will succeed in this course only if we are willing to feel our way, step by step, along the path that seems to increase the probability for world security. We will fail if we refuse to act simply because we cannot know in advance exactly how much world security our action will bring.

The United States has a fleeting opportunity to insist on the only solution acceptable to a nation committed to peace. It has in the past month demonstrated to some extent its desire to take such a lead. Irrespective of other international agreements, we feel that international or world control of atomic energy is essential to the maintenance of peace. Such a system of effective controls implemented by inspection should be considered immediately, because to introduce controls into the world at the earliest possible moment gives us the greatest possibility of successful operation. Once other nations promiscuously build atomic energy plants throughout the world, the introduction of an inspection system will be more difficult.

We realize clearly that the over-all feasibility of international control and inspection of atomic energy installations is a political problem of great difficulty. At the same time we recognize that a portion of that problem involves the technical feasibility of inspection and control throughout the world. The men of various specialities on the

project and elsewhere in the country could offer their special abilities to the committee. It is, however, not only for the scientists associated with the Manhattan District to consider the problems of inspection, but men competent in discussing airborne missiles and rockets, control of strategic materials, and the economics of engineering processes must also contribute their knowledge.

The present procedure for compartmentalization and secrecy of information makes it impossible for them to work together effectively on this problem. A major portion of the information needed to appreciate the properties of an effective system of inspection and controls is secret and cannot be assumed known to this committee.

It seems to us that there are at least three ways out of this impasse. First, the Manhattan project, or our Government directly, could authorize an expert committee to receive and digest the material from selected scientific contributors. Second, this Senate committee could hear all the testimony of the individual experts and attempt on their own to integrate the information which they have obtained. Third, this Senate committee may arrange to appoint and direct a special committee of scientists and engineers to receive, study and integrate this material. Our men and the results of their thinking on the technical portions of the problem are at the disposal of the committee. For a few weeks we have planned to have experts in the plutonium project, the gaseous-diffusion project, the electromagnetic project, the centrifuge project, the thermal-diffusion project, along with the bomb-manufacture project, study the problems which they are peculiarly capable of analyzing. This is to be done at the earliest possible date in separate classified reports. This program has been proposed in the full realization that unknown to us a similar or more adequate program may be in existence.

We realize that this will not solve the problem of world control of atomic energy. The integration of the scientific and political facts and thus the most probable solution of the over-all problem rests in the hands of our statesmen.

Senator AUSTIN. I have a foreign relations matter that is very important, and I want to ask you before I go whether this voluntary coming together of the scientists which you have described here spiritually, mentally and physically, as it were, has broken down in fact the departmentalization of the knowledge?

Dr. SIMPSON. No, sir; I do not think so. To some degree we are ignorant of the details of each other's problems. It is natural, however, that as scientists we do know a lot of the fundamentals of each phase of the project and can more or less understand what problems we must attack in these various fields.

However, the fields are separate and we have not made any attempt to break down security.

Senator AUSTIN. Then there are secrets in respect to this subject which are not available to any one person except a person at the top level of organization. Is that right?

Dr. SIMPSON. That is correct, sir.

Senator TYDINGS. You point out only two alternatives in your very thoughtful and very helpful testimony. I think there might be three. First of all, we can have an arms race with atomic bombs. That is one alternative.

Secondly, we can turn over the control of atomic energy and atomic bomb making to some international organization with inspection and all that that implies.

Thirdly, we could prohibit the manufacture of atomic energy and have our inspection for that purpose.

Have you given any thought to the latter alternative?

Dr. SIMPSON. I had assumed that my statement was made somewhat more general, and that my second statement would include both of your latter statements.

Senator TYDINGS. The reason I asked you that is that a great many of the men who have come before us picture the horror of this next war fought with atomic energy, what it will do, destroy so many cities, and so many people. We have also had men who have publicly testified that a large percentage of the manufacture of the bomb will already be in being if peacetime atomic-energy plants are licensed, that the step from there on taken from the peacetime use to the construction of the bomb will be, let us say, a relatively short one compared with the whole project, and therefore if you release or if you license atomic energy even under world control you are pretty near to the proposition that any nation may make a bomb or may make several bombs, aren't you?

Dr. SIMPSON. I think there are two points which I would like to mention in regard to that. No. 1, I think, is a political one, and I cannot testify as an expert on that.

Senator TYDINGS. None of us can.

Dr. SIMPSON. I believe we have all made the underlying assumption, or have made the assumption implicit principally because we have never really taken an interest in this political field before. The definition of aggression on the part of a nation is the time of the immediate breakdown of controls. It is not 3 months, not 6 months from the time that they start to get away from controls, but the following day that something has to be done.

Senator TYDINGS. Let me put it to you this way to give you an illustration that may not happen, but which will focus your attention to what I am driving at.

Let us suppose that international controls have been carefully thought out and agreed to by all the nations of the earth. Let us suppose that atomic plants for peacetime usages under that system have been licensed. Let us suppose that these plants are at the moment constructed in some six countries on the face of the earth. Let us suppose that those plants have been in operation for 3 years.

Now the inspector goes to country B, and mind you, all the plant is not in one place; it is somewhat like our situation, with 5 or 6 different operations. But he goes to country B and he finds that everything is just as it should be.

Now, immediately upon the leaving of that inspector, some of this atomic energy in the form appropriate is used to manufacture a bomb in that country at once, or 10 bombs, or a hundred bombs, and those bombs can be constructed within 6 months after the last inspection took place; the time has gone by, and the inspectors are not quite as careful as they might be.

Now, one of two things would happen. A nation that had the bomb would evidently be making it for some particular purpose, and

that would likely be a surprise attack. Then we would have nothing with which to counteract that. You couldn't send the UNO in there to beat a nation that had atomic bombs in quantity, because it would be rather difficult.

The second thing is that if you found it out before those bombs were so used, that would be an act of aggression which you would have no counterstroke equal to the stroke held by the country that had breached the contract with which to immediately interdict it. What is your thought on that?

Dr. SIMPSON. The point is that I am not convinced that the inspection system should provide for inspection only once every 6 months, or once every 3 months.

Senator TYDINGS. Let us assume it this way, that in spite of the inspection, enough material has been sequestered and taken to manufacture 100 bombs.

Dr. SIMPSON. I believe the inspection system must be such that the possibility of this is reduced to a minimum.

Senator TYDINGS. I agree with you, but suppose it doesn't work out that way?

Dr. SIMPSON. Then you have the additional assumption that you have developed a plant in which the men know how to assemble the bombs, they have had practice doing this thing and can carry out the job in 6 months. I believe that most of us feel that it will be a period of 3 to 6 months before you start making the bombs once you pull the material out of the unit, but that it will take perhaps 6 months to a year in addition to develop enough atomic bombs to wipe out a number of cities or all the cities of any given nation that may be under attack.

Senator TYDINGS. But every one of the scientists who have appeared before us, including yourself, and quite properly, conceive that if we have an atomic war, the future of civilization, to say the least, is seriously jeopardized, and yet we keep clinging to the idea of letting these guns be passed around; the only thing we don't put in the gun in the cartridge, and you can get the cartridge in not too long a period.

I would like to get your advice on whether you think it wouldn't be wiser to outlaw the entire manufacture of atomic energy, which will give us the greatest chance of safety, plus inspection?

Dr. SIMPSON. This is certainly not true of very small atomic energy installations, because you have a different problem. You cannot produce enough material in a reasonable length of time.

In the large-scale job, I think the majority of us believe we must do that, because this is the fundamental issue. But I think there should be this consideration taken into account: That is, it is possible to design a unit for atomic energy which is designed very unfavorably for removing fissionable material in a short period of time.

Let us consider the Hanford pile. I think what I can say about it is the following, that the Hanford pile was designed to produce material with a byproduct of energy, and it might be concealed to the world under the guise of producing power with a byproduct of plutonium. The Hanford pile was designed to remove that material as easily as possible. You cannot remove that material and carry it around in a handkerchief. You have to have extensive and adequate installations to handle very intense radioactive material. If the

installation is inspected by a person competent to know, he will know that this installation can remove so many pounds per unit in a certain interval of time.

Now, if by international agreement we can agree that our power unit will be designed within certain principles which will discourage—

Senator TYDINGS. What you are doing in effect is saying that the degree of opportunity for the manufacture of the bomb is lessened by the program you outlined; but you will admit also that it permits a degree toward the manufacture of the atomic bomb which is greater than if you did not have the power plant at all:

Dr. SIMPSON. That is quite true.

Senator TYDINGS. In other words, we are opposed to grand larceny but not opposed to petty larceny, to make a humorous observation.

Dr. SIMPSON. That will depend upon our attempts to set up or study a control system. I don't believe we know enough about this problem, and that is in our proposition.

Senator TYDINGS. I am not saying I favor this program, but it is one of the things we have got to explore.

Take, for example, this phase of it. There are a few men at the top of this project, or maybe several thousand in the world whose mental development in many lines—and particularly the scientific line—is like comparing a mountain to a molehill when you compare them to the rest of us. Likewise, you have got to consider a country on the basis of its average population. Many nations have large numbers of illiterate people. Many nations have systems that we might call unenlightened according to our standards.

Now, you have got to project your inspection in the face of all those human equations, which are facts, just as the atomic bomb is a fact.

Visualizing that, do you think that it is possible for us to devise an inspection which will permit the manufacture of say 60 or 75 percent of the bombs for peacetime purposes?

Dr. SIMPSON. You are asking me a question I do not know the answer to.

Senator Tydings: I only want your opinion. You might change it a month from now.

Dr. SIMPSON. My personal opinion? I could not then talk for any of the other men I am trying to represent today.

My personal opinion is this, that we do not know with certainty whether we can succeed. We know that we have a chance to succeed and that is the only fact we do know. From a reasonably detailed survey of the technical system of inspection, we think that we can have an effective system provided certain political conditions are met. We therefore come back to your problem. Will those political points be met by all nations?

Senator TYDINGS. What is our greatest objective in this whole matter? The preservation of civilization, isn't it?

Dr. SIMPSON. That is correct.

Senator TYDINGS. Without that all benefits that flow from atomic energy are secondary to the preservation of civilization; therefore, if that is our greatest problem, what avenue of approach is best calculated to achieve that goal: prohibition with inspection, partial manufacture

with inspection, or uncontrolled production of atomic energy? There are three avenues open to us.

At this present point, which one of the three do you think offers the greatest hope for the preservation of civilization, not only now, but 20, 30, 40, 50, or 100 years from now, because if we license the use of atomic energy for peacetime purposes we are probably going to have it in existence for years and years to come with all the refinements and improvements that come with it. What is your opinion on my question in the light of those facts?

Dr. SIMPSON. I would say that as we carry out this experiment—which it certainly is—if we make it a calculated experiment, then in the immediate future our best possibility of success may be to immediately stop atomic energy production on a very large scale, on a scale that interferes with this problem.

Senator TYDINGS. Other than for scientific purposes?

Dr. SIMPSON. Yes; until the nations of the world do have an appreciation of this problem as we do. I do not think they understand this problem even as well as we do, as little as we know about it.

Senator TYDINGS. You have answered my question. In other words, the first approach is not to get out on thin ice and get too far from shore, but to stay near shore until the ice gets strong enough so that we can safely go further from the shore.

I therefore take it that you recommend to this committee that the first step toward the preservation of civilization or the control of atomic energy, whichever term you want to use, should be international prohibition supplemented by inspection until such time as a better plan offers?

Dr. SIMPSON. With minor modifications; yes.

Senator TYDINGS. Of course, there would be exceptions for scientific research, and so on, but not for the manufacture.

Dr. SIMPSON. This is my personal opinion and not necessarily that of the men I represent.

Senator TYDINGS. In questioning most of the gentlemen who have preceded you, in one form or another I think they all pretty nearly arrive at the conclusions you expressed; at least I got that impression.

Dr. SIMPSON. I believe we differ only in the details, the minor details in this issue.

Senator TYDINGS. But I can leave my questioning with this thought, that we ought not to venture into the field of the manufacture of atomic energy nationally or internationally first. We ought to prohibit it and inspect, and then find out after that is done, for once it is started in many countries it will be more difficult to go back to the place we are now than it will after the plants are put in operation.

Dr. SIMPSON. Yes.

Senator TYDINGS. You get used to a thing, and then the edge of your fear is dulled and the edge of your imagination is dulled.

Dr. SIMPSON. Once we start producing atomic energy, I am afraid the process is irreversible.

The other point, as a result of that, I believe is this: We should act as fast as possible, consistent with the political situation, to institute international controls.

Senator TYDINGS. Is it your opinion that the point of view you have just expressed is the majority point of the men with whom you

have been associated and have described in your paper? It is your opinion—not that you are stating it as a fact?

Dr. SIMPSON. Yes, I believe it is the opinion of the group. No matter what we must do, we must at least give ourselves a chance for obtaining world security.

The CHAIRMAN. Doctor, admitting of course that this is a new force in the world, not a difference in degree but a difference in kind and admitting that you have to think of it in new terms, still admitting all the past history of civilization, no matter how desirable it might have been at the time, do you know of any advance in the history of science that was ever made that was capable of producing more energy, wealth, or more productivity, that has ever been suppressed?

Dr. SIMPSON. I think the answer to that is already implied in your question; certainly not. One of the most fascinating things about our recent achievement of reaching within the nucleus and attaining energy which is the energy which runs our stars is the fact that it is only the beginning of our knowledge. There is nothing comparable with it.

However, it should be pointed out that what we have learned in the past was really the logical prelude to this study; and one of the encouraging things is that the discovery of atomic energy logically is an advancement in our ability to think and to do things. I think we can all hope that as citizens and as thinkers in the field of politics and relations among men that we begin to note a forward trend in our thinking that way also.

It is not quite so clear to us that we are following a line of advancement in our relations with other men. I hope that it becomes more clear in the next few years.

The CHAIRMAN. Doctor, I would not attempt to denominate what it is in human beings which has insisted throughout history that full advantage be taken of anything that will do the things that I have mentioned, such as increase wealth. Whether you want to call it instinct or urge of the species, or what you may call it, you nevertheless have to contend with it, do you not?

Now, there are over 2,000,000,000 people on the face of the earth. There are 400,000,000 in China who carry on their backs loads that we put in railroad cars or motortrucks. There are 400,000,000 people in India who live at the most primitive level of starvation.

Now, we are a rich country. We have power and energy in abundance. To hold to that proposition it seems to me that because we are fortunately situated and in order to attain the highest degree of security we are going to insist, if we can, on prohibiting its development.

I just suggest the difficulties of maintaining that point of view when we measure it against a somewhat less perfect system of security that would come from peacetime manufacture. That is really the problem, isn't it? And that is not altogether our problem to solve, is it?

Dr. SIMPSON. No; I agree, first, that the United States must take the lead, but they must also bring in all nations to discuss this problem. Also we have not implied from the discussion that Senator Tydings and I had that we are going to stop development. At the present time I believe it is possible to carry out almost unlimited scientific developments, and, secondly, to carry out certain engineering devel-

opments under international authority at some one location where all nations may come together to work on this problem.

I don't see that you are excluding the possibility of future development. I think that all you are doing is holding up your development of engineering programs until the various nations understand this problem and the control system gains the respect of the nations. After all, all nations will not have the same respect for this control system, no matter how good it is. You must see it in action before you have confidence in it.

Senator TYDINGS. Doctor, you are familiar of course with the fact that throughout history there has been a war about every 10 or 20 years. Indeed, that is a very liberal spacing.

You are likewise familiar with the fact that the war is still going on in many parts of the globe, even after the two or three big wars are over.

You are likewise familiar with the fact that disarmament hasn't taken place, and while we all hope that the world will some day have nobody carrying a gun, it is a long, long way off.

Now, knowing all those things, what reason is there to believe that if atomic energy is licensed for peacetime purposes that when some event happens 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100 years from now that will bring on another war—I am not just thinking for 20 years—almost instantly, I will say, after atomic energy becomes commonplace it will not be used to destroy civilization?

We have to think of this problem not only for 10 or 20 years, but 40, 50, or 100, as far as our imagination is capable of thinking. What is there in the picture that would lead one to believe that civilization can exist if atomic energy is used 75 years from now in a world war?

Dr. SIMPSON. I don't know the answer to that, but I think the only thing I can say is this: Over a period of 100 or 200 years, I cannot see the difference between licensing atomic energy and prohibiting the development of atomic energy industry. I think they will both smooth out to the same classification.

Senator TYDINGS. I think you have missed my point, and maybe that is my fault.

You and I, both, know that there have been many movements to end wars since the beginning of time. We have had alliances of the churches to do it. We have had economic alliances, military alliances, every kind of alliance.

Now, of course, we have never had a real honest attempt to do it such as we have now in embryo in the UNO; but if you start out to license atomic energy before you create a climate where peace is almost certain—not only in theory but in practice—has been proved to be almost certain—if you start the manufacture of atomic energy for peacetime purposes before that time, where do you come out in the event the machinery breaks down?

Dr. SIMPSON. Well, if it is agreed that the machinery will break down after a study of an inspection system—and this comes back to the question we were discussing a short while ago—then we will have to hold off on our very large scale or industrial applications with regard to power until such time as we feel reasonably certain of success. I think that was really implied in our discussion.

Senator TYDINGS. Most of the men who have preceded you—or a great many of them—have told me in private that they wish there had been some way to prevent the discovery of atomic energy. They would rather it had never been discovered when they think of the future implications of it.

It has already been discovered, and there is no use thinking about that; but the thing is: Where do we go from here?

If I had the state of mind that it is too bad it had ever been discovered because of its implications, my next thought would be to crush it out and keep it crushed out.

Dr. SIMPSON. You cannot do that, but what I think you can do is create a situation which gives you the best chance for introducing controls.

Senator TYDINGS. But prohibition should come until that situation is developed; otherwise, you are letting the horse out of the stable before you have girth the bridle on him, and you cannot ride a horse with no bridle.

Dr. SIMPSON. It is still to be determined, I believe, at which stage you have an industrial plant or an experimental unit. I think that can be defined within fairly close limits.

Senator TYDINGS. My opinion at the moment is—and I am not committing myself to any final conclusion—but you have got more faith in mankind than I have been able to mass up to the moment for letting this deadly force out any time that I can see in the foreseeable future without almost a certainty that when another war comes—and, God, let's hope we can prevent it—that it will be used and used quickly.

Dr. SIMPSON. I like to think this way—that I have more faith in succeeding in this whole problem if we attack it with the idea that we do not know how far we will succeed, but since that is the only course of action open to us, at each step we must decide what we know about the problem and act accordingly. Tomorrow it may be different.

Senator TYDINGS. I did not mean to imply that we should not try, but I think we ought to try with the knowledge that the task is not as easy as many people think it is. I think it is darned near as difficult as discovering atomic energy, in the first place.

Dr. SIMPSON. I believe scientists think it is more difficult.

The CHAIRMAN. Doctor, I don't want to be accused of being hopelessly idealistic, but letting my mind run back over history, certainly back to the Crusades, those wars were fought for the most part over ideologies between, of course, the Moslems and the Christians.

Since that time wars have largely been based upon the desire of "have-nots" to have.

Economic factors have been the basis of them.

Letting ourselves perhaps dream a little—and I guess we have to dream some in this problem—if through the peacetime use of atomic energy we could increase the living standards of the "have-nots" of the world, do you not believe, or have you thought of the possibility, that that might reduce the occasion for war?

Dr. SIMPSON. I am a little skeptical of what atomic energy will do for the world in the next generation or two generations. I am thinking now in terms of all the population of the world. We have had steam power, we have had electrical energy, we have had the energy from electronic forces now for a century, and we have not been able to

solve their economic problem. We haven't yet solved the problem of distribution or production of goods among all the peoples of the world.

Senator HICKENLOOPER. Right at that point, we have made, as compared to a hundred years ago, unbounded progress, haven't we—unimagined progress?

Let's go back 100 years before the use of electronics and all those things which go with it affecting labor and work performance, and the ease and convenience of things are unimaginably better than they were at that time, aren't they?

Dr. SIMPSON. Yes; I would say in the major countries, but I am thinking also of all of those other nations that are really just beginning to get their teeth into this industrialization problem.

Senator HICKENLOOPER. They still use wheelbarrows in most parts of the world.

Senator MILLIKIN. Those countries to which you now refer have no present capacity for war, atomic or otherwise; isn't that correct?

Dr. SIMPSON. My impression is that this is probably so. It is, however, also true that with the introduction of relatively few men in engineering and science they can be converted to atomic energy development without this intermediate step, by bringing in materials and manpower.

Senator MILLIKIN. Assuming a little further the thesis of the chairman of our committee, we have evolved from where the average man controlled one or two horses to where he is driving several hundred horses.

The CHAIRMAN. It isn't a fixed thesis.

Senator MILLIKIN. He has now evolved to the point where he is driving several hundred horses, but that has not abated in any particular his war-making ability or his war-making desire. So, if we took these regions that now have no development, that are barbaric as far as modern economy is concerned, and lifted them to our own level, it certainly does not follow that they will become peaceful while the rest of us are war-loving.

Dr. SIMPSON. I think so. Human nature is the same all over the world in many respects.

Senator MILLIKIN. Now, I think you have put your dagger right into the heart of the question.

Dr. SIMPSON. May I make one statement with regard to these undeveloped and relatively backward countries where atomic plants have, in many respect, unique application. Many of them are backward because they don't have water power, don't have adequate supplies of coal in the right places for getting a job done, and therefore large industrial atomic energy plants in the next decade or 30 years may very well vitalize these countries, or bring them up among the nations of the world; and that is, of course, one factor to consider.

Senator MILLIKIN. I am not challenging that thesis. I am challenging the thesis that if that came about that automatically would make them more peaceful.

Senator HICKENLOOPER. I would like to pursue just a little further the question raised by Senator Tydings on the matter of prohibition.

Every new discovery in science has been rudimentary at first and with great rapidity has extended its limits.

With telephone they talked between rooms at one time, and now we talk around the world. It is the same way with armaments and with all our scientific beginnings.

It is inconceivable to me that science will stop experimenting in this new field which they have just scratched, regardless of whether it is in this country or abroad; and it seems reasonable, at least for the sake of argument, that we can prohibit the commercial manufacture of this stuff and still, in the advancement of science and experimentation, develop methods that are so infinitely much cheaper and much more available and readily productive of this stuff in the future purely through the experimentation of science; so that within a very short time science, either here or abroad or some place in the great universal field of science, may develop merely in the laboratory methods of the manufacture of atomic energy in quantities—that is, this material in quantities—so that it will be a very slight effort indeed to turn from that to the almost immediate manufacture of bomb material for warfare.

I suppose only time will tell whether that will happen or not, but the point I want to make is that if we have this prohibition I wonder if we don't have a very short time indeed in which to get our house in order under this prohibition.

We may be able to prohibit for a short time the manufacture of this material for war; but there comes a time, if we believe history—I mean if history is going to repeat itself—when the efficiency in this field of investigation will be so great—when that time will come I don't know; 10, 15, 25, or 50 years make little difference if we are trying to save the world from destruction—that this very human nature you are talking about may look forward to some bandit nation or some outlaw group using this immediately convertible material, based on the advances of science, for warlike purposes.

It appears to me at the moment at least that we have a very short time to put our house in order and establish the beginning of these understandings on a firm basis, because I have little faith that we can dilly-dally along for a long period of time and more or less let nature take its course.

Dr. SIMPSON. Yes; the time is short.

Senator HICKENLOOPER. I don't know. I am not saying that Senator Tydings has adopted this as his theory necessarily, but you have been arguing the point to develop it, as I understand it. I have little faith in the eventual or long-range success of prohibition.

In my opinion, I think we can prohibit for a while, but we have got to eventually consider in our own minds the very potent possibility that prohibition will not work for too long a time.

Senator TYDINGS. Give us 10 more years probably as a universe.

Senator HICKENLOOPER. We have got to have a period in which we can prohibit successfully until we can establish a program and then get it working.

Dr. SIMPSON. If we don't utilize the short time we have to make the most effective system operate, and I believe we were talking about the immediate period, then we contradict ourselves because we are following on one hand one philosophy and also trying to follow on the other hand another philosophy of thinking.

Senator TYDINGS. Having our cake and eating it too.

Dr. SIMPSON. Yes. In one case we say we must do whatever is possible at any given moment to increase the possibility of success. Then, on the other hand, we say, "But let us take our time, because we don't know exactly what is coming." These two philosophies are incompatible.

Senator HICKENLOOPER. Do you know of any scientific development or discovery that has ever been made that anyone has ever thought might have some potential war possibility as a matter of defending ourselves that has not been thoroughly explored either by science or engineers, or both?

In other words, haven't we taken scientific development and immediately turned to see how it can help us in war?

Hasn't that been a natural development in self-preservation?

Dr. SIMPSON. I don't think that has been true of the scientists.

Senator HICKENLOOPER. I am talking of the whole field.

Dr. SIMPSON. Well, it is natural. I think that there are certain fluctuations in the length of time between a discovery and its military use. Sometimes it has taken a long time to understand that a particular development has a military application. At other times military application aided the scientists.

Senator HICKENLOOPER. He might have a knife with which to cut meat, but at the same time he has thought it might be good to kill somebody with and made use of it.

Dr. SIMPSON. I would like to make one statement regarding what you said, namely, that science isn't going to stop, no matter what kind of laws or controls you have, and say this: If people are thinking about any system of international control and inspection which you sit down and work out and say, "Here it is, gentlemen; we have thought about this problem for 4 years, and we think this is good enough to last 20 years," then I think we will fail. I think that what we must do is say, "Let's set up a system after careful study, set it up and provide for methods for changing the control system so that as new developments are found out all over the world this control system will reshape itself so as to take into account the developments of the future." We don't know what is coming next.

Senator TYDINGS. We are liable to raise the point there that what the control system is doing is unconstitutional.

Dr. SIMPSON. I do not quite understand that.

Senator TYDINGS. You see, we are delegating power to the control council to take jurisdiction over a certain amount of our internal affairs. I am not arguing against the wisdom of it, but we have got a system that is so set up. That may call for certain renovation of our industrial machine.

Our Constitution provides that every man shall be secure in his person, his papers, his house, and his effects. That is in there. Nobody is advocating that we take it out; there it is, and he can go into court and say, "This is my castle."

Therefore, when this supergovernment says, "Look here, we don't care what your Constitution says, we are going to send 2,500 men over into your country to go through everything," we may say, "How about that?" and so may other countries.

I am not arguing about the wisdom of it, but we humans don't always build as wisely as we think. We build for a generation or

five generations, and we have done a pretty good job when we can go that far along, because our Government is the oldest unchanged government in the world today.

That being so, we have got to approach all of this solution with a thorough knowledge of the limitations that are here, there, and everywhere. I don't mean that we should stop in trying to preserve civilization; but it isn't just like saying X plus Y equals Z. It is X plus 2 minus Y over 12 times 367 divided by 472 equals Z to the 20th power. That is how complicated it is.

Dr. SIMPSON. You are raising the question now of giving up certain rights that we have always assumed we have. If it is necessary to give them up, we say give them up, but there is one point I would like to bring out with regard to the development of science. It should be possible, without changing our ideas, at least among the scientists, to provide for free exchange of scientific information and the right of publication.

Senator TYDINGS. You scientists confuse me terrifically, and I don't want to interrupt you. You come in here and say—and I understand why you come and I agree with you—that if atomic war comes in the future, 40 cities will be destroyed, 40,000,000 people will be killed, then there will be retaliation and so many cities will be destroyed, so many millions killed, and then the Army will come in and fight this out with the old-style weapons.

That is the prospect, and yet you say, "We know that, but we would like to edge in on that situation as far as we can."

The very fact that you start to edge in on it makes the horror of what you picture come that much nearer. If it is as bad as you say it is, then we ought to fight it out. If we have got pneumonia in the community, and it is a contagious disease, we ought to fight it out. I cannot see this temporizing with it.

Dr. SIMPSON. No; I believe you perhaps misunderstand. I was referring to only one little phase of that over-all problem. Anything we have to do to make this thing function, or to help make it function, we must do.

Senator TYDINGS. Suppose your alternatives are this in theory, because none of these are 100 percent—but suppose your alternatives are prohibition against the manufacture of atomic energy either for peacetime or for wartime uses, coupled with an international agreement against its manufacture, coupled with thorough inspection to prevent its manufacture, coupled with penalties for a breach of the agreement, and your other alternative is to license, in the world as we know it and in the world as it has been, the manufacture of atomic energy for peacetime purposes with the knowledge that when you do that you are 75 percent on the way toward constructing bombs?

What, as a matter of common sense, just taking the two theories without going into all the various implications that ought to be considered, is your choice in that situation?

Dr. SIMPSON. Our choice is obviously to take the former course, the one where we keep prohibition up until we have a reasonable assurance that our control system is functioning.

Senator TYDINGS. But there is nothing in the world in the past which has given us that vista so far.

Dr. SIMPSON. I think there is one other possibility, though; namely, that in the near future it will be possible to license certain types of power plants without getting 75 percent close to your atomic bomb.

Senator TYDINGS. Well, suppose you get 25? With men like they are, you know you let men have shotguns to go hunt ducks and rabbits and one thing and another, and once in a while you see where a fellow has used a shotgun to kill somebody. If a shotgun is an individual weapon, used from one man to another, you can afford to take a chance; but when you use the atomic bomb you are putting into the hands of the murderer something that will kill 40,000,000 people with one discharge of the gun, and I don't want that kind of murderer to be at large.

Senator HICKENLOOPER. I think the chairman raised a question a moment ago that goes right to the bottom of this thing. I don't think we can discuss this fully right now, but we have devoted so much time to talking about treaty prohibition of this potent weapon. It seems to me I recall we have had agreements to scrap battleships and cut down calibers of guns, and we agreed that we wouldn't invade the other fellow's territory, and so on.

Now, as long as we were not hungry in this country, as long as we didn't feel that we were being abused in this country with some of our rights being taken away, we cut down and went toward the road of peace in armament.

But other countries in the world, rightly or wrongly, began to believe that they were abused either through food or through economics, and the treaties we had made, the prohibitions solemnly entered into and specifically put on paper, the promises that were made were immediately scrapped.

Senator TYDINGS. Your comparison is not the one I had. You see, we didn't have prohibition; we only had the right to have a little of what we wanted. When we kept a part of our battleships and kept a part of our armies and a part of our military air forces, and all that, we were always ready; the only difference is, instead of having 100 atomic bombs we allow each nation to have 10.

Senator HICKENLOOPER. My thought is this: There is a problem beyond the question of agreement and treaties. There is the problem of the underlying human causes as to why people fight. The average man doesn't go out and shoot another fellow with a shotgun unless he has a pretty emotional reason.

Senator TYDINGS. Labor and capital are fighting a war right now without bloodshed, and the only reason they are fighting is that someone wants to get something the other fellow's got, whether it is a hundred million dollars, a house, a farm, or whatever it is. Therefore, I say that the world has absorbed so little of the Sermon on the Mount that if you allow 10 wolves to escape in Havre de Grace, Md., instead of a thousand, you have got a problem; and I don't want any of them. You have got a problem, and the only way I see to handle this problem is to realize you have got a weapon. I am not binding myself, I am thinking out loud. I may change my whole idea of this and so may you tomorrow, but we have got to discuss these things in order to get them out of our system.

If you eliminate all the armies and all the navies and all the air forces and all atomic bombs and all artillery, then you have got some chance for peace.

Senator HICKENLOOPER. But they are fighting with bamboo staves in Java today.

Senator TYDINGS. They are fighting with something that will do very little damage; but what we are fighting with is something that cannot only do damage, but can destroy 1,900 years of darn hard efforts.

Senator HICKENLOOPER. There is no question of that, I merely based that on the fact that the chairman mentioned that there are other elements that would contribute to the success of treaties we hope to get—human elements.

Senator TYDINGS. I don't see at the moment any hope of the world eliminating war—and I don't mean in the next 5 minutes, because it cannot be done—until all armaments of every kind and description, except those limited to the United Nations, are all that are in existence in the whole world. Anything else is temporizing with the situation.

The CHAIRMAN. What is troubling me is that if we can prohibit the controlling weapon of war, then I see no reason why we cannot prohibit all weapons of war.

Senator TYDINGS. The thing is as logical. Why sit up here talking about eliminating the atomic bomb and leave the buzz-bomb and the bacterial germ and poison gas and the rocket and all the other things we are working on? You say, "Well, I am not opposed to destroying 20,000,000 people, but when you get down to 40,000,000 I draw the line." That is virtually what we are saying.

The CHAIRMAN. Senator, the elimination of other weapons of war would of course reduce the potency of this weapon of war.

Senator TYDINGS. Knowing we are all thinking out loud, I want it distinctly understood that these are not my ultimate opinions; I am just groping, and I may change my whole approach to this on subsequent testimony, but I want to say this: Considering that the average big world war lasts 2, 3, or 4 years—we have had two that lasted 4 years—and the atomic bomb is now known as a thing that can be produced, in the next war it is certain to be used in spite of all the prohibitions you can make, because no nation is going down to defeat that has got one big sock left in the right arm. Therefore, if we are going to approach this rationally, we have got to consider almost total disarmament if we want peace. If we don't want it, then all well and good.

The CHAIRMAN. Senator, I have the feeling that we would like to bar its peacetime use. My present feeling is like King Canute down at the shore trying to push the waves back. You see, your thesis is based upon the proposition, as I see it, that prohibition all over the world is possible, but control is not. I cannot follow that.

Senator TYDINGS. If your objective is world peace—Good Lord, I have heard that word uttered so often in the last 6 years, that I have almost gotten to call my right arm the word "peace," it is so closely woven to everybody's anatomy. If our objective is world peace, we are not going to achieve it by the simple outlawing of the atomic bomb, anymore than you are going to have an outlawing of everything else and supplement that with world-wide inspection. The logic of the thing flows that way.

If you start a war without an atomic bomb in existence anywhere, before that war is over it is sure to be used. No nation could afford not to build a plant in case the other nation did build it.

Then, when some nation was threatened with extinction, or wanted to save human life, we would go over and wipe out that nation or they would wipe us out.

So, if we want to limit the use of the atomic bomb, it seems to me world disarmament is the only way to do it.

The CHAIRMAN. You will remember it was you who called my attention to the fact that Litvinoff, in 1926 at the Disarmament Conference when there was talk about limiting cruisers, stated: "I thought we were here to disarm; and the way to disarm is to disarm."

Senator TYDINGS. It is quite true Mr. Litvinoff came before the League of Nations and said, "This is a disarmament convention; I propose that the world disarm"; and that is exactly where we are today. We are sitting here talking about disarmament without being willing to disarm.

Senator MILLIKIN. The nation that has no armament has always advocated disarmament, and that was the basis of Litvinoff's plea; Russia was not armed at that time.

Senator TYDINGS. That is right, and now Russia is.

Senator MILLIKIN. I don't hear Litvinoff asking for disarmament.

The CHAIRMAN. I haven't heard of Mr. Litvinoff in some time. I wish he were present making the same kind of speeches.

Senator TYDINGS. I am trying to think my way through this thing, and I certainly haven't gotten to any place where I want to get off the train yet. Here we are all talking about the horrible destruction of this thing which must be controlled, and we have two alternatives. One, it is bad, but we will play with it a little bit; the other is we are adopting a course which will make sure that it will be used if the League of Nations or the UNO falls down.

Senator HICKENLOOPER. In other words, we are saying that a few little healthy minor wars aren't bad, but we don't want a major one with the bomb.

Senator MILLIKIN. Would you say, Doctor, until we reach this stage of perfect world cooperation that we should keep our own bombs and our own manufacturing facilities?

Dr. SIMPSON. No; I don't think that is consistent with trying to attain this world cooperation.

Senator MILLIKIN. What would you say we should do with our own stock of bombs as they are in existence or as they may develop if we continue to make them?

Dr. SIMPSON. Suppose I make my own personal proposal on that to see how it would shape up. It has been stated that we have atomic bombs, that the Uranium-235 plants are in operation, and plutonium project is still running.

Senator MILLIKIN. Assume that.

Dr. SIMPSON. Yes. If we agree that the best possibility of getting in the immediate future some cooperation among the major nations of the world is by being certain that the atomic bombs are not assembled or that there are no atomic bombs, then we can do one of two things: We can shut down our plants and throw away our material, or we can take that material and distribute it to other scientific laboratories of the world. If one-half kilogram is distributed to each of many of the principal laboratories of the world, that material cannot be used for destructive purposes.

The CHAIRMAN. But it can be analyzed, Doctor, with great help to the recipient, can it not?

Dr. SIMPSON. I don't understand that. It will be material that is known already. The men know what that is, and they will know anyway the number of its properties, even from ordinary cyclotron research.

Senator MILLIKIN. I would like to hear all your reasons, but I will put a little plug in at the moment. I want you to explain at some point why we should do that.

Dr. SIMPSON. All right. I will explain that later. That is one possibility. Another possibility is to push ahead in our own research by making available to the universities and to the Government laboratories in our country the material that would go into this bomb to produce new types of power plants that use this enriched material. That is another possibility that would prevent the use of bombs at the moment.

This does not, however solve the problem.

Senator MILLIKIN. As Senator Tydings points out, that takes you three-fourths of the way along to an atomic bomb.

Dr. SIMPSON. Not these power plants that are developed; they would not be that type at all. It would be practically impossible to take this material from them in a short time without definitely planning such a thing.

Another step, of course, is to merely discard your material, but how do the other nations know you have done that? We cannot assume that they trust us.

Now, what do you suppose that any of these proposals offer to the other nations? How are they going to determine our program for themselves? Are we going to institute the beginnings of an inspection system and let the UNO try working it out in the United States? Are we going to propose to bring these people in who could calculate closely what the plant produces from its design, the way the machines operate and the number of days of operation?

Senator TYDINGS. There were a lot of stills during prohibition days, Doctor.

Dr. SIMPSON. That is right.

Senator MILLIKIN. I am oversimplifying, but I would like to get a sharp focus on this simple thing: Assuming that we do not trust the rest of the world, until that moment of trust comes should we dispose of our bomb stock pile and our plants for making bombs?

Dr. SIMPSON. I cannot answer that question, because I don't see any way of starting out on the assumption that we cannot trust the world to hunt for a solution of our problem. I just cannot see any solution to this problem at the present time.

Senator MILLIKIN. Do you trust the world in its present posture?

Dr. SIMPSON. No; but I trust the world, at least if we make a determined effort, to look for some solution in the immediate months following. We do not necessarily have to give up our bombs tomorrow or by February 15, or something like that. We have to start the ball rolling, and if making things move faster means that we have to throw away or unassembled our bombs, if we have them all assembled, I cannot see any other way out.

Senator MILLIKIN. Doctor, that puts the burden on you of demonstrating that if today we disposed of our stock pile and destroyed our plants that that would bring about a state of trust and confidence in the world.

Now, make a demonstration of that, please.

Dr. SIMPSON. I cannot, and I know of no man that can do that.

Senator MILLIKIN. That is a sheer matter of faith?

Dr. SIMPSON. It is a matter of trying to develop the only course open to us. I don't believe that we have made an effort to do that.

Senator MILLIKIN. Suppose we did. Suppose we destroyed our stock piles, destroyed the plants that make them, and invite the world to come in and satisfy itself that we have done so.

Will you please explain to this committee what assurance we would have that it would reform the human nature of the world and its war-making tendencies, and that we would have nothing further to fear as far as the atomic bomb is concerned?

Dr. SIMPSON. I cannot offer such assurance.

Senator MILLIKIN. It comes back to an act of faith, doesn't it?

Dr. SIMPSON. It comes back to this: There is another possibility. We certainly face the imminent development of a full-fledged armament race over the period of the next few years.

Senator MILLIKIN. Let's take the next step. You haven't demonstrated, and you say you can't. I have suggested a way out as a sheer act of faith, and I am not disparaging faith except that I would not allow my own country to become insecure, or what I thought was insecure, on a sheer proclamation of faith.

Let's take a look over the world, without mentioning specific countries or specific controversies. If we today destroyed our bomb pile, do you think that that would cure the situation, let us say, in China?

Dr. SIMPSON. I think that no single step would cure any situation.

Senator MILLIKIN. Do you think it would cure the situation in Burma?

Dr. SIMPSON. No.

Senator MILLIKIN. Do you think it would cure the situation in the Dutch islands? Do you think it would solve the question in Iran at the present time? Do you think it would solve the questions in the countries bordering on Russia? Do you think that if we did that we would solve those questions?

Dr. SIMPSON. To date we have not made enough of an effort to get any evidence one way or the other whether we can obtain a solution by making, as one of the many steps that we propose, the unassembling of any bombs we may have.

Senator MILLIKIN. Suppose we invited the representatives of the world into this room and said, "Gentlemen, we are going to make the sublime gesture of all history. We are going to destroy our bombs. We are going to destroy our bomb plants. We are doing this as an act of faith, as a gesture to enlist your faith to bring about a state of true world cooperation, a true state of peace."

They would all get up and applaud. They would be delighted, of course, because they haven't got bombs.

But would that act of faith change them in their hearts? Would it change the whole attitude of the world toward war and peace, which I suggest is the worst it has been in our history. I respectfully sug-

gest in that connection that the problems of this world are worse than they were at the beginning of the last war, and worse than they were before the beginning of World War I.

Do you think an act of that kind would change the fundamental facts that are leading to these conflicts?

Dr. SIMPSON. You make a very interesting argument, but I cannot agree that any single step or any few steps or gestures will create that condition.

Senator MILLIKIN. Let me put it to you this way, Doctor: Suppose you had complete power to do what you wanted to, that you could assemble the nations, that you could make any kind of an agreement that you wanted to between the members of the nations of the world. What would you do at this moment respecting the atomic bomb? Assume you had a blank check that you could maneuver this thing the way you wanted to. What would you do?

Dr. SIMPSON. This is answering a question which is theoretical, but I will make an attempt to point out two or three things on my mind.

Senator MILLIKIN. This not entirely a theoretical question. We are going to have a meeting over in Moscow in the very near future which I read in the papers will touch this subject.

If you could do exactly what you wanted to do at that meeting, what would you do?

Dr. SIMPSON. First of all I think you must have an educational program, at least an explanation of the problem involved. I do not think all nations, or even the heads of the governments, thoroughly understand the problem of the bomb itself and some of the technical facts behind it.

Senator MILLIKIN. You would educate?

Dr. SIMPSON. No. 1.

Senator MILLIKIN. Let's assume you kept the heads of state there until you could educate them, and now they know as much about it or more than we do here. Where would you go from there?

Dr. SIMPSON. The second detail is one of asking them how they would solve this problem, what part they would play in this. They realize after all, whether they say so or not, that they want to get into atomic energy developments.

Senator MILLIKIN. Wouldn't you say they would unanimously say, "We want you to get rid of your bombs."

Dr. SIMPSON. I agree they would say that.

Senator MILLIKIN. They would all say that, of course.

Dr. SIMPSON. Surely.

Senator MILLIKIN. Now that is the next step. They have said, "Now, Doctor, we want you to get rid of your bombs and destroy your bomb plants."

Now, where do we go from there?

Dr. SIMPSON. I think that we have to say that this is a possibility that we are at least willing to consider, but that this has been our first meeting. I don't know of any other meetings they have had aside from Britain and the United States. This is the beginning. In a period of 6 months we have an opportunity to reach some understanding of this problem. Certainly in 6 months man can reach some sort of understanding of the problem.

I do not think that in an interval of 3, 6, or even 9 months that our bomb production is shifting the opinion of other nations as quickly as we think it is. I do think, however, we are in error in stating that we are building bigger and better bombs.

Senator MILLIKIN. Now we are sitting around the table, and you have made that suggestion. During that 6 months, what are we going to do?

Dr. SIMPSON. I don't know. I would like to know what the results of that initial conference would be before defining the next step.

Senator MILLIKIN. So we are right back to where we are here?

Dr. SIMPSON. Yes.

Senator TYDINGS. Doctor, I would like to ask you a question.

As we try to think this problem through, and certainly it is a most difficult one, it seems to me that the logic of all you have said, and particularly since you have had your colloquy with Senator Millikin, is that for the time being our principal task is to get the first essential step, which is to get a treaty on the prohibition of the use of atomic energy in any form, plus inspection. That is primary, and all the other things must come after that by international agreement rather than to try to control it in its initial stages and find that it is beyond our grasp because we have tried to control it by jumping to the middle step in the stair instead of getting on the first. Am I wrong?

Dr. SIMPSON. No; I think it would be very interesting.

Senator TYDINGS. Why did you say to Senator Millikin, then, in answer to his question, which is the question we are all asking ourselves, this: Gentlemen, we have atomic-bomb plants and we have atomic bombs. We don't believe any other nations have them. If you will give us a treaty giving us your solemn obligation that you won't manufacture these bombs and will not permit plants to be built, plus terms of inspection which are satisfactory to us, we will consider that and attempt, if we can implement it, and so on, to make it satisfactory and prohibit it in our own country.

That is the logic of your testimony, isn't it?

Dr. SIMPSON. Yes. I would like to clarify one or two things you said. One is the treaty and how long it may exist before the system is in operation.

Senator TYDINGS. But you have got to have a beginning. Our trouble now is in this muddled world to get a beginning on this problem. Do you think that that beginning—and I don't mean in all its refinements, but in the rough idea to be refined later—is the right approach?

Dr. SIMPSON. Yes. If this came out of the Moscow meetings I think we would be very happy.

Senator TYDINGS. My second question is, suppose that agreement was in the process of being discussed. Would the people of America support giving up their atomic bomb plants and factories in the world as it is today under such a proposal, and if they wouldn't obviously Congress wouldn't.

Dr. SIMPSON. I don't know the answer to that.

Senator TYDINGS. You see, this is the thing where science cannot be quite as exact as it might be in some other things.

Dr. SIMPSON. I am not talking as a scientist now. For the last hour you have been talking to me just as a citizen of this country, and not an entirely well-informed one in this field.

Senator TYDINGS. But you do think prohibition is the first step, or don't you think it is the first step, supplemented by inspection?

Dr. SIMPSON. Well, I believe it is. I almost hate to use the word, because many times it denotes something you plan to extend for almost an unlimited length of time. It is the step to make now.

Senator TYDINGS. You have got to make a beginning. In other words, suppose you were Secretary of State Byrnes and you were going over to this council and you had this problem. You had possession of the plants and you had the bombs. What approach can he make to solve this problem? He probably would like to know. I would like to know if it were I that were going, and what I am thinking about is what other approach can you make at that time? Is there another approach, and if so, what is it?

Dr. SIMPSON. I don't know any other approach. I think that this is a step forward as we look at it today, on December 12, 1945. Two or three days later some nation may do or say something which will modify our opinion on that matter.

Senator TYDINGS. What I mean is that all of you gentlemen quite properly have said you are not going to leap up to the top of the stairs and solve this problem in one leap. It is going to be made by successive steps.

Now, what is the first step?

Dr. SIMPSON. This may be. Legally, treaties are the things by which you agree to carry out this mechanism, which is very well if you can get an agreement which means that international control will work. That, in itself, is very important, because there are political issues involved there; in fact, they are almost all political. Then, you have created a great first step, and these steps must come fast.

Senator TYDINGS. It seems to me the logic of what you have said here, and what everybody else has said, is this, boiled down: Here we are faced with an atomic bomb armament race. Here we are faced in the next war with obliteration of our people and devastation of our cities, the killing of millions of people because of atomic bombs and atomic energy, and the world is in a terribly unsettled condition. Something has got to be done about it.

The first step, it seems to me, is to stop everything, provided other nations will stop everything and submit to inspection.

Now, is that your thought and is that, in your opinion, the thought of the men who have thought about it, the other scientists?

Dr. SIMPSON. I think the men will support that. That, at least, is my thought at the moment.

If that could come out of the Moscow agreement and be tentatively proposed to the UNO, that would be a great step.

Senator TYDINGS. But here is what I am ultimately driving at. Your paper is excellent, and I think it is one of the best we have had. We have had some fine papers that have been read here, both in open and in executive session.

The thing that we all agree on is that it is a big problem and the implications are terrific; but so far as I know, except in the most general way, nobody has outlined what the first step ought to be, and obviously, and we cannot go from the first to the second floor until we build the first step.

Dr. SIMPSON. I think the hesitancy on the part of the men you have been hearing in the past 2 weeks has been a justified one, that we don't know enough about the political problem.

Senator TYDINGS. None of us know; none of us can know. You know as much, let us say, about Burma or India or China as most of us know. We all get our news from the press.

What I hope your organization will do, and I hope the chairman will ask you to do, is after deep thought and discussion within the limits of Army regulations and secrecy to give us what you consider to be the plan of approach of the scientists of America and those who are associated with you, step 1, 2, 3, and 4; not that you won't make mistakes in it, but it will be the best thought that you can contribute to our efforts here.

The general statement of what is going to happen if we don't do something—we are all sold on that. What I am taking home with me every night is, "Well, how do we start this thing; how do we get rid of it?"

I want to get rid of the feeling of frustration. I want some door open some place in the room where I can get out of here and get into an atmosphere where I am making progress.

If your organization in exchanging its many views, which I think is very helpful because you are reaching a more mature thought, were to arrive at some program with steps 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and so on, as far as your imagination and your reasoning goes, that would be something concrete that we could then mull over and study and we would begin to make progress.

The trouble is we are all learning what this thing is, but nobody is telling us what to do about it.

The CHAIRMAN. Doctor, Senator Tydings wants the door open, and I share his desire to open the door.

Would you say that we would be opening it at least a crack, just as far as a crack in the door, if we were to announce that we had stopped making bombs and had closed down that portion of the project which has to do with transferring of fissionable material into bombs, but we were continuing to manufacture the fissionable material with the hope that it would be devoted to peacetime purposes? I do not mean plants so much as I mean medical research. Do you think that would be a step forward?

Dr. SIMPSON. My answer, of course, will be immediately attacked. I think that is not what you call a step forward, but at least it is a trend forward. I think that throughout the world, whether or not nations trust us, they at least know that some of the things we say are true, that the things we say, we do; and this certainly may be one of them.

If we say it and we do it, I cannot in history see any error in our judgment on that point.

Senator MILLIKIN. I am afraid, Doctor, there will be nobody to write that history.

Dr. SIMPSON. As I say, that statement was open to attack, and I knew it.

The CHAIRMAN. That is the most gloomy prophecy of all, Senator.

Senator MILLIKIN. As I interpret the doctor's general tenor, he rests his thesis on far more faith than I would be willing to indulge in. I do not mean to indulge in human prophecy, but I seek to indulge in the kind of light Senator Tydings is talking about.

May I make a suggestion, Doctor?

Dr. SIMPSON. Yes, please.

Senator MILLIKIN. The scientist, as I see it, and as I get it from the testimony that we have had, is an idealist. He is in a true sense—and I am not using this in a disparaging sense—an internationalist. He is, because he is accustomed to interchange and meeting people from all over the world. His specialty is science. He works in the field I have described, and therefore he does not specialize in human nature and in the causes of war and therefore underweights that when he proposes a practical solution. He proposes a solution naturally out of his own environment, out of his own way of thinking; it couldn't be otherwise. Therefore, perhaps a committee of this kind might be said to be trying to fit a jigsaw puzzle. We have got a piece from the scientists which is perhaps too big. We have got a piece from the military, which is perhaps too big. We may have to whittle those down, both of them, because we have got to make a picture that will fit the frame of human nature, that will fit the posture of the world as it is; and if I were to take the liberty of making a suggestion to the scientists, I don't believe they have given enough weight to the way this world is, to the way people are, to the enormous revolutions that we would have to accomplish in the way people are—not as we would like to have them—in order to make a strictly scientific program work. I don't say that in a disparaging sense. Personally, I am delighted to get the testimony of witnesses like yourself. I myself say frankly that I have got to discount it somewhat, just as I have to discount somewhat the testimony of the military, because I don't think any of the special pleaders have taken into consideration enough things that must be taken into consideration.

But it certainly would be helpful to us, if, as suggested by Senator Tydings, someone came in here and gave us a practical program that not only fits science but fits human nature, fits the problems of the world as they are.

The CHAIRMAN. You have given some consideration, I presume, not in any way in derogation of what Senator Millikin has said, to what an atomic armament race would be if it is allowed to go uncontrolled?

Dr. SIMPSON. We have tried to interpret that in terms of what human nature is like and what it will do. I think there is just one point to make, that at no time are we saying that what we propose is a sure way out. All we are trying to say is that maybe there is a chance here. With the other course, we don't see any chance. We see the end result. The other way we do not see the end result. Our set of facts may lead us to destruction, but at least the facts include also the possibility of extended periods of peace. Therefore we say we are experimentalists, not in the sense of social experimentalists but in the sense that at any time in history we shall sit down and discuss the problem dispassionately. We must weigh the human values, the political issues, and the scientific facts involved, and then we may be able to state, "Now, if we do this there may be a chance that this will create a better condition." We must do this.

Senator TYDINGS. Doctor, I would like, with the permission of the chairman and other members of the committee, to extend to you a request that your organization, composed of scientists and engineers and others who have exchanged these views, and you, or whoever is ap-

appropriate, assuming you will transmit this request to them, will think on this problem collectively in such fashion as they can and give to the chairman at the earliest possible date the best considered program which your group can derive for steps 1, 2, and 3 at least in a very difficult series of steps, the initial steps and any others that you might think of that would follow from there particularly with reference to the question of prohibition, treaties and inspection at this juncture as contrasted with either an armament race on the one hand, or partial international agreement with licensing of peacetime atomic energy on the other.

Senator MILLIKIN. Would you let me offer an amendment?

Senator TYDINGS. Gladly.

Senator MILLIKIN. I would like to have one more thing in that, and that is a specific statement as to at which point we destroy our bombs and level our bomb-making plants.

Senator TYDINGS. That would be a very welcome suggestion, where when we take these progressive steps the point comes that we can in justice to ourselves and our world obligations take the hazard of leaving our country possibly defenseless and relying on treaty and inspection.

If the chairman would permit that request or would make it himself, I would appreciate it, because in groping for a beginning of this thing I find my greatest difficulty not what I want to achieve eventually, but how to start to achieve what I want to achieve eventually.

The CHAIRMAN. I will be very happy to endorse that request as chairman.

As I told you yesterday, Senator, and informed the committee, the scientists are busy on a tremendous project, and that is the inspection system, which they undertook at my request and hope to have done right after the first of the year.

I would like to call your attention to the fact that they have not moved into this field extensively that you now suggest they move into because—and if I am in error you can correct me, Doctor—there was a feeling on the part of the scientists, a modest feeling that I don't think they should have had, although they have been criticized by some Senators and Congressmen that I have heard personally for daring to come in to suggest in the political field.

Senator TYDINGS. I think they ought to be welcomed.

The CHAIRMAN. I agree with you, but you know and you have heard, too, criticism of the scientists on the ground that they were men of science and were not versed in political science, only in the natural sciences. I think they have been aware of that problem, and that they did not want to get out of their field of natural science fearing that they might destroy their influence with those who criticize them for doing the other thing.

I feel exactly as you do, and I hope Dr. Simpson takes it up with the group, that in the light of this discussion that sentiment will disappear, and they will go forward on the program with full assurance that we will welcome the kind of paper that Senator Tydings and Senator Millikin have suggested.

I want at this point to pay a great tribute to Dr. Simpson and to his associates in this Federation of Atomic Science, who have seen the terrific implications of that which they have wrought. I don't

believe that this country is awakened yet to the possibility and the implications, but without them we would be much further back along the road, and they are deserving of great credit.

Senator TYDINGS. I want to reecho what you have said in praise of the gentlemen who are before us. I think that every one of them has made a distinct contribution, and I hope they won't mind a little battering, because the objective is so worthwhile that any little scratches or cuts we may get in trying to achieve the ultimate result are minor compared with the benefits that may go to mankind.

I am very hopeful that it won't take too long for the scientists to congeal on at least what they can agree on as the first two or three steps, because if we had something more concrete than generalizations, I believe with your great knowledge and experience and background in this thing and the vision and the thought you have put on it, we will make a little more progress toward an ultimate solution than we otherwise might make.

The CHAIRMAN. Thank you very much, Doctor.

This shows the difficulties of trying to run on schedule. We had hoped to hear three of these young men this morning. It is now 12 o'clock, and I do not think we had better start with another witness.

If it is agreeable, we will meet at 2:30 to hear the other two gentlemen in open session.

Tomorrow we are to hear from representatives of the Navy Department, more particularly Commodore Parsons who dropped the bomb over Hiroshima.

We will recess now until 2:30.

(Whereupon at 12 noon the committee recessed until 2:30 p. m. of the same day.)

AFTERNOON SESSION

(The committee reconvened at 2:30 p. m., pursuant to the noon recess.)

The CHAIRMAN. The hearing will come to order.

Which one of you gentlemen is coming first? Are you, Dr. Williams?

Dr. WILLIAMS. Yes, sir.

The CHAIRMAN. All right, proceed, Doctor.

STATEMENT OF DR. CLARKE WILLIAMS

Dr. WILLIAMS. Thank you.

The CHAIRMAN. You are a member of the Federation of Atomic Scientists?

Dr. WILLIAMS. Yes.

The CHAIRMAN. You go right ahead, Doctor.

Dr. WILLIAMS. Very well. Shall I introduce myself?

The CHAIRMAN. Yes. I would like to have the record tell who you are.

Dr. WILLIAMS. Yes, sir.

My name is Clarke Williams. I am a physicist. I have been on the faculty of the College of the City of New York since 1930. For the past 4 years I have been engaged on the atomic bomb project—for the

most part in New York City. I am a member of the executive committee of the Association of Manhattan Project Scientists, which is the New York branch of the Federation of Atomic Scientists. This is my statement.

As Dr. Simpson has already pointed out, the atomic bomb scientists and engineers have shown a surprising unanimity of opinion in their belief in the need of an international control of atomic energy.

It seems fairly clear to us that such control involves a rather complete inspection system carried on by some international agency. Because of the ease with which an assembled bomb can be concealed, the only way to create a world-wide feeling of security against atomic bomb attacks is to insure that no bombs are being constructed. Such insurance can be secured through an efficient inspection to detect violations of the regulations of the international control agency.

In order to set up such an inspection, two phases of the problem must be solved; one phase is political, the other technological. We realize that the over-all question of international inspection is primarily a political one. The two phases, however, are completely interrelated, and really require simultaneous solution.

The political problem concerns itself with such questions as the setting up of an international control agreement; provision for the free access of inspectors to all critical points; and provision for enforcement of regulations. Problems such as these must be solved before any inspection force can operate effectively enough to produce a feeling of security throughout the world.

The other phase of the feasibility of inspection is the technological one. An answer must be secured to this question: Is it feasible to inspect operations of various sorts in all countries so that there is very little possibility of clandestine production of fissionable material or diversion of such material produced in legitimate plants?

I have discussed the problem of international inspection with a large number of my associates in the New York laboratories and in the gaseous-diffusion plant at Oak Ridge, Tenn. I have also had the opportunity for such discussion with representative scientists from the other groups within our federation. I have found it generally true that within the limits of his own field, each scientist feels that techniques for inspection can be worked out. However, the compartmentalization is so complete that no one person is in a position to consider the feasibility of inspection covering the whole range of methods for producing fissionable materials.

Senator MILLIKIN. Mr. Chairman, at that point I would like to interject a question.

It is this, that at least one of our distinguished witnesses has said that, regardless of the compartmentalization which was put into effect on this problem, despite that compartmentalization, they knew what was going on. As I understand it, I gathered the impression that the compartmentalization was only a subterfuge.

Dr. WILLIAMS. Well, as far as views on nontechnical subjects are concerned, there is an interchange of ideas. As far as the technical material which is classified as secret, there is practically no interchange of ideas.

I would say that my experience has been that all the people I have worked with on this project have been quite punctilious in observing

the restrictions that have been imposed upon them by the Army. They did this although they may not have approved all of those restrictions. They conformed. I think there has been no deliberate attempt to evade the regulations.

Therefore, we are not in a position to know the technical details which are necessary for a complete discussion of this problem. I think I will present that aspect of it later on in my testimony.

Senator MILLIKIN. It follows then that departmentalization is a good idea for wartime. It worked for the duration of the war.

Dr. WILLIAMS. Yes.

Five different methods of obtaining fissionable materials were successfully developed in this country. Dr. Simpson has indicated that it would be desirable that the testimony of the experts in these different fields be integrated in some manner to be determined by your committee. Most of the information that would be needed in developing a feasible inspection system is now secret and compartmentalized. Should a group of scientists and engineers be selected to make a suitable integration, they should have access to all the necessary material and have the opportunity for free discussion with experts in all fields. I might interject that at the present time this is not the case.

To illustrate my point, I would like to indicate the sort of questions that would be raised in considering the feasibility of inspection of a gaseous diffusion plant for separating Uranium-235. I have chosen this example, because I have been working on the development of this method for the past 4 years. Some of the questions raised, however, will be applicable to the other methods as well.

The problem can be divided into two parts: First, to insure that no material is illegally diverted from existing known plants; and second, to discover any attempts to build and operate a secret diffusion plant. If a plant is operating, openly or secretly, one basic check that may be suggested is to keep an inventory on all uranium from the ore reserves, through the mining, refining and processing, to the final product and wastes. If this is feasible, it would be a very powerful method for preventing the misuse of products of the diffusion plants. Specialists in the fields of geology and mining, in metallurgy, in uranium and fluorine chemistry, and in the gaseous diffusion process itself would all be needed to work out this problem.

The problem of developing methods for the discovery of a secret plant involves a detailed knowledge of all the components that go into such a plant, such as pumps, instruments, special materials, etc. Some of the components may be unique in their construction or in the materials from which they are made, and may, therefore, be relatively easy to identify. It might then be simple to determine whether they were being diverted from legitimate uses to secret diffusion plants.

For example, there are several thousand centrifugal pumps in the gaseous diffusion plant. These pumps have certain characteristic features such that anyone with some familiarity with centrifugal pumps could recognize them in any factory. There are only a few manufacturers in this country that could build such pumps. To build several thousand secretly would be very difficult, unless it were done on a very small scale. The delay attendant on small-scale production would involve a long period of plant construction, again increasing the probability of detection.

Senator MILLIKIN. Mr. Chairman, I would like to interject.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. Could you take a normal pump and modify it to suit this purpose?

Dr. WILLIAMS. I don't believe so.

Another characteristic item in a diffusion plant is the barrier material. Here is a unique material which has to be made and fabricated on a large scale. Such manufacture would be extremely difficult to conceal.

The amount of power needed to operate a diffusion plant is large. Power experts can determine whether such quantities could be diverted from existing electrical networks without the possibility of detection by competent inspectors. As an alternative, the power could be produced directly from fuels available at the site. In this case, the power expert could determine whether equipment could be secretly manufactured and installed without the likelihood of detection.

Engineers who have been instrumental in laying out the present plant could give details as to how extensive the preparation of a plant site must be. This would indicate to experts in photoreconnaissance the difficulty of building such a plant secretly in such a way as to escape detection by aerial or other systematic surveys of all remote territories.

It is also pertinent to question whether a diffusion plant which was already completed and hidden could be detected. Improvements will undoubtedly be made in the design of the various components of these diffusion plants, which will certainly result in an increased plant efficiency. This would make it probable that any plants built in the future could be more compact than the present one, and hence much more difficult to locate once they have been secretly completed.

The CHAIRMAN. Doctor, would you be good enough to give us your opinion on whether the diffusion method is the most efficient method.

Dr. WILLIAMS. I am not competent to answer that question, because of the fact that there was this compartmentalization that we have talked about. I do not know anything about the efficiency of any other method.

In the fact that such plants would be more difficult to find once they are built lies a powerful argument to hasten the setting up of an inspection system on a world-wide basis.

In addition to the inspection of all physical aspects of atomic-bomb plants and their raw materials, there may be feasible methods of inspection involving the scientific and technical personnel necessary to develop, design, and operate such plants. The questions that must be answered to determine the feasibility of these methods involve the following points:

1. The possibility of making a complete check of all the scientific and technical personnel in every country to insure that no important number are being secretly trained and diverted for the development and construction of large-scale atomic-bomb plants.

2. Any intended violation by a given country of the international-control agreement will, of necessity, be known to some of the scientific and technical personnel in that country. Because of their overwhelming desire for maintaining the security of the world, we feel that there will always be a certain percentage of these scientists and technical

men who will report violations to the international-control commission. On this account, international and national laws should encourage and offer definite protection to those who report violations.

3. In order to prevent the secret disappearance of key scientific and technical personnel and in order to detect discoveries and developments which may lead to new methods for the production of fissionable material and atomic weapons, it is desirable that there be a rather thoroughgoing interchange of scientists and technical men. In addition, as a further safeguard, there should be complete freedom of publication of all scientific and technical discoveries and developments.

Undoubtedly no system of inspection could be absolutely certain to prevent secret production or diversion of fissionable material for illegitimate uses. However, under a good inspection system, the chance of evading inspectors becomes small, small enough in fact that in all probability the risk of being caught in a violation would act as a sufficient deterrent to keep any nation from such an attempt. Furthermore, a good inspection system would create among all nations a greater feeling of confidence in the behavior of their neighbors. Such a feeling of security would in itself render the secret production of atomic armaments much less likely.

While the scientists and engineers seem to feel that an international system is technically feasible, it is nevertheless quite clear that an adequate study of this problem has yet to be made. Statements concerning feasibility have been based upon the limited information available to individuals. A complete picture involves the ideas and information of many experts, within and without the atom-bomb projects. Until some means of coordinating this information is provided, the integrated analysis of the feasibility problem cannot be made.

The CHAIRMAN. As I understand it, Dr. Williams, you have requested that the next statement be heard, that you prefer that the other gentleman, Dr. Weinberg, read his statement before either of you is called upon for questioning.

Dr. WILLIAMS. I think that would be more satisfactory, because some of the questions that are raised by the following statement are pertinent to what I have said here.

The CHAIRMAN. Is there any objection?

Senator AUSTIN. No, but I would like to ask one question. I do not know whether he can answer it or not.

You spoke of a provision for enforcement of regulations in your formal statement. Did you have anything concrete in your mind?

Dr. WILLIAMS. No, sir; the only thing that we felt was this, that if any regulations were set up they would not mean anything unless there was some way of enforcing them.

At to the nature of the agency that would be set up, we have not felt that we were competent to pass upon that. It would be in the nature of a judicial and policing force. We do not feel that we are competent to say how such a thing should be set up.

However, it does seem to us that in order to implement anything in the nature of inspections that there must be some way of enforcing the regulations.

Senator AUSTIN. Evidently, you did not have in view any military enforcement.

Dr. WILLIAMS. No. It does not have to be military. In fact, some of the violations in the future might very well be made by individuals rather than by nations.

Senator AUSTIN. Yes. Have you discussed the question of protection for informers?

Dr. WILLIAMS. Only slightly. It is also evident to us that if a particular group in a country attempts to divert materials to an illegal use, there will also be a group of people in that country who will not approve of it and who will want some way in which they can make their knowledge known. There will have to be some sort of mechanism set up to protect them.

Now, I do not know just how that would have to be done, whether it would have to be part of the UNO or just what the mechanism would be. We do feel that something of that nature would have to be included in the international agreements.

Senator AUSTIN. Thank you, Doctor.

The CHAIRMAN. Don't go away, Dr. Williams. Dr. Weinberg.

STATEMENT OF DR. ALVIN M. WEINBERG

The CHAIRMAN. Dr. Weinberg, you are originally from Chicago. You have been working on the plutonium project in Chicago and Oak Ridge since 1942.

You are another representative of the Federation of Atomic Scientists?

Dr. WEINBERG. That is right, sir.

The CHAIRMAN. All right, Doctor, proceed.

Dr. WEINBERG. The last time I spoke to your committee was when you all paid us a visit at Oak Ridge. I am afraid my remarks then were a little lengthy, considering the fact that the hour was late. I didn't quite consider how late it was but it was later than I realized, since you were on faster time than we were and, unfortunately, my remarks were lengthy. However, I will confine myself this morning to the written testimony.

I am Dr. Alvin M. Weinberg. I am 30 years old. I am a theoretical physicist originally from the University of Chicago. I have been with the plutonium project at Chicago and at Oak Ridge since January 1942. Prior to that I worked in the field of biology. At present I am chief of the theoretical physics section of Clinton laboratories in Oak Ridge.

The previous speakers have dealt with the difficult political and technical problems which atomic power and its control have posed for us. I will talk about what we can hope for from atomic power, assuming that these problems have been solved.

The CHAIRMAN. That is some assumption.

Senator MILLIKIN. He is taking the easy part.

Dr. WEINBERG. Pandora's box at the moment is just shut tight and I am just tipping it up so that you can see what is inside.

Senator TYDINGS. If you tip it too much you could loose the whole contents.

Dr. WEINBERG. The atomic era began December 2, 1942, when the first nuclear chain reaction was established in Chicago. It came at a time when one problem—the winning of the war—was important to the exclusion of all else. The relatively few scientists and technolo-

gists who had access to the details of atomic "know how" were thinking about bombs instead of power plants. And these men represented a very small fraction of America's technical personnel. Most scientists were hardly aware of the significance of Oak Ridge and Hanford.

The urgency of war problems has left little time for the few scientists with sufficient knowledge of nuclear engineering to reflect about the future possibilities of nuclear energy. The extreme compartmentalization in the organization of the work has denied the latest facts concerning uranium deposits from those scientists who need those facts to establish the economic feasibility of uranium power. And the exclusion of nonproject scientists from technical knowledge because of wartime security has made really original ideas about future applications—ideas which come from new blood—remarkably scarce.

We thus stand at the threshold of the new era with ideas for applications of the power source which are generally very much less revolutionary than the atomic bomb itself. Nevertheless, the field is so enormous that even the applications which we have already thought about—without trying, one might say—form a lengthy list.

In the very long run we can expect nuclear fission to compete on a strictly economic basis with ordinary power sources. But nuclear power as contrasted to coal power is unique in perhaps five essential respects. It is in the exploitation of these features of uniqueness rather than in particular economic advantages that we can expect the immediate future of nuclear power to lie. I list these distinguishing characteristics and their implications for peacetime as follows:

One: The release of nuclear power is accompanied by the production of enormously intense radiations.

At Hiroshima many people were killed by the gamma and neutron rays emitted by the atomic explosion. At Hanford, Oak Ridge, and Chicago, the chain reacting piles are shielded by enormous concrete or steel shields. But the same rays which cause such damage in massive doses can, like the rays from the sun, have therapeutic effects—when given in moderate doses. Certain types of cancer yield to neutron radiation of the sort that is emitted by our chain reacting piles. Such piles can be built immediately for large-scale radiation therapy for the simultaneous treatment of perhaps 100 patients at each pile. In this capacity piles would serve, on a very much enlarged scale, the same function as large hospital X-ray therapy units.

A second application of high intensity radiation is to industrial chemistry. Just as plants synthesize sugar under the influence of sunlight, so many other chemical reactions—some of considerable importance industrially—can be made to proceed in the intense radiation field of a chain reacting pile.

Two: The release of nuclear power is accomplished by the production of radioactive substances in enormous quantity.

For the first time mankind has at its disposal radioactive materials in sizeable quantities.

Senator TYDINGS. May I ask you, there, whether that would mean that we are pretty well independent of radium, then?

Dr. WEINBERG. Yes, sir.

Senator TYDINGS. So this would be a substitute for radium.

Dr. WEINBERG. It would be a substitute for radium. It would be radium magnified by an enormously great factor.

Senator TYDINGS. So that the radium supply becomes of less importance from now on than it was 10 years ago.

Dr. WEINBERG. If I had stock in a radium factory, I probably would sell it.

Senator TYDINGS. That was a good answer.

Dr. WEINBERG. A chain reacting pile can render practically all of the elements radioactive. It is like a modern King Midas who turns common substances into radioactive ones instead of into gold, although even gold can be made by irradiating mercury. The uses which we can foresee for these radioactive atoms are medical, scientific, and industrial. For example, the waste from the Hanford plant contains enough radioactive material to supersede radium completely in its uses as either a medical therapeutic agent or as a means of industrially testing the soundness of metal castings.

From the scientific viewpoint the importance of radioactive tracers—that is, atoms, particularly carbon, which have been rendered radioactive by neutron bombardment—cannot be exaggerated. One of the most important problems of science is, "How do plants manufacture sugar out of carbon dioxide, water, and sunlight?" If man could duplicate this photosynthesis process, first in the laboratory and then on an industrial scale, the bountifulness of the earth would be multiplied indefinitely. The world's fuel and food supply would be assured as long as the sun continues to emit light. The most powerful tool at the chemists' disposal for understanding, and perhaps eventually duplicating photosynthesis, is radioactive carbon, a byproduct of nuclear power. If, as a result of our greatly increased production of radioactive carbon the riddle of photosynthesis is solved, that, and not power plants or atomic bombs, will stand as the greatest achievement of nuclear power.

Besides radioactive carbon, other isotopes will be useful for general chemical research, and possibly also for routine control of industrial processes and routine diagnosis of certain diseases. There is every reason to believe that the large-scale production of radioactive isotopes for chemical, biological and industrial users will develop into a very considerable industry, perhaps comparable to the present-day pharmaceutical industry.

Three: The release of nuclear power requires no oxygen.

The atomic fire at Hanford burns without oxygen. Here is an ideal fuel for use in a submarine; with it a ship can travel as fast under water as on the surface. The navy of the future, if there is any such, will consist of submarines which will travel a thousand feet below the ocean. The safest place on this tortured planet, should an atomic war break out, will be deep below the surface of the ocean.

Senator TYDINGS. Below the bottom, won't it? [Laughter.]

Dr. WEINBERG. I would not know the exact figure, sir, but my guess on that would be that if you were one mile below the surface of the ocean, you would be safe in two ways: one, they would have the problem of finding you; and two, after they found you, they would have the problem of blowing you out of there.

Senator TYDINGS. I should think that finding you would be the bigger problem.

Senator MILLIKIN. What is the pressure below the surface?

Dr. WEINBERG. Well, that would depend on how much below the surface. It is one atmosphere of pressure for every 32 feet of water. I think the limit would be 30 atmospheres or 50 pounds per square inch; it might be about 500 pounds per square inch.

Senator MILLIKIN. This new development might revolutionize submarine warfare?

Dr. WEINBERG. I don't know, sir. You see, at present one of the reasons why a submarine—I have spoken about this to some Navy people—at present the limitations of the power plant limits the construction design of the submarine.

If the power plant can be multiplied indefinitely, as might be the case with atomic power, then the construction of the submarine could be modified.

Senator MILLIKIN. Do you know the greatest depth that divers have ever gone to under the sea?

Dr. WEINBERG. My recollection is that it was around 300 feet; I may be wrong. Of course, there are the bathospheres.

Senator MILLIKIN. I am thinking of the bathosphere.

Dr. WEINBERG. With the bathosphere, I think it would be beyond that, but I do not know.

Senator JOHNSON. With regard to submarines, would not the resistance of the water to a forward movement be somewhat of a problem?

Dr. WEINBERG. No, I do not think that that counts. That is not the function, particularly, of the depth below the ocean. As a matter of fact, in some respects the depth might result in an increase in the speed of the submarine, a greater speed than on the surface.

You see, on the surface we have what is known as the surface wave. The ship, so to speak, has to slice its way through the water, it goes forward by the breaking of the surface itself; it cuts its way through the water.

Senator JOHNSON. Well, in the air they are increasing their speed by going into the stratosphere, where there is less resistance. I was wondering whether the same principle would apply to water. I should think that in the water the resistance would be greater the farther down you go. However, that is not important. I do not want to bother you with these matters. Proceed, Doctor.

Senator TYDINGS. Apparently, that is one of those scientific facts we are supposed to accept and not ask why.

Dr. WEINBERG. Four: Nuclear energy is extremely concentrated.

One round of fissionable material releases as much energy as several million rounds of ordinary fuel. Nuclear power will, therefore, be particularly advantageous wherever the bulkiness of ordinary fuels is undesirable. Regions of the earth such as the Arctic, in which the cost of fuel transportation makes large-scale power or heating development unfeasible could be supplied, economically, with nuclear power.

Space travel, which has until recently been deemed fantastic, must now be considered more seriously. But progress will be made only when the rocket experts are allowed to speak freely with the atomic power experts.

Five: The release of nuclear power is accompanied by the production of more fissionable material.

At Hanford, U-235 is destroyed but plutonium, which is also fissionable, is produced. Thus a nuclear power plant is unique in that at the

same time it burns up its fuel, it produces new fuel. The emphasis on nuclear power can therefore be shifted somewhat: Either one can consider the fissionable material to be a byproduct of the power or, as at Hanford, one can view the power as a byproduct in the production of fissionable and radioactive materials.

From this point of view the economics of nuclear power is rather more like the economics of water power than that of coal power. We often build dams for flood control, irrigation, soil conservation, and the like; the power which they produce is in these cases secondary. It is not too important whether the power would compete with coal power! the dams are built, anyway. Similarly, we shall build plutonium factories in which the power is a byproduct. These plants will, like dams, have a multiplicity of uses.

They will produce plutonium for use in specialized power plants. They will produce radioactive materials for technology and medicine. They will yield facilities for scientific research. The cost of the power will not determine whether or not we build the plant, so long as the production of the fissionable material is considered a desirable end in itself. And I have no doubt that, even without the atomic bomb, plutonium will always be valuable as an atomic fuel in services such as ship propulsion.

In order to produce plutonium in quantity, an enormous amount of power must be dissipated. We can conceive of a vast complex of large nuclear installations whose many functions include both plutonium and power production. We can properly compare this complex to, say, the Tennessee Valley Authority; it would have a multiplicity of functions comparable to that of any of our large hydroelectric systems. This "atomic authority" would most naturally be located in a region which is not endowed with water power and is not now served by private or public power. It could serve as the basis for industrial development of the region in somewhat the same way that TVA serves parts of the Southeast.

In these remarks I have outlined what to me appear reasonable lines of development for atomic power. There remains the question what can the Congress do to create conditions in which the development will flourish.

Right now there are two problems hampering the development of atomic power. First, because of security, because of general uncertainty, we are appallingly low in trained personnel. One distinguished physicist—the man who conceived and to a large extent designed the Hanford plant—has estimated that there are not more than 15 men in the entire country who have at this moment a sufficiently quantitative grasp of the process to direct adequately the development of a new nuclear power plant. This does not mean that the field of nuclear power is particularly difficult.

Senator AUSTIN. You mean 15 men in all the world?

Dr. WEINBERG. My point is that there are only at this time, I would say—and I am corroborated by this distinguished physicist here—that there are only 15 men in the entire world, if you like, who are sufficiently familiar with all the details in the present process to go right out and start developing it.

That, however, does not mean that there are not—well, there are probably in the order of several thousands of people who, in a year

or so, boning up, if you like, would be able to duplicate the achievement.

Senator JOHNSON. Where are they?

Dr. WEINBERG. Well, most of them are connected with the plutonium project and with the bomb project.

Senator JOHNSON. Are any of them in any other country?

Dr. WEINBERG. The 15 of which I spoke are in this country. In Canada, I would say that there are—well, some.

Senator JOHNSON. You mean on this continent?

Dr. WEINBERG. Yes; there are some.

Senator MILLIKIN. Well, would there be more or less than that number of men, speaking of those who could build bombs. You are speaking of the development of the power plants?

Dr. WEINBERG. I would say there are about an equal number. However, I would say this, without desiring to belabor the matter particularly, I would guess—although I do not know—I would guess that to develop a bomb and build a bomb is probably more complicated than to develop how to build power plants.

Any competent physicist can learn in a matter of a year or so all that has been developed in the past 5 years. But, with security regulations as they are, there is no opportunity for outside individuals to become acquainted with our technical "know how." And nuclear technology will develop normally only when any qualified person with an original idea has access to the data which will enable him to develop his idea.

The second problem is more serious. The previous speakers, the whole previous testimony, has dealt with the profound international implications of atomic energy. On the other hand, the international aspects will determine our domestic atomic energy development. A satisfactory control system will enable us to relax our security regulations and atomic power will develop normally. Without a control system, the development will be stifled by secrecy and by fear.

Evidently a nuclear power plant which by its very nature is also an atomic bomb plant must be controlled very much more drastically than a present-day steam plant. There are those who suggest that a complete halt in the development of atomic power plants is the only way to insure against the use of atom bombs. If, by not building power plants we could really avoid war, I would agree with such proposals. But atomic power can cure as well as kill. It can fertilize and enrich a region as well as devastate it. It can widen man's horizons as well as force him back into the cave. We cannot, and we must not keep atomic power in a Pandora's box—afraid to open it because we fear what might happen if it is misused. Rather we must develop atomic power, and we must develop the power to control it.

The CHAIRMAN. Now, Doctor, I will turn you over to Senator Tydings. [Laughter.]

Senator TYDINGS. Do you think that we ought to try to develop atomic power for peacetime uses if we can do so without threatening the future of civilization? Is that a fair statement?

Dr. WEINBERG. I agree completely.

Senator TYDINGS. Our first problem, however, is to ascertain whether or not the first is possible, before we explore the second alternative.

Now, knowing the world as you know and as you have known it throughout your life, could you give us your opinion as to what should be the 1, 2, or 3 steps which we should immediately take to make certain that the international things can be so worked out as to permit the domestic use of atomic power?

Dr. WEINBERG. Well, Senator, it seems to me that there are various fundamental assumptions which mankind must make at this point.

Senator TYDINGS. Yes, but don't let's take those things, don't let us talk about what ought to be. Let us talk about what there is.

Dr. WEINBERG. Good.

Senator TYDINGS. I agree with you. I would like to see crime and war and unbridled selfish avarice, if you want to compound adjectives and nouns—I would like to see all those things eliminated; but let us look at the world as you and I know it.

Dr. WEINBERG. It seems to me that since we must look into the question of control if the alternatives which you stated this morning—

Senator TYDINGS. At least, we agree that control must come before atomic power can be manufactured?

Dr. WEINBERG. That I agree with 100 percent.

Senator TYDINGS. Then, our problem is simplified. How, in the present world do you suggest that we go about this control initially—not ultimately, but right now?

Dr. WEINBERG. Right now? I would probably agree, although I am not completely sure that—

Senator TYDINGS. Doctor, we are in a way simply thinking out loud. We appreciate that you might wish to revise your opinion after you give it more thought. We appreciate that.

Dr. WEINBERG. Well, then, I would like to say that what I will say is not a solution, probably, taking the present instant, with the world in the sorry state in which it is.

Probably, the best thing that we could do would be to announce that we would establish a control and that, as a prelude to that control we will stop all atomic development, assuming that all other nations do likewise.

Senator TYDINGS. That is it, assuming that all other countries do likewise.

Dr. WEINBERG. That is right, that they do likewise.

Senator TYDINGS. And assuming that the other nations will allow us to inspect them and that they will have comparable rights for their own countries?

Dr. WEINBERG. Yes.

Senator TYDINGS. You are pretty definite about that.

Dr. WEINBERG. Yes.

Senator TYDINGS. You are pretty sure that that would be, at this present stage of your thinking, you would say that that would be your original suggestion?

Dr. WEINBERG. Yes.

Senator TYDINGS. Now, what would you do next?

Dr. WEINBERG. I would like to add one thing, though, in that connection: It does not seem to me that that is a solution, however.

Senator TYDINGS. I am not saying that it is.

Dr. WEINBERG. And if you will allow me to say very definitely why I do not think that it is a solution, I will say this: That means that, instead of starting the war with atomic bombs, you will finish the war with atomic bombs, and I am not sure whether finishing the war with atomic bombs would be better than starting the war with atomic bombs.

Senator TYDINGS. Well, if you finish it with atomic bombs, the man is more exhausted, and, therefore, he will succumb more quickly than if you started when he was fresh.

Dr. WEINBERG. That is true, sir, but we do not know how bad the atomic bomb of the future will be. I don't know. I am not an expert.

Senator TYDINGS. Without going into too much detail, let us assume that we had effected a treaty with the leading nations of the world and had set up an inspecting force which, together with their pledged word will, we hope, solve the thing temporarily.

Now, what is our next step?

Dr. WEINBERG. Well, I think we would have to see—Isn't the question really—

Senator TYDINGS. I will define it further. Say that it works for 3 years, just to make our approach a little easier. Say it was working splendidly. Now, what would you do next?

Dr. WEINBERG. I would like to say that I think the next step would be the following:

That, with the experience in the control, the drastic control which you suggest, with the experience gained by that control—and it will be a drastic control, we will still have to go into the country and snoop around, so to speak—with the experience we have obtained from that drastic control, I would like to hope that eventually it works so well that we can gradually release or allow the development to flourish more strongly.

Senator TYDINGS. To put it in a summary, we would have this situation: We have it where it has worked. I will say that we seem to be getting along pretty well and cooperating.

Now, I suggest that you assume that we release this energy not only for medical and research purposes but for power plant operation as well, as our first step. Let us just assume that our first step, that we are taking that step.

That would mean that there would be construction of this particular kind of a plant under these circumstance, with this sort of inspection.

Now, we have got the power plant, in the 3 years, or after, in operation. Now, what would you do next, assuming that we have these power plants and they are working splendidly?

Dr. WEINBERG. In that case I would say that the problem is essentially solved, if you are having peacetime atomic plants working properly, and we are assured that people are not making bombs on the side.

Senator TYDINGS. Well, let us assume that they are not making bombs. Suppose 6 years have gone by and that our first steps, to all intents and purposes, are successful. What do we do next?

Dr. WEINBERG. I would suggest that if our first two steps are so successful, then we will have succeeded in eliminating war by that time; it will be equivalent to eliminating war.

Senator TYDINGS. In the meantime, I think it would be only fair to say that during those next 6 years, while these things are taking place, we are still maintaining our Navy and our Air Force and our Army and that most of the other countries, in varying degrees, are doing the same thing.

Assume that there has been, during this period, no war in the world and the peacetime inspection looks like it is working all right.

Now, what makes you think that you have eliminated war?

Dr. WEINBERG. Well, the peacetime inspection, as you would have me assume, has been working all right.

Then, it would seem to me as if the very first act preceding the next war, assuming that we do have this control, the very first act of the next war would be the rejection of this control, which means that the control would be no longer working—the control would be lost.

Senator TYDINGS. In other words, the inspection would break down as soon as the nations went into a warlike attitude?

Dr. WEINBERG. Exactly, sir; exactly. In that case, as I said, we would start the war with atomic bombs, rather than finish the war with atomic bombs.

Senator TYDINGS. You understand none were being made when the war breaks out.

Dr. WEINBERG. Well, if you like, I can conceive of the following situation—

Senator TYDINGS. Well, let us assume that none were being made when the war breaks out.

Dr. WEINBERG. Good. Then, country A says, "We will throw your inspectors out." Country B says, "Very well, we will throw your inspectors out."

Senator TYDINGS. They will knock them all out. Perhaps that is the first thing they will do.

Dr. WEINBERG. Probably they will shoot them. Then, does it not seem that the situation will be that immediately thereafter the race will be on?

Senator TYDINGS. Well, Doctor, I am asking you this not to be contentious in any way. It is that I am very much interested in your point of view. I, like yourself, am trying to travel this road and pick up the stones of reason in one hand or the other. That is my hope.

What you are arguing for and what the hope of the world is, is complete outlawing of war.

Dr. WEINBERG. War has been obsolete for a long time.

Now, we have really shown that it is obsolete.

Senator TYDINGS. Now, do you think that this prohibition of the atomic bomb is only by degree more important than the elimination of the battleship?

Dr. WEINBERG. Absolutely not. It is not more important in degree. The atomic bomb did not create wars.

Senator TYDINGS. So, we are back to this point, that what we want in the beginning, if we can get it—not today or 6 months from now, but assuming that the world quiets down someday—according to you is complete international disarmament?

Dr. WEINBERG. Exactly.

Senator TYDINGS. There is no hope of using atomic energy in peacetime for peaceful purposes, with the threat of war hanging over us,

unless you want to exterminate civilization. That is what your testimony seems to logically conclude.

Your testimony indicates that atomic bombs are something that will come in if war comes.

Dr. WEINBERG. Exactly.

Senator TYDINGS. And, therefore, the best thing to do is to eliminate the means by which you can make war, of which the atomic bomb is the most important means.

Dr. WEINBERG. And eliminate the desire to make war.

Senator TYDINGS. Then, your line of reasoning is that there should be world disarmament, plus international inspection to enforce international disarmament. You also say that the atomic bomb is going to be used inevitably. Am I wrong?

Dr. WEINBERG. I agree 100 percent with what you say.

Senator TYDINGS. All right, Mr. Chairman.

Thank you, Doctor.

The CHAIRMAN. Doctor, of course, we are only one of I-forget-how many sovereignties in the world. How many are there?

Senator MILLIKIN. About 50.

The CHAIRMAN. So, any policy that we lay down must of necessity be accepted by the other nations of the earth.

You have laid down before us a very entrancing vista that opens up to peacetime use of atomic energy. The thing that disturbs me is that while we here who have this large development of atomic power might well forswear the vista and the possibilities, I am wondering as to the willingness of the other peoples of the earth to go along with us on that proposition, where they have not got the bomb and we have got it.

Dr. WEINBERG. If they really felt that the alternative to forswearing—let me come back to Senator Tyding's point, that whether or not you prohibit atomic energy simply determines whether the war is going to be started with atomic bombs or finished with atomic bombs.

If the countries in the world were really convinced, first, that there is the danger of extermination from atomic bombs—

Senator TYDINGS. And you believe there is?

Dr. WEINBERG. I believe there is, sir.

Then, it would seem to me that if they felt further that, by forswearing development of atomic energy, they could decrease this possibility—although, of course, they cannot because then the war will be finished with atomic bombs instead of started with atomic bombs—then, I think they will be willing to come to an agreement.

I think, in the present practical situation, they would certainly be willing, because we have the bombs and they do not.

Senator TYDINGS. Could we just say this, that in any war in the future between the major powers that may take place any time before 6 years, the overwhelming odds are that atomic bombs would play a part in it?

Dr. WEINBERG. I would not like to come to that conclusion, but I am afraid I will have to.

Senator TYDINGS. I think we can accept it.

Dr. WEINBERG. That is right.

Senator TYDINGS. The only way to stop atomic bombs is to stop war.

Dr. WEINBERG. Exactly.

Senator TYDINGS. So, then, our atomic bomb is incidental to a greater problem, which is that we have got to stop wars because we have developed instruments which have made war unprofitable.

Dr. WEINBERG. So unprofitable that everybody realizes it.

Senator TYDINGS. I am not interrupting you, Mr. Chairman?

The CHAIRMAN. Not at all.

Senator TYDINGS. How would you go about stopping war?

Dr. WEINBERG. I would—here, of course, I am simply stating an opinion.

Senator TYDINGS. That is all right. Nobody has the answer in his hip pocket. We merely want your view on it.

Dr. WEINBERG. Yes; there are two problems it seems to me. One is the immediate problem of what we can do now. We do not have too much time in which to decide.

Senator TYDINGS. Right.

Dr. WEINBERG. If things do not improve and if things do not improve in a hurry, we will have this atomic war before we can turn around.

First, we have the problem of temporizing to give ourselves time to get the people of the world educated to realizing the fact that war has really become obsolete.

Senator TYDINGS. How would you do that? How would you reach the millions of people that we want to reach? Do you suggest that we send around people who will make speeches—and will they be permitted to do that?

Dr. WEINBERG. I wish I knew how you would really do it.

Senator TYDINGS. It boils down to the fact that we have got to do it through the heads of the governments first?

Dr. WEINBERG. Exactly.

Senator TYDINGS. That is what you were trying to get at?

Dr. WEINBERG. Exactly.

Senator TYDINGS. And you hope that that education, that realization, will trickle down little by little and that you will secure the objective you have in mind?

Dr. WEINBERG. Exactly.

Senator TYDINGS. And unless you have that cooperation of the heads of the governments, to start with, it is going to be pretty hard to reach the masses?

Dr. WEINBERG. Exactly.

Senator TYDINGS. So, the first problem is for everybody to agree that there will be no more war talk; and then go to work to implementing that.

Now, how would you implement that?

Dr. WEINBERG. As I say, the problem has an immediate aspect—

Senator TYDINGS. But your ultimate objective is disarmament, is it not?

Dr. WEINBERG. Yes.

Senator TYDINGS. There is no use in saying, simply saying, that you are not going to war. It is no more use than saying that you are not going to go hunting and yet keep shotgun shells in your house, hang your shotgun over the door, and have your hunting coat hung up alongside your shotgun.

Dr. WEINBERG. I tend to agree with you. I tend to agree with you. It seems to me that the only immediate means of attacking the prob-

lem, as far as I, a layman in the matter, can see, is, for instance, to work through the UNO organization.

But I do not see that the UNO organization will be a permanent solution, because I have the vague impression that the gentlemen involved in that, at least some of them—

Senator TYDINGS. Let me interrupt you again, because I think that maybe I can short-circuit a little what you have in mind, if you have it in mind.

This agreement between the heads of the governments first, the problem of the UNO would be the immediate one, if they tackle it initially—you would have to get a treaty?

Dr. WEINBERG. I should think so.

Senator TYDINGS. In other words, if the heads of the governments made the treaty and called upon the UNO to implement the treaty, with such preliminary work that the governments themselves might do, you would have more progress than if you turned it into a situation where they would have to go through these things in their own ways. Do you agree?

Dr. WEINBERG. Yes.

Senator TYDINGS. What is our immediate problem then?

Dr. WEINBERG. I would say our immediate problem, to put it very specifically and bluntly, is that we get together with the various nations that are really involved in the matter—our Nation, England, Russia, probably France, probably China—

Senator TYDINGS. Some six or eight, let us say.

Dr. WEINBERG. Yes.

Senator TYDINGS. At least.

Dr. WEINBERG. Yes, at least.

Senator TYDINGS. And have them agree with us that, in order to avoid war, there should be mutual disarmament?

Dr. WEINBERG. And to make such agreements as regularly have been made for many, many years.

The point I would like to make and which I think everybody has to appreciate now, is that people will have to see that they really mean the statements and agreements that they will make.

Senator TYDINGS. And we will have to make sure that they mean what they say, in case they don't mean them.

Senator MILLIKIN. You mean, by attacking them if they did not mean them?

Dr. WEINBERG. That is a question which is somewhat difficult to answer.

Senator MILLIKIN. Cold logic reaches that conclusion?

Dr. WEINBERG. Not necessarily, for this reason. We hear people say that an atomic war will necessarily wipe everyone out. I would say that that statement is 95-percent accurate. There is a 5-percent probability that that statement is not completely accurate.

So, rather than fostering, rather than precipitating a war, before an overt act or something that approaches an overt act has been made by another nation, I would prevent rather than precipitate a war, rather than precipitate an armaments race, even if it were a nuclear armaments race. I would not wait for it.

Senator JOHNSON. May I get a repetition of that last statement? It is rather a startling statement. Say it again, please.

Dr. WEINBERG. Well, the question, as I understand it, resolves itself into: At what stage of the break-down in international relationships should we attack?

My feeling is that the American people historically would not like to interpret the stage which would justify attack to be an early-stage but rather a late stage.

I would not like to see us go out and drop 100 atomic bombs, let us say—I don't know when but in the near future—just because we were thinking that such and such a country is at present clandestinely doing research on atomic bombs.

Senator MILLIKIN. Mr. Chairman, let us focus that a little more.

Let us suppose that we found out definitely that a country was clandestinely building and was about ready to have atomic bombs.

In cold logic—politically, I am asking a very abstract question—but in cold logic, would we be warranted in wiping that country right off?

Dr. WEINBERG. It is a question of what stage we would wipe it off.

Senator MILLIKIN. You would not wait until they attack us?

Dr. WEINBERG. Certainly not.

Senator MILLIKIN. So, you would be warranted, under those circumstances, in cold logic, of making the first attack?

Dr. WEINBERG. Probably; but I am certainly not here to judge at what stage.

Senator MILLIKIN. No; but we would, to put it simply, attack prior to them attacking. We would not wait until we were attacked, as we were in the Pacific.

Dr. WEINBERG. I should hope not.

Senator MILLIKIN. Now, basic to this disarmament which you and Senator Tydings have been discussing, would you say that there must first be a removal of the causes of war?

Dr. WEINBERG. Very certainly.

Senator MILLIKIN. Would you say that prior to the time that the causes of war had been removed, at least between the principal nations of the world, that we would be safe in destroying our stockpile and destroying our plants?

Dr. WEINBERG. It seems to me, at the present moment, that we are in an exceedingly safe position. We have the largest Navy, probably the strongest air force. We have the atomic bomb—but I don't think that we have the will to use the atomic bomb.

Senator MILLIKIN. I am not so sure that I disagree with you. I certainly would not want to affirm the proposition, at least in our present stage of affairs in the United States that we should coldly and ruthlessly make the first attack with an atomic bomb.

It might be that there would be an advantage, it might be the logical thing to do; but politically, I would not want to make the argument that we should do it at this time.

I come back to what I said before. If you are going to get rid of the atomic bomb, in our hands or in someone else's hands, don't you have to get rid of the causes of war? Is that not the base upon which you have to build?

Dr. WEINBERG. Exactly.

Senator MILLIKIN. In other words, get rid, by treaty, of the festering causes of war?

Dr. WEINBERG. Yes. As I say, either the bomb begins or ends the war.

Senator MILLIKIN. So, that is the state of the world today. If we have no hope, within 4 or 5 years of eliminating the causes of war, at least among the principal powers, then what should we do with reference to our atomic bombs?

Dr. WEINBERG. At this moment?

Senator MILLIKIN. At this moment and over the next 4 or 5 years.

Dr. WEINBERG. So far as I know, the other powers do not have the atomic bomb. So far as I know, there is no danger from attack by the other powers. So far as I know, in atomic bomb technology, we are far ahead of other nations. So far as I know, the number of atomic bombs which we can make, probably, will be greater—although I don't really know—than the other nations can make in the near future.

Therefore, it seems to me that we do not, in fact, reduce our military potential particularly, because our military potential includes not only the existence and the possession of the atomic bomb, but also the will to use it.

Senator MILLIKIN. But if you give it up, do you not lose your most powerful weapon?

Dr. WEINBERG. But the weapons we have at present are sufficiently powerful—that is what I want to say.

Senator MILLIKIN. Of course, what you mean is that you would like to secure your objective, using your present weapons.

However, why should we sacrifice a weapon which has all the power that the atomic bomb has, if we are contemplating that we might have to use it?

The CHAIRMAN. I would like to interrupt. Senator Millikin asked you about the elimination of the causes of war. Until they are eliminated, you would have to hold on to the stock pile of bombs that you have. If you do that, is it your thought that that stock pile would be one of the contributing causes or might be a contributing cause of bringing about a war?

Dr. WEINBERG. I think it is a cause in the same sense that any large-scale armaments are, because it creates suspicion, it creates fear, it creates distrust.

I do not see that we would lose, particularly, by giving up our stock pile at the present moment because, at the present moment, even without the atomic bomb, I do not think we would lose anything.

I think that is particularly true because we do not expect an attack—at least, I don't expect an attack and I certainly hope that this country is not going to war—at the present moment I do not see that we would particularly reduce our military position by giving up the atomic bomb.

Senator MILLIKIN. I will concede that. I assume that we do have a very large military superiority over any other nation, over maybe several nations, maybe over the rest of the world, in traditional, conventional weapons.

But I am asking you the naked question. If we anticipate the possibility of a war—and it is more than a possibility—I mean if a military man or a sane nation has reason to keep its powder dry, why should we surrender our best weapon?

Why should we sacrifice it if maybe we are going into another war? It would seem that it would be the more necessary to keep it, to use it instead of the traditional weapons of war, because with it you can accomplish the same objectives as you can with the conventional weapons of war and you can do it with a fraction of the men that would be required with the traditional means.

Let me go one step further. We have heard the reason advanced in justification for dropping the atomic bomb over Hiroshima and Nagasaki that it shortened the war.

If that reason is a good reason for applying the use of the bomb, why is it not a good reason to consider now?

Dr. WEINBERG. Might I answer your first question?

If by sacrificing these weapons we increase the probability of not having a war—and, by sacrificing these weapons I imply at the same time that there will be entered into an agreement whereby the other nations sacrifice their weapons—I would say, by all means sacrifice the weapons.

Senator MILLIKIN. All right; let us assume that we have sacrificed them. Let us assume that we have given up the atomic bomb, the stock pile, that we have destroyed the plants. Let us assume that we have assured ourselves that the other nations do not have bombs or plants.

Now, will that solve, will that remove the causes of war today?

Dr. WEINBERG. Obviously it will not. Obviously it will not.

Senator MILLIKIN. Well, then, you are right back to where you started. You can not make an assurance, you can not make an agreement—I am arguing now, I am not affirming, this does not indicate my view, I am just trying to draw out all the facts.

We will be where we were at the beginning of the war. There will be started the atomic race, and all the agreements, all the proclamations you have made, all the noble pieties that you utter will be futile.

Dr. WEINBERG. Could I reiterate once more the statement I have made?

The bombs at Hiroshima and Nagasaki have made the notion of war in modern civilization an obsolete one.

We have got to go on that basis.

Senator MILLIKIN. Mr. Chairman, I would like to suggest, when he says that the bomb has made war obsolete, that that was said after World War I.

I say that war is obsolete, theoretically. War should not be conducted under the causes of war, independent of the bomb.

I respectfully suggest that it does not resolve anything, it does not resolve a single cause for war.

What I am putting to you is, how far can we go along with our arrangements for disarmament before we remove the causes of war between the principal nations?

Dr. WEINBERG. We can go at it, it seems to me, by taking the question once more of whether or not the destruction of the bombs would help the situation.

I say that the destruction of the bombs would help the situation in the sense that it would tend to reduce one of the causes of war.

Now, what is the situation if we do not destroy the bombs?

Senator MILLIKEN. I think that is a fair question.

Dr. WEINBERG. Yes.

It seems to me that the natural course of events, unless, of course, we are going out and conquer the world today—which I, as an American, would not particularly like, although that conceivably is a course of events and that, of course, implies something very important—but unless we do not conquer the world today, we naturally would come to a situation in which everybody has atomic bombs. Then what do we do, sir?

Senator MILLIKEN. Well, then, we just multiply our attempts to try to find the solution.

Senator JOHNSON. You say the atomic bomb has made war obsolete. That is true and I agree with you.

However, just as soon as you don't have the atomic bomb, war comes back into style again, it is no longer obsolete. So long as you have the atomic bomb, then war is obsolete.

MacArthur said once that the cause of war was undefended wealth. I am not certain that he has not a strong point there.

If that is the case, we will always have to have armaments. I understood you to say a moment ago that there never would be another major war wherein atomic bombs would not be used and I thoroughly agree with that statement.

The CHAIRMAN. Doctor, we have got to move. I have got a couple of questions that I very much want to direct to you. I wish you would remain here, we will be back soon.

Senator TYDINGS. Mr. Chairman, I just want to interject to ask if there are any more witnesses today.

The CHAIRMAN. No. Off the record.
(Discussion off the record.)

The CHAIRMAN. We will be back as soon as we can.

(Whereupon, a recess was taken, after which the committee reconvened.)

The CHAIRMAN. We will come to order. Dr. Weinberg, will you come forward?

Senator JOHNSON, I think you had the last question.

Senator JOHNSON. Yes.

Our armaments for the postwar period are estimated to cost perhaps \$8,000,000,000 a year. That is for our Navy and Army and Marine Corps and all the rest of our armaments.

Now, this atomic bomb has been described by several witnesses as the cheapest and, I suppose, they mean the most effective weapon at a low cost, lower than any other kind of armament.

Why should we abandon the most effective weapon, as long as there are dangers of war, for obsolete and more expensive weapons?

It is pretty hard to put a matter such as this one on a dollar-and-cents basis and I do not want to do that; but efficiency is something more than a dollars-and-cents thing. When you get up into the expenditure of \$8,000,000,000 and you stop to figure how much \$8,000,000,000 will do to promote the happiness and comfort and everything else that all humanity needs in this world, it is not exactly a dollars-and-cents problem.

Why should we abandon this very efficient weapon and go back to other more expensive and less efficient weapons?

Dr. WEINBERG. Well, I think—I speak, of course, only as an individual, and let me reiterate that I am not an expert on these things, I am a physicist—

Senator JOHNSON. We enjoy your answers.

Dr. WEINBERG. Well, I am glad you enjoy them, sir, but there are at least 130,000,000 people in this country and I would say that perhaps half of them would be better qualified than I to answer these questions.

It seems to me that if, by abandoning this worst of all weapons—

Senator JOHNSON. Or the best of all, whichever way you look at it.

Dr. WEINBERG. Or the best of all weapons, depending on your point of view, you are really making a start, some progress, in eliminating one of the causes of war, if by that you are reducing the probability of another war, then I would say by all means do so.

One of the causes of war, I believe, although, again, I am not an expert, is armament, as well as a sentiment for war.

Now, let me explain when I say that we abandon the weapon, that I speak of what the situation will be when everyone has the weapon. When I say we should abandon the weapon, then that, of course, assumes that the others abandon it also.

Senator JOHNSON. But my trouble, the difficulty that I have in trying to analyze this very grave question is how to go about differentiating between weapons. How are you going to choose one weapon over another? How are you going to say that weapon A is all right but that weapon B is out?

Dr. WEINBERG. Well, we come back—I am sorry, but we always come back to the same point—that another war is essentially impossible, that, to my way of thinking, it seems to me that eventually we eliminate war and eliminate all weapons.

Unless we do, we have this situation. If we don't go into the next war with the atomic bomb, then the war will end with the atomic bomb; if we do not eliminate the atomic bomb, then the next war will start with the atomic bomb. I don't see any way of getting around that.

Senator JOHNSON. I follow you and I concur with you, except that I think that the atomic bomb is making war obsolete, making it impossible for any sane person anywhere on the globe to think of war.

Senator TYDINGS. Including Hitler?

Senator JOHNSON. Yes. Yes, including Hitler. I do not believe that Hitler, degenerate in his thinking as he was, would have dared to start a war if he knew that the United States had plenty of atomic bombs.

Now, I have got Hitler down in the lowest scale that it is possible to put any creature moving about in human form, but I think that even Hitler would have been afraid to start a war if he knew that somebody else had the atomic bomb ready to drop on Berlin.

Dr. WEINBERG. Does that not, sir, come back to the point, on which I really am not particularly qualified to speak and on which I don't think even the atomic bomb experts are fully qualified either, we can only give out opinions—isn't it then a matter of whether or not there is an extremely great advantage to the aggressor in an atomic war?

Senator JOHNSON. Oh, yes.

Dr. WEINBERG. If Hitler had—I agree 100 percent with you that if Hitler knew, say, that the French had an atomic bomb and he did

not have an atomic bomb, obviously it seems to me that he would not have attacked them.

But if Hitler had atomic bombs sufficient to wipe out 20,000,000 Frenchmen, half the French population, then I am not so sure.

It is a very great question, of how much of an advantage accrues to the aggressor.

My feeling is that the advantage which accrues to the aggressor is overwhelming—but, of course, I am not an expert.

Senator JOHNSON. I think it is obvious that the advantage is to the aggressor.

Going back to Hitler—and, of course, this is idle, except that we have to picture, we have to figure that the next war may be in the hands of outlaws, and that is why Hitler is important here. If Hitler was the last international outlaw that the world is ever going to see, then we can just forget about Hitler. But, perhaps, he will not be the last international outlaw and so we have to consider him as exhibit A in this picture.

Do you think that Hitler would have started out on a war if he knew that France and Britain and Russia and America all had atomic bombs?

Dr. WEINBERG. Well, you predicate, do you not, the assumption, that he also had atomic bombs?

Senator JOHNSON. Yes; everybody—Germany, France, Britain, everybody.

Dr. WEINBERG. You predicate that everyone had atomic bombs?

Senator JOHNSON. Yes; that all of them had atomic bombs.

Dr. WEINBERG. Well, if Hitler had enough atomic bombs, if he thought that he had enough, I think he might.

Senator JOHNSON. You are saying that if he had more atomic bombs than all the rest of them put together and had the means of transporting the atomic bombs over the other nations—of course, I will not argue that with you because in that case he would have started an atomic war.

I am not picturing that much of an advantage to Hitler. I am picturing this, I am trying to think of it this way:

Hitler is going to start a war. He knows that he can destroy certain numbers of cities but he knows that also German cities will be destroyed, that all the cities will be destroyed in Germany and all the cities, perhaps, in France, England, and Russia, that all cities will be destroyed.

I just don't believe that even Hitler would start a war on that sort of a premise.

That is why I am trying to think that the atomic bomb is the agent of peace, because it is such a frightful weapon that no one, other than a crank, a fanatic—Hitler was a fanatic, would think of starting a war. However, Hitler had the proper backing in Germany. He was a fanatic, no question about that. But he had to have the backing of a lot of people, sensible people, before he could engage in a war. All the Nazis were not fanatics; some of them were pretty long-headed men, although they were bad, as bad as men can get in their conspiracy—but, at the same time, they were not fanatics.

Dr. WEINBERG. My feeling on that matter, and on that particular matter I have thought a little bit, is the following:

It seems that atomic weapons differ from all other weapons, in the sense that atomic weapons show what I call the phenomenon of saturation.

This point has been brought up many times that it does not make much difference whether Hitler, if it were a matter of Hitler saying there would be a war, had five atomic bombs with the rest of the world having 100 or 200 atomic bombs. If that were the case, Hitler would not start a war; I am inclined to agree with you completely.

But if it is a matter of Hitler having 3,000 or 5,000 as against the rest of the world having 100,000 atomic bombs, then it would seem to me that Hitler would be fairly certain that the advantage would still accrue to the aggressor because there would be no particular advantage in having 100,000 atomic bombs, having 95,000 atomic bombs more than Hitler if Hitler had 5,000 atomic bombs, because with that he can completely wipe out the rest of the globe.

Senator JOHNSON. But he won't be able to do that if they are properly distributed and if the nations used good judgment in the location of the atomic bombs. You cannot picture the thing as a case where everybody is going to be dead. You cannot picture it as a situation where everybody is going to wait for Hitler to come along, wait for Hitler to drop an atomic bomb on them.

The aggressor does have a tremendous advantage. There is no question about that. But he does not have an absolutely overwhelming advantage, even in atomic war.

Dr. WEINBERG. Well, I say that it seems to me very difficult to assess exactly what is the advantage that accrues to an aggressor. I think there is the point there that the atomic weapon does show the phenomenon of saturation. I think there can be no doubt about it.

Where that saturation point is, whether it is 50,000 bombs or 5,000 or 100,000 bombs, I do not know. My guess is—well, I don't know. It depends on so many other things and on what the bomb of the future will be.

Senator JOHNSON. I have just one more question. We will take the other end of this dilemma, where no one has any bombs and where we are going to outlaw and where we are going to prohibit the use of atomic energy.

I want to ask you a question that Senator Connally asked Dr. Langmuir, who was a witness before this committee: "According to your view, the industrial use of atomic energy according to the dangers you point out is a secondary matter, isn't it?"

And Dr. Langmuir replied: "It is almost trivial."

Now, is that your conception, too?

Dr. WEINBERG. I would say it is not my conception for a variety of reasons. For one thing, let me go back to a point which I raised in this memorandum which I read to you.

As far as I know, there is no individual in this country who has complete access to the latest data on the uranium deposits in the United States and the world, and who also has complete access to the data of what can be done with uranium and plutonium by way of power plants.

So, in making an economic comparison between uranium power and coal power, we are, immediately, at a very distinct disadvantage.

In the very short run, I think it is perfectly true that we can get along—well, we have got along very well without the uranium power plants.

In the very long run, we may very possibly be forced to a uranium economy, as opposed to a coal economy, simply because the coal may run out.

I do not think that one can say that the potentialities from the industrial point of view are trivial. They certainly are not.

Senator JOHNSON. Well, he said comparatively, relatively trivial, of course. He said that the dangers of war and the negative side of it, the war side of it, was so much greater than the positive, the constructive use, that it was trivial.

Dr. WEINBERG. Well, it seems to me—

Senator JOHNSON. That position was concurred in by Doctor—what is that name?

The CHAIRMAN. Dr. Szilard.

Senator TYDINGS. And also by Dr. Urey.

Senator JOHNSON. Yes; they concurred in that.

Senator TYDINGS. In other words, that we should remove the threat, that all these other things are incidental.

Dr. WEINBERG. Well, with such a distinguished array of scientists against me, I am afraid I should better pull in my horns.

Senator JOHNSON. No; that is why we like you as a witness, because you are not pulling in your horns, you are coming out into the open.

Dr. WEINBERG. In that case, I am afraid I am getting out on a limb.

It seems to me that one can get along with uranium power. On the other hand, as I have pointed out here, there seems to be a large number of interesting and useful and desirable things that can eventually be done with uranium power, and some in the very near future.

The point I would like to emphasize is whether or not you eliminate the uranium power plants does not determine whether or not the atomic bomb will be used in the next war.

If you have the plants and you make the bombs, the war starts with the atomic bomb.

If you do not have the plants, then the war is finished by the atomic bomb.

It seems to me that the question whether or not you have the plants is not really and completely a relevant question.

Senator JOHNSON. Well, I thoroughly agree with your conclusion. I am glad to find someone that I can agree with on that point.

That is all, Mr. Chairman.

The CHAIRMAN. Doctor, can you picture the state of mind of the peoples of the world if everybody was armed to the teeth with atomic bombs?

Dr. WEINBERG. Well, I can picture my own state of mind. Several of us on the project have felt particularly badly about the development.

One of the theoretical physicists with whom I have talked and with whom I have worked has said to me that the one thing that he considered the most difficult decision for him to make in connection with the development of the bomb was the fact that he had a young son.

Now, probably to many of us in this room the question of the atomic bomb will remain an academic question. I hope so. For the children

of the people in this room, I am not so sure that it will be an academic question.

The CHAIRMAN. Do you have any feeling that all creative work, all real productivity might cease on the face of the earth if the minds of the millions and millions of people in the world were filled with the overwhelming fear that they might be blown up to kingdom come before morning?

Dr. WEINBERG. I don't see how they will be able to do anything but be awfully scared.

Senator TYDINGS. Would it not tempt them to strike first so that the other fellow would not?

Dr. WEINBERG. I guess they would, in fact, be tempted strongly to strike first.

The CHAIRMAN. That would be an intolerable state of mind for the men, women, and children of the world, would it not?

Dr. WEINBERG. Speaking for myself, I would find it intolerable.

The CHAIRMAN. I would find it intolerable if, sitting on the floor of the Senate, I had to remember that there was a machine gun pointing at me and I did not know when it was going to go off.

Dr. WEINBERG. Yes. As you brought out when you made the analogy about the world being armed to the teeth with atomic bombs, I think we would find it intolerable.

As I say, if you have loaded machine guns in a locked room, we will have a situation where we would not trust each other. It would make no difference whether one man had a machine gun with 1,000 cartridges and another man had a gun with 100 cartridges.

Senator TYDINGS. Doctor, we are exploring a great many of the world's problems in these hearings and we have covered a good many of them this afternoon.

I take it that you say that, to remove the causes of war, you will have to put things in the minds first of people.

Some of those things that may be causes of war cannot be removed. For example, you can not have everybody agree in the matter of religion. There is nothing you can do about that.

I doubt if you could throw the United States open to all unlimited immigration, because so many people would come that then we would have a problem that would be a tremendous one.

We have got the clash of nationalism, races, divisions between creeds, economic and military arrayments, money and many other factors that we can not remove.

I take it that what you mean when you say that we must remove the causes of war is that wherever you have a glaring case that is susceptible to evolution, that the nations must try to find ways and means to alleviate the injustices that exist in that particular case.

For example, it would be pretty hard to tell the Dutch that they should get out of Java. It would be pretty hard to tell the British to get out of Indian Burma. It would be pretty hard to tell the French to get out of French Indo China.

Furthermore, in line with all the other imponderables, there are a multitude of things that will have to be rectified as much as it would be humanly possible to do it.

So, I am assuming when you say that the causes of war are to be eliminated, that you are taking the most conservative view of the

numerous causes of war, that you are thinking about the aggravations to justice rather than all the causes that enter into the picture.

Dr. WEINBERG. Well, I agree. On the other hand, it seems to me, to take

Senator TYDINGS. That would be a worse problem, not to interrupt, once you accept it, than settling the atomic bomb itself, don't you think?

Dr. WEINBERG. I think so.

Senator TYDINGS. Then, just what do you mean when you say that we should try to eliminate the causes of war?

Dr. WEINBERG. Let me preface the following remarks again with the statement that I am not an expert. The person that should be talking about these things, I am afraid, should be a professor of international law. I am simply a citizen who is interested in these matters.

It seems to me that there are many situations in the world today in which there exist factors and forces which at one time were considered to be equivalent to war but which at present are not equivalent to war.

To give you an example, various religions—and you have mentioned religions—get along peacefully, whereas the same religions used to be continually fighting.

Now, I personally am inclined to believe that perhaps the most important reason for the elimination of the causes of war, in spite of the fact that the causes are still there, is the fact that there is a higher sovereignty which prevents both religions who used to go to war over religion which the individuals in those various religions adhere to and recognize.

So, it seems to me that when all is said and done, what we are saying when we say that we must eliminate war is that the only system which in the past has ever, in any sense, reduced the number of wars has been a system in which the sovereignty has been extended.

Senator TYDINGS. Well, to put my question rather bluntly, the elimination of the causes of war really means the elimination of the causes of war between the countries that are strong enough to make it. Is that right?

Dr. WEINBERG. Yes, sir.

Senator TYDINGS. I mean what goes on between a great and strong nation and some little nation is something that it is very difficult to get excited about, to raise a war about, even though there might be a great injustice being done there.

Eliminating the causes of war really refers to our getting along with the French, the British, the Russians, and those powers getting along with us.

You find then that the causes of war are limited to 5, 6, or 8 nations, in the final analysis. Is that correct?

Dr. WEINBERG. I think it is, sir.

Senator TYDINGS. And the great masses of the people of the world, who may have to live under the greatest injustices, they really may have nothing to say about it?

Dr. WEINBERG. Unfortunately that is true.

Senator TYDINGS. So, don't you just get this, that you have only to get the agreement between the strong people? Won't that determine what will be done and what won't be done?

Senator MILLIKIN. Would you say, Doctor, that as long as the causes of war do exist that, regardless of our weapons, there will be wars and that since we know of this powerful weapon for waging war, that someone else will start duplicating it, they will take the steps that we ourselves have taken, to provide themselves with the weapons?

Dr. WEINBERG. They will provide themselves with the weapons before or after war has started.

Senator MILLIKIN. Of course, a brutal nation would start as soon as the thought crossed the mind of those that directed that nation. Certainly other nations will come to it, they will start after the war has commenced. Isn't that correct?

Dr. WEINBERG. I am afraid that is correct. If we do not succeed in eliminating war, then evidently war will be atomic war. We always come back to that.

Senator MILLIKIN. Supplementary to what Senator Johnson was saying, I saw a very alarming thing in the New York Times today. There was a story of the showing to these fellows who are being tried at Nuremberg of moving pictures of the days of their glory.

Of course, it was one of the thoughts of showing that picture that they would contrast their present humble position with the position they were occupying in the days when they had their mass flags and banked bands and great crowds and all that.

The picture had just the contrary effect. They had a great time restraining themselves from getting up and applauding.

In other words, they had not learned a thing. They had not learned yet that they had been defeated.

Now, when you have that sort of an upside-down philosophy on life, so long as that is any place in the world, how can you rest assured of peace, no matter what idealistic plans you may have?

Dr. WEINBERG. Let me simply come back to the remark which I made to Senator Tydings.

In the Middle Ages there certainly were people who were outlaws and who made a living by war. There were various other groups which had, they thought, to go to war with each other over problems which they thought simply could not be resolved.

Yet, when the higher authority was established over them, a higher authority with force, then, these unresolvable difficulties which ordinarily led to war still remained unresolvable, it is true, but they did not lead to war any longer.

Senator MILLIKIN. Of course, the Middle Ages were full of minor wars. There is hardly a period in world history when we haven't had wars in some degree.

The Roman Empire kept the world in its longest period of peace through force, the overwhelming force of arms.

The British Navy kept the world at peace in modern times for the longest period of time through overwhelming force, the force of the British Navy.

That has a direct significance to what we are talking about today.

In other words, if you are feeling belligerent, Doctor, I don't believe that you would go out and slap Joe Louis in the face. I think you would rather be looking for a midget for a punching bag.

I merely am bringing that up because we have the overwhelming force at the moment.

Will that keep the world at peace or will it invite an armament race?

Dr. WEINBERG. I think I agree completely with you, that a sovereignty which has force, a greater force than any other states under the sovereignty have—I agree that, historically, that is the only possible way to keep peace, it is the only way peace has been kept in the world.

I do not think I agree that that implies that the United States, say, should go out and be that authority.

Senator MILLIKIN. I am not drawing that conclusion: It is something to think about in this problem.

We have either got to keep that overwhelming force or we have got to work out a transference which will be equally satisfactory. Is that correct?

Dr. WEINBERG. I don't think that we can keep that overwhelming force, sir, for the reason that the other nations will have that force in a very short time.

Senator MILLIKIN. That is true, relatively. That has been true, relatively, through all history.

It may not follow. When Spain tried to get the sea power away from Great Britain, they did not get the sea power from Great Britain. When the Dutch tried to take away the sea power of Great Britain, they did not do it. Many nations have tried to take on the same armament that gave Great Britain her superiority but it did not work.

Let me make this suggestion. I believe that if a man wanted to make a cold-blooded argument—and I am not making it; I am merely tossing it in for consideration—I think it can be demonstrated that the possession by one nation of overwhelming force, in the light of history, is a greater conducive to peace than any other arrangement.

Dr. WEINBERG. Either one nation or, if you like, a super-nation.

Senator MILLIKIN. That brings us to some harsh realities.

I am afraid that we would not start—it has been suggested here many times that we probably would never be an aggressor in that kind of a situation.

But suppose it was determined today, as our national policy, that we were going to keep an overwhelming amount of atomic energy at our disposal for war-making purposes.

We would either have to keep that superiority or it would fizzle out on us.

If we adhered steadily to that intent, then we would have to come to the cold-blooded decision of annihilating anybody that challenged our overwhelming force. Is that correct? And, in this kind of a country, do you not think it would be exceedingly doubtful that we would make that decision?

Dr. WEINBERG. I do not think that we could maintain overwhelming superiority in atomic forces. I say that for the reason that, to my way of thinking, atomic weapons follow the phenomenon of saturation.

If we had, say, 10,000 or 50,000 or 100,000 bombs, that does not mean that we have, say, five times or more force than a nation which has, perhaps, only 1,000 bombs.

Senator MILLIKIN. I think we can use that as an example. That might be true; but if they had 100, then the whole preponderance of weight would be with us?

Dr. WEINBERG. One hundred? I agree; but there is a point at which the thing saturates.

Senator MILLIKIN. I agree. That brings me to the suggestion I made awhile ago, that if we were going to be brutally realistic about this thing, the moment our superiority was challenged, we would have to move, or there would be no point in going on.

Dr. WEINBERG. If we thought that that was a feasible method of procedure, I agree.

Senator MILLIKIN. If we said that we were going to keep the world at peace by preserving sheer overwhelming force in atomic energy, we would then have to reach the conclusion that if anybody threatens to become an atomic power, we would have to annihilate him?

Dr. WEINBERG. That is essentially equivalent to conquering the whole world.

Senator MILLIKIN. Yes, in the sense that Great Britain conquer the world by obtaining naval superiority in the day when naval superiority had the greatest effect.

Dr. WEINBERG. Except that this time I am afraid—I am afraid that we would actually have to go out and kill those people. I, as an American, do not like that.

Senator TYDINGS. We have the atomic bomb. Is it not true that we retain the largest navy, the largest and I hope the most efficient air force? Is it not true that we retain those weapons simply because we want to be strong in anything for any conceivable emergency, that we want to be ready to knock the aggressor?

Dr. WEINBERG. That is true, but—

Senator TYDINGS. Well, then, if that is so, all we have done if we eliminated the atomic bomb is to get down from 212°, which is the boiling point, to about 160° or 150°, which is still pretty warm.

Dr. WEINBERG. It would perhaps lower the lower temperature to 20° or 30°, because it seems to me that with ordinary weapons—well, if we have a navy, say, four times as large as everybody else, if we have an air force four times as large as anybody else, maybe we still would not have really overwhelming superiority.

Senator TYDINGS. Let me see if I have summed up your view. You said that if we had another war it would either start or finish with atomic bombs. You say that will be so whether you outlaw or do not outlaw the atomic bomb. Am I right on that?

Dr. WEINBERG. Yes.

Senator TYDINGS. You likewise feel that this problem is incidental, considering the atomic bombs, to the proposition of eliminating war, that that is the major, No. 1 problem.

Now, what reason, except in degree, assuming that my summations of your thought are correct, what reason is there, except in degree, according to the thought that you are voicing here, of eliminating the atomic bomb, unless you go along and eliminate the next most potent weapon, unless you eliminate them all?

Dr. WEINBERG. I agree. It would be a matter of degree, but it would be a very large degree.

Senator TYDINGS. Yes, this is the greatest danger to tackle first.

Dr. WEINBERG. By far the largest.

Senator TYDINGS. But your logic tells you that you cannot stop with the atomic bomb.

Dr. WEINBERG. We cannot.

Senator TYDINGS. We cannot stop with the atomic bomb, because the other weapons, the buzz-bombs and the incendiary bombs which have ruined so many cities in the world were simply doing what one atomic bomb would do with less effort?

Dr. WEINBERG. Exactly. They are both doing the same thing.

Senator TYDINGS. So, therefore, in your plea today—I do not mean the whole plea but the basis, the core of your plea—is—and I am willing to help as much as anybody—your plea is to outlaw war because the prospects of the consequences of the next war are too horrible to contemplate.

As a precedent to that plea, I believe that your thought is that world disarmament is what must be done. Am I wrong?

Dr. WEINBERG. No; I agree.

The CHAIRMAN. Doctor, I do not want to keep you any longer, but there is one important sentence in your statement which I would like to explore very briefly.

You say:

The second problem is more serious. The previous speakers, the whole previous testimony, has dealt with the profound international implications of atomic energy. On the other hand, the international aspects will determine our domestic atomic energy development.

Now, one of the purposes of the setting up of this committee, as I understand it, is to explore the domestic as well as the international aspects of this question.

The effort was made by the War Department to enact legislation on this subject of domestic consumption, as it were; that is, to take care of our domestic problems.

Now, what has been bothering me the last week or so is how you can set up any program for domestic atomic energy development until you know what the international situation is going to be.

Dr. WEINBERG. I do not think one can. I think the two are so closely interrelated that a domestic solution without an international solution is impossible and an international solution without a domestic solution is impossible.

The CHAIRMAN. Well, now, suppose we enacted a bill today over in the Senate to set up a commission to handle what might be called the domestic phases of the matter.

This commission, if I understand you correctly, would not be able to determine a policy of continuing to operate these plants, continuing to make finished materials, in the absence of some international clarification of the subject?

Dr. WEINBERG. Yes, sir.

The CHAIRMAN. Do you agree with that?

Dr. WEINBERG. Yes, sir.

Senator TYDINGS. Doctor, there is one more thing. We are all thinking out loud. I would like to have you assume, as I know you would want me to assume, that everything that you are saying in response to these questions, in 24 hours, after deliberation, you might want to

modify what you are saying now—we are merely speaking in an exploratory vein.

Let us suppose that we accomplish this world situation you are advocating. Let us suppose, then, that the Indians in India want independence. Without any armaments existing in the world, suppose they start a march, 50,000 or 100,000 of them. We would have perhaps another affair such as they had 75 or 100 years ago, where an attempt was made to assassinate all British.

Now, let us suppose that takes place not only there. The movement catches fire and it takes hold of the masses in many other of the similarly situated countries.

In that case, would the international police force intervene to put down the rioting and keep the status quo, or would you attempt to find—well, what would you do?

Dr. WEINBERG. If the international sovereignty is a real sovereignty, then I would hope, although, of course, we do have civil wars—I would hope that long before they had started to march, that they would have gone through the international channels, the judiciary bodies, and so on, that would then exist, so that their particular problems could be settled peacefully.

Senator TYDINGS. But the point I make is that they are not settled peacefully. Would there not be a civil war?

They would not need weapons. I mean there would be no armaments, they would not need weapons, they would only need their hands.

What it would amount to, maybe, if we had disarmament, if it took place, would be that immediately these nations would be turned loose.

Now, suppose that if they were turned loose, that there was a fight for power in those nations which does become civil war. What side would the United Nations Organization take? Which one of the two factions would they attempt to stamp out if they begin to fight and they use and improve the available weapons and if the thing spreads around the globe?

Dr. WEINBERG. I am afraid I cannot answer that.

Senator TYDINGS. That is a perfectly logical consequence, in my opinion, if you disarm the world. You will find that the tenants will take over the house, they will occupy the house and tell the landlord that he cannot come back any more. What will you do when the tenants begin to fight over who is to have the house? What are you going to do when there is a good, big row going on and it spreads to other places similarly circumstanced? I wonder what the United Nations Organization will do. I imagine that maybe they will just let the riot subside unless it overlaps into some other country.

Dr. WEINBERG. I am afraid that I really do not advocate complete anarchy in the sense that there will be no force at all.

Senator TYDINGS. No, there will always be the international force, I understand. When the other nations are disarmed, there would always be the Security Council with 200,000 or 300,000 men, or 600,000, whatever is necessary, with airplanes or whatever is necessary. It may be atomic bombs, even.

Now, if you start wiping out all the injustices in the world that you and I might agree should be wiped out, there would be not only India and Java, the Dutch East Indies, the American mandated islands and

border troubles and Lithuania and Estonia and Latvia, and all of those places. Possibly even Palestine might come in there.

When you have got all those things breaking loose, and if there is no armament, no restraint, nothing, no police force, except a man with a big hickory stick and a helmet and nothing more, probably not even a revolver, what happens to the United Nations Organization? I mean, when we achieve our dream, where are we?

Dr. WEINBERG. Would we be any worse off than, say, the 48 States are at present, with a supreme authority which essentially has the final police power?

Senator TYDINGS. Well, do you think that the 48 States are comparable to the countries which I, without intending any criticism of the existing situation, have designated?

Dr. WEINBERG. I am not an expert on American history, but if I remember correctly, Vermont and New York were almost at war several times before the Thirteen Colonies got together.

Senator TYDINGS. It is purely in the field of theory, but sometimes it is well to know where you are going to arrive when you start to go some place.

Dr. WEINBERG. Well, to that I must again say that I must answer in general terms. I want to say that it would be rather presumptuous of me, who, as I say, a physicist, to try to answer those questions.

Senator TYDINGS. Well, we are all just as green as you are, Doctor, in this field of world peace. There is no man, no one man, who knows the answer, and it is only by common counsel that we can learn.

There are so many injustices that I might think should be corrected in the world. You, on the other hand, might not agree with me on many of them. There would be cases where you would say that the injustices were terrible and I would not agree with you.

Now, if we disarm completely, that situation will encompass nations. I have no doubt, if you eliminated the force of Great Britain that civil war would break out in India, maybe not immediately, but it would break out; and it would be the same in some other countries.

You would find that there would usually be three men who wanted to be boss and the situation would only permit of one man being boss, who will hold that job.

Senator MILLIKIN. Senator Tydings, I would like to suggest that if the international force disintegrated, pretty soon we would have complete world chaos.

Senator JOHNSON. Doctor, I have just one little question. I don't think it will take you very long to reply to it. I note that you say in your statement that the atomic era began December 2, 1942, when the first nuclear chain reaction was established in Chicago.

Do you anticipate that that statement will ever be challenged as a historical fact? Do you think it is going to stand up?

Dr. WEINBERG. It will be challenged as a historical fact if we have another, atomic, war. In that case the atomic era will be supposed to have started July 16, when the first atomic bomb blew up.

It will not be challenged if we do not have an atomic war. We will have other atomic power developments, naturally, and in that case

December 2, will be the date when the first peacetime atomic chain reaction was established.

The CHAIRMAN. Well, Doctor, you have had quite a workout.

Dr. WEINBERG. I have had, sir.

The CHAIRMAN. We thank you very much.

Senator TYDINGS. I wish we could all go home with this question solved so that we could get a night's rest in comfort, for one night at least.

The CHAIRMAN. Thank you very much, Doctor.

We will meet again at 10 o'clock tomorrow morning in this room.

The committee is adjourned.

(Whereupon, at 5 p. m., an adjournment was taken until 10 a. m., Thursday, December 13, 1945.)

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ATOMIC ENERGY

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

FIRST SESSION

PURSUANT TO

S. Res. 179

A RESOLUTION CREATING A SPECIAL COMMITTEE
TO INVESTIGATE PROBLEMS RELATING TO
THE DEVELOPMENT, USE, AND CON-
TROL OF ATOMIC ENERGY

PART 3

DECEMBER 13, 14, 19, AND 20, 1945

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III

ATOMIC ENERGY

THURSDAY, DECEMBER 13, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Millikin, Hick-enlooper, and Hart.

Also present: Vice Adm. W. H. P. Blandy, Deputy Chief, Naval Operations for Special Weapons; Rear Adm. William R. Purnell, Assistant Chief of Naval Operations for Matériel; and Rear Adm. Lewis L. Strauss, special assistant to the Secretary of the Navy; Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. The committee will be in order.

Gentlemen, we will let you handle your presentation in your own way.

Admiral STRAUSS. Mr. Chairman, we have two introductory paragraphs, with your permission.

The invitation to the Navy to appear before your committee this morning has not afforded sufficient time for the preparation of a formal statement, but in the light of the fact that the Navy does not appear before your committee to urge any special position, advocate any particular point of view, nor sponsor any pending legislation, there would not appear to be any purpose in a statement beyond such as may be elicited in the course of response to your questions.

The Navy is represented here today by Vice Adm. W. H. P. Blandy, Rear Adm. William R. Purnell, Commodore W. S. Parsons, Dr. Ross Gunn, and myself.

Admiral Blandy, formerly Chief of the Bureau of Ordnance, until very recently in command of amphibious groups in the Pacific, is now Deputy Chief of Naval Operations, his special duties being in charge of all interests in the Navy in atomic energy, guided missiles, and related matters.

Admiral Purnell is Assistant Chief of Naval Operations. From the outset of the Manhattan project, he has been the principal Navy representative on the Military Policy Committee for the atomic projects.

Commodore Parsons is Admiral Blandy's principal assistant. He combines the background of the Regular officer with that of the physicist. He has been associated with the development of the Man-

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hattan enterprise since May 1943. He took the first atomic bomb to the Pacific and supervised its delivery all the way to the target.

Dr. Gunn is attached to the Naval Research Laboratory, where, at his suggestion and under his direction, the separation of the uranium isotope, or more properly the enrichment of uranium, was first successfully performed on any appreciable scale and many months before any other project had been inaugurated.

As for myself, I am special assistant to the Secretary of the Navy and have been serving as the Navy member of the Interim Advisory Committee on Atomic Energy.

We had expected, if you had no specific plan as to how you wished us to present the Navy aspect of this, to open with Dr. Gunn, to follow him with Commodore Parsons, Admiral Purnell, and Admiral Blandy summing up.

The CHAIRMAN. Admiral, that will be quite satisfactory, I am sure.

I presume that the Navy is conducting rather intensive research and study into the integration of this weapon into future naval operations. I understand, of course, we could hardly expect any testimony on that score today, although I do not want to restrict any testimony that you might need along that line. We would be glad to have it.

I was of the opinion that perhaps that work might be proceeding rather expeditiously and that after we return from the Christmas holiday we would hear the Navy again, either in open or executive session, as you gentlemen would determine, on your thoughts on the integration of this matter into the Navy's program for the national defense.

I wish you would proceed along those lines, if you would.

Admiral STRAUSS. We certainly will welcome the opportunity to appear again, Senator, whenever it is the pleasure of the committee, and I think with respect to those specific points you mentioned, if they should come up today, that Admiral Blandy and Admiral Purnell will be those witnesses who would be qualified to discuss them.

The CHAIRMAN. I might say further to you gentlemen that we have been leaving with the witnesses, of necessity, the election, if they are asked some question they feel should be answered in executive session, to just say so, and we will afford that opportunity. No offense will be taken if you say just that.

All right, Admiral.

Admiral STRAUSS. Dr. Gunn.

STATEMENT OF DR. ROSS GUNN, TECHNICAL ADVISER TO THE NAVAL ADMINISTRATION OF THE NAVAL RESEARCH LABORATORY

Dr. GUNN. Mr. Chairman, I think I would like to open my remarks by explaining to the committee the reasons lying behind the Navy's interest in this problem, in relation particularly to the work of the Naval Research Laboratory.

Admiral Blandy and Commodore Parsons will be more interested in the bomb, but our original approach was in a little different direction, which we knew had a direct bearing on the bomb problem.

I think a good many of us have been considerably alarmed in the last few years at the rate at which our coal and oil reserves were disappearing. We emerged from the war, and even though the Navy

had oil reserves of various kinds we have cut into those reserves in a very deplorable manner.

I think that future generations will probably have something to say about our waste of the tremendous hydrocarbon reserves, oil and coal. The utility and usefulness of coal and oil under present-day developments in organic chemistry cannot be measured in terms of what they will do to run furnaces, boilers, and engines. The amount of oil and coal available is distinctly a fixed quantity. We are not getting any more. It takes millions of years to make it, and when it is gone, it is gone.

A good organic chemistry industry can make medicines, oils, lubricants, plastics—thousands of things that modern man and civilization requires and must have.

Many of us have worried about that, as I said, and within the last 15 or 20 years we have realized that there were other sources that might be tapped. Some of us were not at all surprised when, early in 1939, the conversion of the uranium nucleus was observed and energy from that transformation was made available.

As I see it, the main function of nuclear transformations is to take on the job of turning the world's wheels and driving its ships. In spite of the awful manner in which it has been presented to the world, I, for one, welcome it as giving a promise of a longer civilization than we would have ordinarily looked forward to; because at the rate we were going we certainly wouldn't have fuel to turn the wheels of industry in another 500 years.

One of the jobs of my Mechanics and Electricity Division at the Naval Research Laboratory is to explore the fundamental aspects of power production, utilization, storage, and conversion. We have spent years studying special methods of power production and conversion that were suitable for special naval applications. We have explored the use of special fuels, new methods of power storage, new types of engines that will achieve a particular objective; for example, the range and speed of a military ship is of the utmost military importance, and many an engagement at sea has been broken off under otherwise very favorable circumstances because the fuel supply was getting low and the ship didn't have enough fuel. Many a man has lost his life and ships have been lost while refueling at sea under adverse weather conditions or in the presence of an enemy submarine.

Obviously, if a fuel were available that was powerful enough to provide power for a capital ship, for example, for a year or more, such a fuel is obviously invaluable to the military services and will increase the military usefulness of that ship to a major degree.

We need more power; we need more speed. Our present capacity to carry energy, if you please, is limited by the bunker size and what fraction of the ship's displacement we can assign to fuel. The Navy's installed horsepower of large units that are constantly in operation is measured in tens of millions. It is the largest single user of such power in the world, and for this reason the Navy has a profound interest in all aspects of power conversion.

We had been alert to the implications of nuclear power even before the announcement of the uranium fission, and we actually had under way in March 1939 work at the Naval Research Laboratory looking toward the utilization of nuclear power in ship propulsion.

I would emphasize again that the interest of the Naval Research Laboratory, which I particularly represent, has been in the practical utilization of nuclear power rather than the bomb aspects.

Admiral Strauss thinks that it might be worth while for me to review what we have done at the Naval Research Laboratory on this program, and I think I can summarize it very quickly and tell you why we want to use it.

Of course, the announcement that triggered off this recent change in our thinking was the announcement by two Germans of the fission of uranium and the further suggestion that this fission could be promoted by the fission of another particle, which had happened a short time before. In other words, we promote what we call a chain reaction. In January 1939 that announcement was made, but we were uncertain as to what part of the uranium material was important. There are two kinds of uranium in ordinary uranium, 235 and 238.

Senator HART. Was that January 1939?

Dr. GUNN. That was January 1939 when it was announced in this country. Many of us had been on the alert for this; and I must say that you should recognize that the scientist, since he has accepted the so-called Rutherford atom, has known that energy of this order of magnitude was going to be available sometime if we just knew how to unlock it. The energy was there, but we didn't know how to make it available.

On March 17, 1939, there was a discussion at the Navy Department, with both Navy and Army officers present, and scientists of the Naval Research Laboratory, of which I was one. A meeting was held, at which Professor Fermi and Professor Pegram, of Columbia University, were present. Fermi was known to me as a highly competent physicist, unexcitable, conservative, and while he did not definitely state that uranium chain reaction would take place—and this is a critical matter—he was fairly sure it would from all the data he had.

A few days afterward, in company with our Director, Hollis M. Cooley, a captain in the Navy at that time and, incidentally, son of Dean Cooley at Michigan, I went to Admiral Bowen, who was Chief of Engineering at the time, and asked for a minimum amount of \$2,000 to get the work going on this project.

Our analysis showed, and it has been borne out completely, that there were three or four main problems to solve, one of which was the determination of which part of the uranium was the effective one. We now know what that is.

The next problem was to separate out the effective components, the so-called isotope separation problem; and the other one was to produce suitable chemicals that would permit this separation. One just cannot throw uranium into a hopper and separate it out. It is a big technical problem to do it actually.

We realized that if we could get enough of the active material together we could, if the theoretical people were right, take thermal energy from the so-called pile and convert it through the use of an engine into a propulsion system. We realized that if we could get very pure material it probably had application to a bomb, but that was not the laboratory's specific interest.

I have cited one case in which we are interested in nuclear power; namely, the case in which we would like to increase the range and speed of our surface ships. There is another possibility which appeal-

ed to us even at that time, and that is in a submarine. The great limitation in a submarine, as we have determined as a result of our experiments at the laboratory, is the fact that one must take down in a submarine not only the fuel but also one must take down the oxygen. That is true even in a battery, for in a battery operation you take down essentially oxygen in one plate and metallic lead in the other. In general, that limits the range and submerged speed that one can get, because one must provide volume and weight for the fuel and volume and weight for the oxygen with which to burn it.

Now, the utility of atomic power in submarines lies in the fact that one takes into the submarine one material only, and out of that one material it is possible to promote a nuclear reaction which will give you heat.

Moreover, the fact that the amount of energy per atom is so tremendous in a nuclear reaction means that this thing is going to be concentrated. It is hard to think of any ship more concentrated than a submarine; so, in a sense, the uranium conversion has direct application to the submarine problem. It is a possibility at least.

I don't think it is necessarily desirable to go into the details of this matter except to point out that, if there is any particular use for nuclear power, the submarine certainly suggests itself as a good place to try it.

With the foregoing background in mind, I would like to put on the record that on June 1, 1939, after analyzing this problem and making arrangements for cooperation with Prof. Jesse Beams at the University of Virginia, a memorandum was sent to our director on the possible uses of uranium power in the Navy.

Later on, various letters were sent out, but the important thing, I think, is to point out that even as early as February 1940, in cooperation with Professor Beams at Virginia, we had secured modest amounts of enriched uranium. By modest amounts I am thinking in terms of a gram or so.

By July 1940 we had actively set up a program in cooperation with the Carnegie Institution of Washington, the University of Virginia, and Columbia University, a forward-looking program that would ultimately lead to a power-producing pile.

We financed the work with the help of the Bureau of Ordnance, the Bureau of Ships, and the Army Ordnance at that time to an extent of about \$40,000, and the work was coordinated entirely through the Naval Research Laboratory.

As a result of that work two or three things emerged which bear repeating.

The Carnegie Institution contract—the Department of Terrestrial Magnetism, this was—was to support a new method of isotope separation which Dr. Philip H. Abelson had examined and run some preliminary experiments on. It looked like a good wartime way of doing it, and our support put that method on its feet. We built a pilot plant at the Naval Research Laboratory and drew off samples of modest amounts for analysis. These showed that it was a practical method.

The CHAIRMAN. Is that the thermal diffusion method?

Dr. GUNN. That is the liquid thermal diffusion method.

The CHAIRMAN. What date was that?

Dr. GUNN. That contract was in effect and we were working with them in July 1940. The liquid thermal diffusion pilot plant at our laboratory—and this work was finally transferred to our laboratory along with Dr. Philip Abelson—was set up and operating in December 1942, and operating on such a basis that the data that we obtained at that time were later shown to be essentially correct.

It also happened that in December 1942 General Groves was invited to our laboratory and saw our outfit.

We gave to him the quantitative data that we had at that time, and suggested that it might have an important bearing on the national production. However, the Army took no action on our method until June 1944, which was 18 months later.

As a result of our work, and being sure that we had a method which was tolerably good, we went ahead with the help of the Bureau of Ships, and in June 1943 we recommended that we build a plant in Philadelphia, but construction was not started until November 1943 because we couldn't get the authority to do it. That plant was finally put in operation and we were taking samples off of it, in July 1944. We had some difficulty getting raw materials, but that was finally straightened out. I think the success or nonsuccess of that plant should not be discussed here.

This review of our part in the production of uranium isotopes is given, sir, to emphasize the fact that we are actively interested in power and its utilization in the Navy, particularly the special problems that face the naval service. We think that by means of our very early work we have shortened the time it took to produce the critically required material. If we had not worked on the thing at the start and early supported these university people we think perhaps the national production might have been delayed.

The CHAIRMAN. Doctor, how much money has the Navy spent altogether?

Dr. GUNN. The Naval Research Laboratory, including the experimental work at Philadelphia, expended \$2,000,000. To that \$2,000,000 should be added an amount which, as close as we can estimate, is about \$1,000,000 assigned to the Naval Boiler and Turbine Laboratory at Philadelphia, direct from the Bureau of Ships.

The CHAIRMAN. That would be \$3,000,000 altogether?

Dr. GUNN. That would be about \$3,000,000 that the Navy itself put into it.

The CHAIRMAN. What contact did you have with the Army on the problem between the first meeting that you had, which I believe was in 1939 with Army Ordnance? What meetings did you have with the Army or they with you in the interim period up until General Groves was shown what you had done in December 1942?

Dr. GUNN. There was established a committee, the S-1 Committee of the NDRC, which had an Army representative. At one time General Styer was on it, and they had, I think, two other representatives from time to time. The chairman of this committee was Dr. Briggs, who was then Director of the Bureau of Standards. The Army was informed of the work carried on by the committee through their representative.

The CHAIRMAN. Were you on the committee?

Dr. GUNN. I was on the committee for a time.

The CHAIRMAN. Did you report to the committee as to what the Navy was doing on it?

Dr. GUNN. The chairman of the committee was kept in touch with everything that we did.

The CHAIRMAN. That is Dr. Briggs?

Dr. GUNN. That is Dr. Briggs.

The CHAIRMAN. When was that committee set up?

Dr. GUNN. I am sorry, sir, I don't know; but you will find that in the Smyth report.

Senator HART. To connect up some of this early chronology, Doctor, the first witness before this committee gave a good deal of data covering the chronology of those early years.

I believe you stated that your first move outside your laboratory in order to get started was on March 20, 1939. Is that correct?

Dr. GUNN. That is correct.

Senator HART. Doctor, have you any idea as to when the President was first acquainted with the possibility of atomic fission?

Dr. GUNN. I understand that there was a meeting with a Mr. Sachs—I judge that is the man you refer to—on October 11, 1939.

Senator HART. Insofar as you know, did the Navy Department ever make these ideas known to the President prior to Dr. Sachs, whom you mentioned?

Dr. GUNN. I would not know about it, sir, if they had. I was too far down the line.

Senator HART. Do you recall receiving anything from Dr. Einstein in August 1939 that antedated or postdated your original undertaking of this problem?

Dr. GUNN. As far as I know, our laboratory never received any communication from Professor Einstein. In part answer to your original question, the Director of the Naval Research Laboratory did send to the Secretary of the Navy on November 13, 1939, a general review of our interest and proposals in this matter.

Senator HART. In case it ever was called to the President's attention directly by the Navy Department, who would know?

Dr. GUNN. I think Admiral Bowen, who was Chief of the Bureau of Ships at that time. The laboratory was operating under the Bureau of Ships, and he would be the man who would know.

Senator HART. You mentioned Dr. Sachs. In his testimony he stated that during those early steps, I believe in 1939, there had been an adverse report by the technical adviser of one of the services in the summer of 1939, and it was because of that that he, Mr. Sachs, went directly to the Commander in Chief, meaning the President.

Do you think that technical adviser could have come from your laboratory?

Dr. GUNN. I am sure that he wouldn't have come from our laboratory.

Senator HART. Did you hear Dr. Sachs' testimony?

Dr. GUNN. I read parts of it; yes, sir.

Senator HART. Do you know or have you any opinion as to why he said that there was a previous adverse report?

Dr. GUNN. I haven't the slightest idea why he would say it. I suppose that was his experience.

The CHAIRMAN. Doctor, when you met with Fermi and Pegram on March 17, 1939, did you put them under contract, or was any arrangement made with them for them to work on this problem?

Dr. GUNN. No, sir; not at that time.

The CHAIRMAN. You had great confidence in Fermi?

Dr. GUNN. We think very highly of Fermi. He was an experimenter in nuclear physics, and was an outstanding exponent at that time.

The CHAIRMAN. Was any arrangement made that Fermi and Pegram be put under contract and the Columbia project be started?

Dr. GUNN. That came later.

The CHAIRMAN. When?

Dr. GUNN. We made arrangement to set up the Columbia contract with our laboratory in July 1940.

The CHAIRMAN. In February 1940 you had gotten one gram. Now, where was that gram produced?

Dr. GUNN. I misled you, sir, in my testimony there. That was one gram of a 10 percent enriched sample, and that was produced at the University of Virginia. That was not pure metal, which you apparently interpret my testimony to mean.

The CHAIRMAN. But in July of 1940 you had concluded a contract with Columbia University?

Dr. GUNN. That is correct.

The CHAIRMAN. Was it the Navy that set up the Columbia project?

Dr. GUNN. The Naval Research Laboratory was the coordinating agency for the Bureau of Ordnance, the Bureau of Ships, and the Army Ordnance. The Army was in on that allotment of funds at that time.

The CHAIRMAN. Did you have any correspondence with Fermi and Pegram between March 17, 1939, and February 1940?

Dr. GUNN. I am quite sure we did. I had considerable correspondence with Pegram, and I think it fell in that interval.

The CHAIRMAN. I understand, Doctor—I am not certain of this, and I do not make it as an assertion of fact—that when Fermi and Pegram went to see you people in the Navy on March 17, 1939, they came away from that conference much discouraged, and that it was as a result of that discouragement that they got in touch with Dr. Sachs, who in turn got in touch with the President.

As I say, I don't vouch for that at all, but that is my recollection either of testimony or conversations to which I have listened.

Dr. GUNN. I think that is a fair deduction from what happened. You gentlemen must realize that this picture looks a great deal different today than it did look then. Here was a group of scientists who had been looking for something like this, but we didn't quite believe it. We didn't object in the least to the conversion of nuclear energy. It was conceded that energy was there all right, but the chain reaction, the idea of one molecule tripping off another, and that one tripping off another, and the same thing going on in a chain, was distinctly something that placed us in the position of being "from Missouri." We weren't sure of it.

I think everyone would be discouraged. I was discouraged. The laboratory didn't go into this work with the idea that the result was all going to fall out in a year or so. If we had known—and that is the point—that there was actually going to be a sustained chain reaction,

we would never have got a chance to look at it. There would have been thousands of scientists working on it immediately.

The CHAIRMAN. Well, it was after Roosevelt, in the spring of 1940, had the meeting with Sachs that things began to happen.

Dr. GUNN. Well, unfortunately that is the way you get money to do a job in the Government service.

Senator HART. May I correct you, Mr. Chairman? I think that that date was October 1939.

The CHAIRMAN. October 1939? My recollection was confused. It was after the fall of France that additional effort was put in, and it was after that that things began definitely to happen.

Dr. GUNN. That is right.

Senator HART. Doctor, during those early days in the spring of 1939, did you or your associates or any one up in the Navy Department pay very much attention to the possibility of fission as a weapon rather than a source of power?

Dr. GUNN. Not very much attention to it specifically. We realized the two important solutions would fall out together, sir, and we knew that if we could solve the power problem the bomb application would automatically come out with a very small amount of additional work.

The CHAIRMAN. Doctor, how big were the contracts that you first made?

Dr. GUNN. Our first contract went to the Carnegie Institution. We tried to give them some money, and they said, "No; we don't like to take a contract; we will do it for you for nothing."

Finally we prevailed upon them to take a contract in the amount of \$2,500, which was simply to cover the costs of some work that Dr. Abelson started there. That contract was dated November 3, 1940. As I say, they did work for us without charge and as a public duty.

Columbia University, on July 18, 1940, entered into a contract for \$29,700, and on the same date, July 18, 1940, we entered into a contract with the University of Virginia for \$13,000.

The work at Virginia was under the control of Dr. Jesse Beams. The work at Columbia was under Professor Pegram, and that at the Carnegie Institution was under Dr. John A. Fleming.

The CHAIRMAN. After General Groves took the thing over, how close was liaison kept with the Navy on this thing?

Dr. GUNN. There was liaison, sir, but I think it was one way; down at my level it was. Probably there was liaison farther up, but I did not experience it.

The CHAIRMAN. You mean you didn't know what was going on in the project?

Dr. GUNN. I had no idea what the Army was doing.

The CHAIRMAN. You had no idea?

Dr. GUNN. Except by making a guess. Being a scientist, I could make an intelligent guess.

The CHAIRMAN. Did you have any idea that there was a two billion dollar project under way?

Dr. GUNN. I don't know how much it was. I know it was a pretty big project, because we couldn't get additional people after it got under way.

The CHAIRMAN. General Groves is in Army Engineers, isn't he?

Dr. GUNN. That is correct.

The CHAIRMAN. Do you have liaison with the Engineers? Does the Navy have liaison in this branch with the Engineers or with Ordnance?

Dr. GUNN. That I cannot answer. I don't know of it. It didn't reach to our laboratory. I can only speak of what happened at our laboratory, sir; I cannot speak for the Navy as a whole on that matter.

The CHAIRMAN. Are you the Chief Physicist for the Navy?

Dr. GUNN. No; I am superintendent of two divisions at the Naval Research Laboratory, the Mechanics and Electricity Division and the Aircraft Electrical Research Division.

The CHAIRMAN. You were the fellow in the Navy that ought to know about this, weren't you?

Dr. GUNN. That is right.

The CHAIRMAN. You didn't know about it?

Dr. GUNN. I didn't know about it.

The CHAIRMAN. Did you make any attempt to find out?

Dr. GUNN. Yes, sir.

The CHAIRMAN. When you did, what were you told?

Dr. GUNN. I just didn't hear anything, sir; that was all.

The CHAIRMAN. How did you make the attempt—by letter or by phone?

Dr. GUNN. By direct personal contact, and I tried to write letters.

The CHAIRMAN. You tried to write them?

Dr. GUNN. I wrote letters, sir; I am sorry.

The CHAIRMAN. Did you get answers?

Dr. GUNN. No.

The CHAIRMAN. Acknowledgments?

Dr. GUNN. Yes.

The CHAIRMAN. What was in the acknowledgments?

Dr. GUNN. That the matter under consideration would be taken up with higher authority.

The CHAIRMAN. As far as you know, it never was?

Dr. GUNN. As far as I know, it never was. I think those are questions that should be directed, sir, to the military members of this naval representation.

The CHAIRMAN. Well, you have the Smyth report, though?

Dr. GUNN. Yes, sir.

The CHAIRMAN. Maybe that is what they were waiting for.

Senator JOHNSON. I should like to ask if you are familiar with the thermal diffusion set-up at Oak Ridge?

Dr. GUNN. No; I have never seen the gaseous diffusion plant, sir. In the early days before it was reorganized I had a good, full acquaintance with what was being done, but along about the time war began—December 6, 1941—the S-1 Committee was reorganized and we were disassociated from the project. I don't know what happened after the war began.

Understand, sir, that our laboratory has really done only one part of this job. We set out to take on the whole thing, but we did one job apparently too well, and we spent the rest of the war doing that one job.

Senator JOHNSON. What do you mean by saying "apparently too well"? I didn't know any job could be done too well.

Dr. GUNN. We have worked out a successful method for producing the fissionable material, and the country urgently needed it. That is what we did. We turned it out.

Senator JOHNSON. That is some other material?

Dr. GUNN. No; this is the separated isotope of uranium.

Senator JOHNSON. And they kept you on that particular job; is that what you mean?

Dr. GUNN. That is right.

Senator JOHNSON. Doing that particular job?

Dr. GUNN. That is correct.

Senator JOHNSON. Was that a fundamental part of the whole operation?

Dr. GUNN. Yes, sir; that was a fundamental part of it. There were three ways of doing it, three ways of separating isotopes, as summarized by the Smyth report.

Senator JOHNSON. At least three ways.

Dr. GUNN. At least three ways—I am sorry—the electromagnetic method, the gaseous diffusion method, and the liquid thermal diffusion. Our process was the liquid thermal diffusion process, and that is the one we worked on.

The CHAIRMAN. When you say "liquid," do you say that instead of the steam plant?

Dr. GUNN. Instead of the gaseous.

The CHAIRMAN. There is a thermal diffusion process—isn't that what they call it?

Dr. GUNN. They are both thermal, both the liquid and the gaseous are thermal diffusion processes.

The CHAIRMAN. What does the Smyth report say they used?

Dr. GUNN. They used all three.

The CHAIRMAN. The thermal process?

Dr. GUNN. They used both our system, the liquid, and the gaseous thermal diffusion, both of them.

Senator HART. I think the Smyth report limits its description of the gas diffusion to "gas." They don't mention "diffusion" in the title.

The CHAIRMAN. That is what confused me.

Mr. CONDON. Perhaps I ought to say here that your question, Senator, refers particularly to the thermal diffusion plant at Oak Ridge, I suppose, and that is the liquid thermal diffusion method that was developed by the Navy, I believe.

Senator HART. I think, Mr. Chairman, that in most of our description, and possibly in Dr. Smyth's report, the word "liquid" is left out of the description.

The CHAIRMAN. That is what confused me.

Senator MILLIKIN. I would like to know now whether the plant at Oak Ridge is a liquid thermal-diffusion plant, or whether it isn't?

Dr. GUNN. Oak Ridge has three plants, sir; one of every kind.

Senator MILLIKIN. And is there a liquid thermal diffusion plant there?

Dr. GUNN. There is.

The CHAIRMAN. Were you consulted about the construction of that plant?

Dr. GUNN. Yes, sir. Dr. Abelson went down there and spent some 2 or 3 months, and 10 of our men spent some months down there to help operate it and get it organized.

Admiral PURNELL. You designed it, didn't you?

Dr. GUNN. We designed it; yes, sir.

The CHAIRMAN. When you were applying for information, was it about other methods of separating the isotope?

Dr. GUNN. Well, sir, I was charged apparently with the research work that the Navy was doing at that time, or at least I thought I was, and I was trying to look at the problem as a whole. Naturally there were certain parts, and when you got one part going, you naturally turned to the next part to try to get that going. I wanted to find out in general what we should be doing.

Naturally I was trying to see the picture as a whole, sir; and I was interested in knowing what was going on so that in laying out my program of work I would not duplicate what other people were doing.

Now, it was suggested that we go ahead and get this information ourselves, but I was brought up to think you should not waste your money, and I didn't want to duplicate effort. I wasn't going to be a party to spending millions of dollars, or even one hundred thousand, to duplicate some work I knew my fellow scientists were doing elsewhere. It didn't make sense to me, so I refused to expand our work at that time because I was forced to work in the dark.

The CHAIRMAN. Does that mean that you were compartmentalized?

Dr. GUNN. Oh, I was compartmentalized all right.

The CHAIRMAN. Was that for security reasons?

Dr. GUNN. I think, sir, that should be addressed to Admiral Purnell.

The CHAIRMAN. All right.

Senator MILLIKIN. I should like to invite your attention, Doctor, to the fact—it appears to be a fact on the record—that the Germans did not compartmentalize. They were all working on an over-all basis, with the result that they never got anything done by the end of the war.

The CHAIRMAN. Do you think that follows as a result, Senator?

Senator MILLIKIN. I think you could argue that the method used of compartmentalizing, while offensive to science, resulted in the objective.

Senator HART. Might I say, Senator, that possibly instead of describing it as compartmentalized, that the scientists were managed.

Senator MILLIKIN. I can understand why that would be offensive, and I can also understand why it might be a good thing if you were seeking in a short time to produce a certain result.

Dr. GUNN. I don't believe scientists are as temperamental as some people say they are. We all recognize that there is a valid reason for security. There are two reasons for it, one to keep the enemy from finding out what you know, and also to keep the enemy from finding out what you don't know.

I think most scientists are willing to "play ball" on that basis when it is necessary.

Senator HICKENLOOPER. I understand, Doctor, that the chief efforts of the Naval Research prior to the time that this set-up was an over-all proposition, the Oak Ridge plant had been established, and so on, were devoted entirely to the development of the liquid diffusion method of producing this material, and that under your direction the Navy did go on until this method was perfected.

Let me ask you if in that development of that process you suffered any restrictions of accessibility to methods and to means directly affecting that particular process?

What I am trying to get at is whether you were restricted in information or in working in that particular process, or whether the restrictions applied to the gas diffusion method and the electric method and the plutonium development.

Dr. GUNN. But, sir, I would point out to you that we were developing this information. No one else in the world had it, and obviously we had access to our own information.

Senator HICKENLOOPER. I realize that. I am not discussing the question of the advisability of restriction of that information. I am trying to see if I can narrow it down to what was restricted and what wasn't, on the theory that if they adopted a strict compartmentalization philosophy as to this development program—whether we agree with it or not—there might have been at least some plausible reason as to why it should be done for the over-all project.

I am wondering whether the restrictions you have referred to on information applied to any information that you needed or that you wanted which applied directly to the liquid thermal diffusion process. Were you restricted as to that?

Dr. GUNN. There was no outstanding limitation. We had some difficulty in getting things we wanted, but they were straightened out ultimately. Of course, we had to do some fighting to get them.

Senator HICKENLOOPER. I would presume those difficulties would increase in proportion as you got into other fields where you meet, as Senator Vandenberg called it, an iron curtain.

Dr. GUNN. I never saw an iron curtain, but I think I understand what that means.

Senator HICKENLOOPER. He gave a very graphic description of the iron curtain. That is a question I wanted to get clear in my mind.

Senator MILLIKIN. The iron curtain in your business, Doctor, is when they tell you, "This will be referred to higher authorities."

I got the impression from something you said, Doctor, that on the whole you view this development of atomic energy as beneficent to the world rather than as harmful to the world.

Dr. GUNN. I am satisfied that is correct.

Senator MILLIKIN. That, of course, depends on whether we can harness the destructive features of it.

Dr. GUNN. That is correct.

Senator MILLIKIN. If we could harness the destructive features, then we would have nothing but the beneficent features left, and that, of course, opens the whole problem we have before the committee. It has been repeated here several times that when you use atomic energy for power purposes you are three-quarters of the way along toward using it for war purposes.

I think you have probably already answered the question that I intended asking you. If we cannot control that next, last step, then perhaps it would be better if we didn't take the first three steps. What would you say as to that?

Dr. GUNN. I don't know. That is a hard question, sir. I think I will leave that to the statesmen to answer.

Senator MILLIKIN. I won't press it further.

Senator HICKENLOOPER. I think the doctor is a citizen, and so are we all. I would value his opinion, if he cares to give it.

Senator MILLIKIN. It happens I have to leave in a moment, and I want to ask two or three questions of the doctor.

Let me ask you this, doctor: Who were the nuclear scientists working with you at the time you conducted these early experiments?

Dr. GUNN. I was the only one that was qualified in the early days, and I finally hired away from the Carnegie Institution, after we had a contract with them, Dr. Philip H. Abelson, who was the codiscoverer of element 93 and he has been with me throughout this operation.

Senator MILLIKIN. Are you familiar with the testimony of Dr. Sachs?

Dr. GUNN. I have read parts of it, sir, but I would not say I was familiar with it.

Senator MILLIKIN. As I understood his testimony, he portrayed a picture of a neck-and-neck race between the scientists of various countries to make a weapon out of atomic energy and that he sold that picture to the President specifically on the ground that Germany was about to develop this kind of a weapon at most any moment.

Are you aware of the fact that we have had testimony that at the end of the war Germany had not even commenced to build a plant?

Dr. GUNN. That is correct.

Senator MILLIKIN. You spoke of this energy as a substitute for our dwindling resources in oil and coal. Would you say that we have suffered, considering the amount of coal we have, a serious depletion of coal?

Dr. GUNN. Not of coal, but distinctly of our oil reserves.

Senator MILLIKIN. But we do have very well-known methods expanded and developed by the Germans during this war of making oil out of coal, so that if we did not have this substitute method, and even if we ran out of oil, we could fall back on coal as a source of all the fuel oil we could possibly use over the long foreseeable future. Is that not correct?

Dr. GUNN. That is correct.

Senator MILLIKIN. Would there be any control factors in a pile in a submarine or a boat that might get out of control in the event of a hit which would cause larger damage than is now caused if you hit your steam plant or something of that kind?

Dr. GUNN. I would prefer to answer that in executive session, sir.

Senator MILLIKIN. What other nations, if you care to say, are working on this problem from the naval power standpoint?

Dr. GUNN. I have no direct information on that question.

Senator MILLIKIN. As far as you know, no other navy maintains a research program with the specific object of developing power for naval vessels?

Dr. GUNN. Right.

Senator MILLIKIN. Thank you very much, Doctor.

The CHAIRMAN. Doctor, did Naval Intelligence furnish you, from time to time, or at any time, with any information as to what was going on in Germany with regard to this project?

Dr. GUNN. No, sir; I never asked them for any information on the subject. I didn't think Naval Intelligence was informed in this matter.

The CHAIRMAN. I gather from your testimony, Doctor, that at least in this project there was no unification of the Army's and Navy's efforts in the matter?

Dr. GUNN. I think there was somewhere, but it didn't drift down to me. I didn't experience it.

The CHAIRMAN. And you were chief of the nuclear development—

Dr. GUNN (interposing). I was chief of one part of the work.

The CHAIRMAN (continuing). Having to do with nuclear energy, and nobody else in the Department except yourself was in charge of that work?

Dr. GUNN. I am glad to say that, throughout this whole matter, Commodore Parsons, who is here before you, was definitely associated with it, and I felt quite happy that the Navy had someone who was fully informed and, if anything important came up, the Navy had access to it, at least. Whether I had it is beside the point.

The CHAIRMAN. You didn't get it from Commodore Parsons?

Dr. GUNN. I will let you ask him that question, sir.

The CHAIRMAN. All right.

Senator HART. Mr. Chairman, I wonder if I might get an answer from either Admiral Purnell or Commodore Parsons to my question about whether or not the President was informed through the Navy Department of these early developments. Do you know, Admiral Purnell?

Admiral PURNELL. No, sir; I cannot answer that. I did not get here until July 1942, sir.

Senator HART. Does Commodore Parsons know?

Commodore PARSONS. I first heard of the project in May 1943, so it was far along before I got in on it.

The CHAIRMAN. If you would like the answer to that question, Senator, perhaps for the record they can furnish that information.

Senator HICKENLOOPER. Dr. Gunn, I would like to ask your opinion, partly in your capacity as a scientist, and partly in your capacity as a citizen—who is, I think, generally a pretty smart fellow—because I would value your opinion as such.

First, as a scientist, do you know of any substantial or revolutionary scientific discovery with tremendous potentialities for the good of humanity that has ever been discarded or has, in fact, ever been curtailed so far as scientific investigation is concerned?

The point of my question is: Are we going to stop investigating this atomic field from a scientific standpoint in spite of anything we may do in the way of laws, agreements, or anything else? Is science going to stop that?

Dr. GUNN. Well, I don't think you can stop progress. I think the answer to that is so obvious that it requires no discussion. We never have stopped it and never will. For short periods of time there have been impediments but averaged over a long period of time such discoveries have always proceeded.

Senator HICKENLOOPER. I think the answer is obvious, too, but we have a record to file here, and I wanted to have your opinion on that.

Now, as a scientist, and also as a citizen who undoubtedly has given some thought to general political aspects as life goes on, do you believe—considering human nature, considering the magnitude and the technicalities of this thing, or a combination of the political and scientific fields—that it is reasonably feasible or possible to continue with scientific investigation to the limit of our ability as we learn more, to develop this atomic field of energy, and to devise some human way to limit it to the development of energy for the public good and to stop,

control, or prohibit that last 25 percent, after you get the material, from going into bombs?

Dr. GUNN. Well, sir, that is a tough question, and I want to answer that as a citizen.

Senator HICKENLOOPER. We have got to answer that here.

Dr. GUNN. As a citizen, I am not too happy about the proposals made by some of my fellow scientists. I would like to have one question answered before I go along with their recommendation on international agreements.

If there is any basis to scientific endeavor, it means that if we perform an experiment five times and get a certain answer, the basis of our belief is that if we do it the sixth time we will get the same answer, or the tenth time, unless the fundamental variables have changed.

When people talk about international agreements, I would like to ask them to give me a quantitative figure of the probability of an international agreement lasting 25 years, 50 years, or 100 years. And if that probability isn't finite and of appreciable size, then I say we should not do the experiment over again. That is all I know about it, sir.

Senator HICKENLOOPER. I don't think there is any difficulty in the mind of anybody as to what we should do with this thing. We should prohibit its use as a weapon. It is easy for anybody to say that. I don't mean to say that is exactly what you said, but that is the end result here.

We should prohibit its use as a weapon because of the horror and the vastness of its destructive power; but between having this awful thing on our hands, and what we should do with it, and how we should accomplish that result of prohibiting its use for the destruction of humanity, are some of the questions that this committee is going to be called upon to try to answer.

Manifestly, in my mind, science is going on to experiment. You cannot stop it. You couldn't stop it in the electrical experimentation, and electricity has been used to kill people. You couldn't stop it in gunpowder, although it has peacetime uses and is beneficial; yet it has gone into the field of destruction and killing, and countless other things.

Radio investigations, electronics, and all those things with their vast peacetime good have been turned to some of the most terrible killers that we have when man feels he is in danger.

Now, this can go to a point where it will produce energy. It will produce materials that can be beneficial to medical research and public health. It will ease life and probably give us a lot of comforts at some time in the future, and yet there is always that last 25-percent step there through which the material that will bring the benefits can be taken in order to bring about the most destructive thing that we yet know.

I think if we did have some kind of a snub we could put on that thing to snub it right down to the uses for benefits, of course that would be one answer. If we could stop it, or stop some dishonest nation from violating its contracts, or doing things of that kind, to use or divert some of this to the weapon stage, well and good. If we cannot, then what?

Dr. GUNN. Well, sir, we are all looking for a snub to be applied at the right time. The trouble is rascals fix it so there is grease on the snub.

In figuring the probability of international agreements lasting long periods of time, I would like to set over against that the probability of unilateral agreements lasting over long periods of time.

The Monroe Doctrine has lasted for a long time. It was not an international agreement; it was a one-man agreement. I think that is the only way.

Senator JOHNSON. Backed up by force, Doctor.

Dr. GUNN. Yes; backed up by force.

Senator JOHNSON. And it was only as good as the force back of it?

Dr. GUNN. That is correct.

Senator HICKENLOOPER. I would like to go into the matter of inspection, and I am not trying to cross-examine you.

Dr. GUNN. I am glad to be cross-examined, but I don't know anything about it.

Senator HICKENLOOPER. Neither do we. You have nothing on me, at least, in that respect.

Inspection has been discussed here, and manifestly that is a very plausible field for discussion. It gives a very plausible answer on the surface: "Sure; go in and inspect all these people, and the minute you find them diverting, do something to them."

What?—that is anybody's opinion, but that can be worked out.

I don't know whether you have gone into this sufficiently, or whether your experience in this field has been sufficiently extensive in the weapon end of the thing to say that, but if you would care to give an opinion, do you believe that it will be feasible to establish such an inspection system that can detect and immediately make available the information as to the diversion of this material in that last 25-percent step at a reasonably early period in its diversion before people can start making bombs that will go off?

Dr. GUNN. I don't think any scientist really knows the exact answer to the question you have propounded, but I think it can be done.

We have powerful instruments—Geiger-Mueller counters, we call them—which detect quite a small amount of material, and if backed up by adequate and competent and continuously observant personnel, I think it could be controlled. The trouble is, of course, that someone will perhaps grow careless.

I would put it this way: I think it is not impossible; I think it would be a hard job.

Senator HICKENLOOPER. Have you thought a great deal about this inspection?

Dr. GUNN. No, sir; I honestly don't know anything about it.

Senator HICKENLOOPER. Thank you, Doctor.

Senator HART. May I ask any of the witnesses to answer this, whichever one knows most.

The Navy Department has given out a statement dealing with future experiments, using the bomb against a ship or ships. I would like to ask if, in planning this experiment, the Navy Department intends to make full use of all the scientific knowledge and experience available in this country?

Admiral BLANDY. No final plans have been approved, Senator, for those tests. We are in the act of planning them now. We have not come to that particular bridge yet, but we certainly will.

Senator HARR. My question is: Do you intend to use all of the talent which is available in making the detailed plans for this experiment?

Admiral BLANDY. I wouldn't say that we intended to use all of the talent available in the entire country. I think that might be an unwieldy organization. But we do intend to consult the scientists whom we consider qualified and responsible in that matter; yes, sir; particularly to take care of the hazards involved.

Very thorough study will be made of the hazards in planning the details of the test so as to minimize the danger not only to those of us involved but to anyone else.

Senator HART. Will there be full cooperation with General Groves' organization?

Admiral BLANDY. Yes, sir.

The CHAIRMAN. Admiral, when do you prophesy that this test can be held?

Admiral BLANDY. We have set no exact date, but I think we can do it sometime in the coming summer.

The CHAIRMAN. Has a joint board been set up?

Admiral BLANDY. There has been established a Military Advisory Board to General Groves. There also has been established a committee for planning the test, but that committee has not completed its work.

The CHAIRMAN. Has the personnel of that committee been announced?

Admiral BLANDY. The personnel of the committee has not been announced; no, sir.

The CHAIRMAN. Do you intend to announce it?

Admiral BLANDY. It would not be in my province to announce that. It is a committee under the Joint Chiefs of Staff.

The CHAIRMAN. I wish you would take it up with the Secretary and let the committee have a statement as to the personnel, what branch of the service they represent, which is going to supervise the test.

Admiral BLANDY. I will do that, sir; but, as I say, that cannot be done yet because the exact organization has not been determined, the organization for executing the test and for appraising it. It is in the process of being determined now, and I am sure the names of the personnel involved will be published as soon as that work is completed.

Senator JOHNSON. Is it planned to make this test in the nature of a depth bomb and also in the atmosphere above the sea?

Admiral BLANDY. Studies are being made of both of those phases, but, as I say, the details of the test have not been completed.

Senator JOHNSON. I want to ask the Doctor a question. He made reference to a submarine using uranium power. I presume that the problem of eliminating the death rays or gamma rays has been overcome for that purpose?

Dr. GUNN. Sir, I think that ought to be discussed in executive session. It is a technical matter.

Senator JOHNSON. A physicist testified yesterday and suggested that it might be advantageous, especially in wartime, for sea traffic to be all done by submarines, or to be largely done by submarines; that is, large ships moving below the surface of the sea, escaping the storms and the waves and other resistance.

Have you made a study of the propulsion of very large cargo ships?

Dr. GUNN. Sir, I would rather delay that to an executive session. I think we should observe, however, if the enemy doesn't know where

you are, they are not going to drop a bomb on you; and if you are in a submarine, they wouldn't know.

Senator JOHNSON. Yes; I think that is quite obvious, and that is one of the reasons why the physicist suggested that that held great possibilities for the future protection of transportation.

Dr. GUNN. I won't disagree with him.

Senator JOHNSON. This same physicist testified yesterday that the atomic era began on December 2, 1942.

You have testified to the chronological development of this whole matter. Do you agree that historians will say that December 2, 1942, was the date the atomic era began?

Dr. GUNN. I would like to word that as the "beginning of the era on the earth." Atomic processes have been taking place in the stars for a great many millions of years.

Senator JOHNSON. And have probably taken place on earth, too, before man came here; but that is the historical date?

Dr. GUNN. I think that is correct. That is the date at which the first pile was started. It operated very weakly, but it showed that the numerical calculations were substantially correct.

Senator JOHNSON. And the chain reaction was in effect?

Dr. GUNN. The chain reaction did in fact take place. If we had known that one simple fact, irrespective of all technical developments—if we had known this one simple fact when uranium fission was first announced, I think we could have gone ahead a great deal faster, and the scientists would have been willing to recommend a greater expenditure of money more rapidly if we had been sure of that one thing. That was the crucial experiment.

The CHAIRMAN. Doctor, as I take it, you believe that the liquid thermal diffusion method that the Navy developed and operated in December 1942 on a laboratory scale, which General Groves saw in December 1942, had a material bearing upon the development of the process?

Dr. GUNN. Yes, sir.

The CHAIRMAN. As I understand your testimony, and I want to get it straight, the Army, however, took no action until 18 months later?

Dr. GUNN. On our method, sir. They had other methods they were actively pushing, but on our method they took no action.

The CHAIRMAN. On your method there was nothing done for 18 months?

Dr. GUNN. That is right. Our method had the serious objection that it took a great deal of steam to operate it. We recognized that it is not a method one would normally select in peacetime, when one had plenty of time. It had the recommendation of being exceptionally clean. We felt, weighing all the factors, and having the steam boilers in the country, it offered a practical solution that looked better to us than anything else that we had seen.

Naturally we were prejudiced, and thought it was pretty good. I think the other methods are good, and I am amazed at what they have done with them. I think the Manhattan project did an amazingly good job in the time they had to work on it.

Senator MILLIKIN. Doctor, from the testimony of one of our previous witnesses the impression was brought to my mind that if you explode an atomic bomb at great depth you would produce a sort of marine earthquake. I assume that the Navy has a vast store of infor-

mation and experience on the effect of underwater concussion. Am I correct in that?

Dr. GUNN. That is correct in terms of ordinary explosives, sir; but we have no data, obviously, on the atomic explosive.

Senator MILLIKIN. If you know the forces that are released at a given moment at a given depth in the water, you can calculate with reasonable accuracy how far that will extend and what the effects will be within an area?

Dr. GUNN. That is correct.

Senator MILLIKIN. Would it be appropriate in open hearing to ask you whether you gentlemen have made calculations on the effect of the atomic bomb if dropped at depth and if dropped at less than depth in an assumed disposition of naval forces?

Dr. GUNN. Some rough and highly speculative calculations have been made. I honestly don't recall the final results, but they lead to results which we would infer from simply the land data, I think.

The CHAIRMAN. How do you gentlemen now wish to proceed?

Admiral STRAUSS. We would like to offer Commodore Parsons' testimony, Mr. Chairman.

STATEMENT OF COMMODORE W. S. PARSONS, ASSISTANT TO THE DEPUTY CHIEF, NAVAL OPERATIONS FOR SPECIAL WEAPONS

Commodore PARSONS. I came into this project at a fairly late date in its career. It was, I think, the 5th of May in 1943.

I was informed by Admiral Purnell that I was assigned to this project and was instructed by Admiral King as to the security limitations, which were of course paramount at that time.

The CHAIRMAN. Commodore, wouldn't it be a good thing if you were to tell us about your previous experience that led the Navy to bring you into this work?

Commodore PARSONS. All right; I will do that.

I was assigned to the duty of experimental officer at the Naval Proving Ground at Dahlgren, about 40 miles down the river, in August 1939, and was associated with some of the original NDRC ordnance experiments which began in the fall of 1940.

Senator HICKENLOOPER. Mr. Chairman, I would rather have these alphabets interpreted.

Commodore PARSONS. That is the National Defense Research Committee originally, which later transformed into the Office of Scientific Research and Development, as far as the parent organization was concerned.

That, of course, as the war proceeded, led into more and more scientific and accelerated ordnance development, especially experimental ordnance, and in April 1942 I was called to Washington for additional duty, which turned out to be about 5 days a week as Special Assistant to Dr. Bush in connection with the development of the radio proximity fuse. That was development in which, you might say, the electronic initiative was taken by the section under Dr. Tuve, and the backing and enthusiasm for the production were taken by the Bureau of Ordnance and the Navy Department; so it was a fair combination to put an experimental officer from the Navy Proving Ground into the middle of the scientific organization, so that he was wearing two caps.

That led to taking the fuses into battle in January of 1942. I made it a condition to get down there, presumably with a one-way ticket; but it turned out to be a two-way ticket.

I came back, and this project descended on me in May of 1943, I think partially as a result of saying good-bye to Dr. Bush.

I think the ordnance concept of the project was crystallized somewhat in April of 1943. The physics laboratories at Los Alamos were then under construction, and a committee went out there, composed of Dr. Tolman as chairman and quite a few scientists and engineers who had experience in ordnance developments. During the war they advanced the idea that the ordnance work would have to be so closely integrated with the physics work and the chemistry that a proving and testing ground would have to be constructed in the immediate vicinity of the laboratory and presumably under the direction of the laboratory. That led to getting an ordnance engineer nominated for the job of Ordnance Division leader at Los Alamos.

The set-up at Los Alamos was not conducive to the immediate construction of proving grounds for heavy ordnance work, being 50 miles from the nearest railroad and having ravines and mountains all around; but it was possible, with the priority and urgency of the project, to get results in spite of that.

I would say throughout 1943 there was very little except theory to go on. We finally forced ourselves to design one or two types of workable bombs, and then having hypothesized them we built models of them and got started that way in actual work with B-29's in the early spring of 1944.

The concept of the laboratory turned out to be good, but about one-tenth of what we actually needed in terms of men and materials. It expanded, I think, from the original idea of 70 good physicists to many times that number, and a lot of lesser talent besides.

By the middle of 1944 we were getting active materials from Oak Ridge and Hanford, and experiments in physics threw more light on the design that was required. We made some very discouraging discoveries in physics which controlled our ideas of design, but nevertheless there was always ahead a good chance that the thing would succeed in at least one way, making a bomb.

We organized the delivery group of aircraft in September 1944, and from that time on we were training our delivery B-29 crews, and at the same time experimenting in the perfection of the bomb itself.

By the spring of 1945 we had the active material coming in faster and faster, and the experiment, fortunately, the ordnance experiment, also bore fruit; and it was possible by the early spring to take the first step to go to an advanced base and start the laboratory buildings and assembly buildings which were essential to the building of the bomb in battle.

Parallel with that, we prepared for the test in the desert, which we hoped would be a test of a bomb which could be delivered in battle and not some monstrosity which could only be set up over 2 or 3 acres of ground. Of course, we assumed that the test we made in New Mexico would succeed, and we had all of our groups en route to the Marianas when the bomb went off in New Mexico. It did succeed, and we were ready to go in less than 21 days.

The CHAIRMAN. In other words, Doctor, from the time that you entered the project there was the hardest kind of work to get it out as quickly as you could, and there was no delay at all that you can tell us about except the delays that were consequent to the difficulties of the project?

Commodore PARSONS. That is right.

The CHAIRMAN. And the bomb was delivered as quickly as it possibly could be delivered?

Commodore PARSONS. Yes. I think the material which went to Hiroshima probably had not been 3 weeks out of Oak Ridge, out of separation, or Hanford. It was going that fast.

Senator HART. Commodore, to carry you back a little, you used the word "monstrosity" just now.

Do you mean that there had to be a great deal of adjustment of ideas between the ordnance engineering personnel and the scientists who had to devise the means by which the bomb would be exploded?

Commodore PARSONS. No; I don't think there was much adjustment, if you mean friction in the adjustment. It was an absolute confirmation of the need to have the engineering on the bomb done with the physicists and by the physicists.

With the changes being made as they were in that development, the basic engineering had to be done practically by the Nobel-prize-winning physicists who were developing the bomb. It turned out that way. An ordinary engineer is about two stages removed from the furthest advances in nuclear physics, obviously, and that was the integration that we had to have.

Senator HART. It was decided that the bomb should be used from a plane. Did you take great part in deciding upon the dimensions, and so on, of something that would be practicable of use?

Commodore PARSONS. Yes. We worked on the problem beginning in December 1943, trying to settle on something which could be carried by an existing airplane. The B-29 was then a secret, and it had a lot of weaknesses which were eliminated in the next year, I would say; but we adopted the B-29 without serious modification as our airplane. We realized that if we built something that could only be carried in an airplane which had to be tailored to it, we would probably not make the war even if the bomb was developed. So we forced ourselves to take an existing successful airplane as the carrying vehicle.

Senator MILLIKIN. Commodore, may I ask whether the advance base was necessary to accommodate the airplane or the peculiar nature of the bomb?

Commodore PARSONS. The advance base was not necessary to accommodate the airplane, because they already had in the Marianas almost a thousand B-29's based there. It was the most tremendous concentration of air power that I think has ever occurred, and we just cashed in on that.

Senator MILLIKIN. But the bomb problem itself made it necessary to get as close to the target as possible, without going into the bomb problem? I mean, could you produce the same result from San Francisco, assuming you had the proper plane?

Commodore PARSONS. Staging it across, you mean? Oh, yes.

Senator MILLIKIN. Could you have assembled your bomb at San Francisco and carried it from San Francisco to the target, assuming

you had the plane to do it, as well as you could from your advance base?

Commodore PARSONS. Yes.

Senator MILLIKIN. In other words, the proximity of the base to the target is not an essential factor so far as the bomb is concerned?

Commodore PARSONS. That is correct.

The CHAIRMAN. What is the distance of that nonstop flight from Tokyo to Washington?

Commodore PARSONS. I think it was 6,500 miles.

The CHAIRMAN. How far would it have been from the Aleutians down to Hiroshima and Nagasaki and back again?

Commodore PARSONS. I don't know, sir.

The CHAIRMAN. Does anybody know that, approximately?

Admiral PURNELL. I think it is approximately the same as from the Marianas.

The CHAIRMAN. You mean it is approximately the same distance from the Aleutians down to Hiroshima as it is from the Marianas up to Hiroshima?

Admiral PURNELL. Yes. I would have to look it up, but it is in that neighborhood.

The CHAIRMAN. So far as we can see, there would be no reason why you couldn't take the bomb from the Aleutians down there and return to base?

Admiral PURNELL. I would have to check that, but I think it is close.

Commodore PARSONS. If the distances are comparable, that is a correct assumption.

The CHAIRMAN. Of course, Commodore, with the improvement in airplanes that are projected, the possible distance for flight round trip is going to be much greater; don't you think?

Commodore PARSONS. Yes, sir.

Admiral STRAUSS. Mr. Chairman, I don't know whether I made it clear in my introductory description of Commodore Parsons that he was the weaponeer on the plane which delivered the initial bomb. He was present in person.

The CHAIRMAN. Well, I gather from that, Admiral, that you think it might be advisable to go into the experience itself.

Admiral STRAUSS. No; I simply felt my introduction was deficient in making that point clear.

The CHAIRMAN. Perhaps you should tell us about it, Commodore.

Commodore PARSONS. Well, I think I might say why that idea was sold originally. It is, I think, a sound philosophy in ordnance design to have the person who is responsible for the design, the reliability of the design, and the workability of the design, at all times have in the back of his mind that he is going to see it into the initial battle use. It has, let us say, a sobering effect on the ordnance designer, and I had had that philosophy in mind in other weapons.

It is such a good philosophy that I sold that idea to General Groves early in the game, so I had my ticket written about the summer of 1943 for that job.

The CHAIRMAN. You released the bomb personally; did you not?

Commodore PARSONS. No; I didn't pull the lever. I was there, and the identification of the target was confirmed with me.

Senator MILLIKIN. You prepared the bomb, didn't you, Commodore, for the job, without going into detail?

Commodore PARSONS. You mean in the airplane after the take-off?

Senator MILLIKIN. Yes.

Commodore PARSONS. I had an assistant who made the electrical tests on the bomb in flight. I went into the bomb bay and performed an assembly operation on it after the take-off, and then also supervised the final preparations which took place just before we climbed to delivery altitude.

We were about 20 minutes before the final climb which would put us at delivery altitude over the Empire and decided to make it a final bomb then and there, and of course we could have gone into reverse if we had to go back, but we made it a bomb about 20 minutes before we climbed to delivery altitude, and made final tests about 10 minutes before we reached the target.

Senator MILLIKIN. I had read that you did a lot of practice before you tried it on that trip.

Commodore PARSONS. Yes; we had to do that to prove each component, and unfortunately we didn't have all the components at the same time, so we had to make a large number of tests. It was so large and so apparently adequate that my assembly crews said they could hardly believe it was anything but one of the old practice bombs, because it involved all of the nonexplosive components.

Senator MILLIKIN. Tell us some more about that.

Commodore PARSONS. I would say there is another advantage in having the ordnance designer go along, and that is that when you cannot inform the crew of the nature of the design or anything except that it is an extremely powerful bomb, it is also steadying to the crew to have the ordnance designer riding with them on the delivery flight.

Senator JOHNSON. Did you see the bomb as it exploded? Were you looking in that direction, or could you feel the impact?

Commodore PARSONS. We certainly felt the impact. We were about 11 miles away, I believe.

Senator JOHNSON. And you felt the impact?

Commodore PARSONS. Yes; we felt two shocks; one, the direct path, and the other the first reflection from the ground.

To answer your question about whether I saw it go, I did not see the one on Hiroshima actually function because we had just completed a maneuver to get a lot of distance between us and the bomb, and that put our tail toward the bomb. The only one who could see it clearly at that time was the tail gunner.

Senator JOHNSON. Was the light so bright it blinded him?

Commodore PARSONS. I know this: He had his polaroid goggles set to maximum extinction, and he was also looking down into his machine gun when the bomb actually went. He got quite a lot of flash, anyway.

I got a flash through the side window, which indicated that the sky was sufficiently bright, even looking 90° from the bomb, to give you a flash through full-extinction polaroid goggles. That was at 8:15 in the morning, Japan time.

At 5:30 in the morning, New Mexico time, I was looking at the first atomic bomb from a B-29 rehearsing the Hiroshima job, and the flash there was tremendous, of course, because it wasn't in competition with

the sun. It lit up the whole sky, and it also went through these goggles, not quite blinding but almost blinding through full-extinction polaroid goggles.

Senator JOHNSON. How far away were you at that detonation?

Commodore PARSONS. I think we were about 28 miles slant range.

Senator JOHNSON. Did you feel the impact?

Commodore PARSONS. Barely. It was a very soft impact which was only felt by myself, the pilot who felt it on his controls, and the bombardier. The rest of the crew did not notice it at 28 miles.

The CHAIRMAN. How much of a toss did you get over Hiroshima?

Commodore PARSONS. Well, the crew who had been over Germany a lot and had been in heavy flak said it was just like a very close—about 20 to 25 feet—heavy antiaircraft shell bursting.

The CHAIRMAN. Was it like hitting an air pocket at all?

Commodore PARSONS. It is sharper than that. With an air pocket you usually have a slight warning. This thing came just like a blow.

I think Ashworth, who was over Nagasaki, said it was as if the B-29 were being beaten by a telephone pole.

Senator MILLIKIN. Did the flash have any unusual color?

Commodore PARSONS. We couldn't tell the color, because we were seeing it through these goggles. If you look at an electric arc through those goggles, it looks bright purple; and that is what this thing looked like, bright purple, like a tremendous electric arc.

Senator MILLIKIN. If you had looked at normal flak through the same goggles, would it have appeared the same?

Commodore PARSONS. The bursting of an antiaircraft projectile? No; I think it is much on the blue side. It is so hot it is like an arc rather than the color of a detonating explosive.

Senator MILLIKIN. If you looked at a big TNT explosion on the ground through those same glasses, would there have been any difference in the appearance of the flash?

Commodore PARSONS. It is very different, really. TNT will give a ball of fire which is red, I think, at night; and this is white or blue.

Senator MILLIKIN. The colored movies gave the effect of a very weird sort of light, at least weird because it is different, I suppose.

Admiral STRAUSS. Polaroid goggles depend on alined quinine crystals. They transmit only one color at extinction.

Senator MILLIKIN. Let me ask you this, Commodore: Assuming that we want to develop atomic weapons, in time, am I correct in the assumption that they could be delivered in a routine way, the same as a normal bomb, or will they always require sort of personal attention and handling in addition to that which you give to a normal bomb you are dropping out of a plane, let us say?

Commodore PARSONS. Well, I think they will always require attention by highly qualified people until nuclear physics is as common as ordinary explosive chemistry is now.

Senator MILLIKIN. You believe that in the evolution of the subject, if we evolve—if you would call it that—that you could deliver the bomb with a rocket or a pilotless plane?

Commodore PARSONS. I certainly do.

Senator HICKENLOOPER. I know we had some discussion the other day about the investigations in either Nagasaki or Hiroshima by a scientist who was over there investigating.

I don't believe his discussion as to the extent of this light was in executive session, was it? Didn't he discuss that in open meeting here about the question of this priest who was 3 or 4 miles away?

The CHAIRMAN. That is my recollection.

Senator HICKENLOOPER. As I recall Dr. Morrison's testimony, he said there was a priest about 4 miles away from the point of explosion of this bomb that went off over Nagasaki—one of the two places, anyway—and he said that the priest was apparently looking right in that direction, at that explosion, about 4 miles away on the ground, and he said they had no record or evidence of any effect on his eyes in any way, shape, or form, no blindness nor temporary blindness, as I recall.

He didn't say that there was not any, but he did not have any statement to make on that. It was my impression that being that close and looking right at it, at the tremendous blinding flash, from all we have read and heard, it should have some perhaps permanent effect on his eyes.

Commodore PARSONS. Well, I don't quite understand that priest's experience. I should think his feeling would be that he was blinded for half a day, or something like that.

Senator HICKENLOOPER. As I recall Dr. Morrison's testimony, there was no special emphasis laid on that, and I think he said there was a bright light, but they didn't have any record of any particular outstanding effect on this man's eyes. They got a direct report from a priest who had gone down there to help get some of the people out of there.

Commodore PARSONS. That does not quite check with the experience of one man who did not have blinders on his eyes in the New Mexico test. I don't know just how far he was away, but something in the order of 6 miles, and of course it was 5:30 in the morning and his eyes were dark-adapted, so he was in a position to be blinded much more easily than someone in the middle of the day with the sun shining. That man didn't recover for a day and a half.

Senator HICKENLOOPER. In all fairness to the statement that was made the other day, I think Dr. Morrison said they didn't have too much special data on that, but as far as he knew, there was no unusual effect, nothing that they had recorded as any general effect on the eyes.

The CHAIRMAN. I think that was General Groves, Senator, who had the letter from the Jesuit priest. He is the one who told us about that.

Senator HICKENLOOPER. As I recall it, it was a scientist, and I believe it was Morrison who had actually gone over there to view these things.

Commodore PARSONS. Two of our people in the delivery airplane, who were sitting up in the forward seats, the copilot and the bombardier, did not have their goggles on; they forgot to put them on. Of course, we were heading away from the thing, and they got the impression of a tremendous flash, but that is all. They were not damaged. They were not looking directly at it.

Senator HICKENLOOPER. It would be bad to have a blind copilot on a trip like that.

The CHAIRMAN. Because of business on the floor, we will have to recess. There are some other things that we will want to hear from

you, Admiral Purnell and Admiral Blandy, at 10 o'clock tomorrow morning, if that will be satisfactory. And, of course, Admiral Strauss, we want to hear from you.

Admiral STRAUSS. Will you want Dr. Gunn back again?

The CHAIRMAN. No; I believe not.

Admiral STRAUSS. Or Commodore Parsons?

The CHAIRMAN. I think, Commodore, unless you have something particular you want to tell us, that will be quite satisfactory.

I take it we will not be very long with you gentlemen tomorrow.

Admiral PURNELL. Frankly, Mr. Chairman, most of the information that I have has been covered by General Groves and Dr. Bush; that is the work of the Military Policy Committee; and as far as my part of the Navy effort goes, representing the Navy in the project, I can put it this way: It was probably the easiest job I ever had in my life. I had a White House overriding priority plus Admiral King back of me. I don't know of anything that could make work easier for you than that.

I can answer Dr. Gunn's statement on the information, but, in fact, General Groves could do it much better.

I passed on the requests that he sent up, I think, through Admiral Mills. They were taken up in the Military Policy Committee and discussed, and also the reports that were made of the process at the laboratory were passed on to the examining board which was set up under the scientific end of the project. It is my recollection that Dr. Briggs was the liaison man, and when any information was secured in the project which was considered to be of value to Dr. Gunn in his research, it was supposed to have been passed. At what time, I haven't any information. I could probably get it.

Senator MILLIKIN. Mr. Chairman, it would probably be more appropriate for executive session, but I should like to hear from somebody in the Navy as to the Navy's role in the possible development of atomic energy as a weapon, offensively and defensively.

Admiral BLANDY. I think I should probably answer that, Senator, because those are my present duties.

Senator MILLIKIN. Do you think that should be in executive session?

Admiral BLANDY. I think so, but some of it I could answer in open session.

Senator MILLIKIN. We could make a start with that in the morning.

The CHAIRMAN. We will recess until 10 o'clock tomorrow morning. (Whereupon, at 12:15 p. m., a recess was taken until 10 a. m. Friday, December 14, 1945.)

ATOMIC ENERGY

FRIDAY, DECEMBER 14, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Connally, Byrd, Johnson, Austin, Millikin, Hickenlooper, and Hart.

Also present: Dr. Ross Gunn, technical adviser to the naval administration of the Naval Research Laboratory; Commodore W. S. Parsons, assistant to the Deputy Chief, Naval Operations for Special Weapons; Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. This morning we will hear from Admiral Blandy. Will you go right ahead, Admiral.

**STATEMENT OF VICE ADM. W. H. P. BLANDY, DEPUTY CHIEF,
NAVAL OPERATIONS FOR SPECIAL WEAPONS**

Admiral BLANDY. My connection with the subject of atomic energy lies in the present and the future rather than with past developments.

On the 13th of November of this year the Chief of Naval Operations, with the approval of the Secretary of the Navy, established a Deputy Chief of Naval Operations to coordinate within the Navy Department all matters relating to research, test and development of atomic energy, guided missiles, and related devices, and to represent the Navy Department in Army-Navy and other composite organizations dealing with the same matters.

I was ordered to duty in that capacity on the 22d of November.

It might be worthwhile to give a brief résumé of my service, which apparently prompted the Navy Department to order me to that duty. I have been throughout my career both a combat-line officer and, since immediately after the last war, a postgraduate in ordnance engineering. From February 1941 to December 1943 I was Chief of the Bureau of Ordnance of the Navy Department, and from January 1944 until July 1945 I commanded a group of the amphibious forces under Admiral Turner and participated in the campaigns of Kwajalein, Saipan, Palau, Ulithi, Iwo Jima, and Okinawa. From July until November 1945 I commanded the cruisers and destroyers of the Pacific Fleet.

I have had my present duty such a short time that it has naturally not been possible to formulate a complete policy for the approval of

the Chief of Naval Operations and the Secretary of the Navy regarding development of these special weapons, but consistent with such limitations as may be imposed by Executive order, national law, and international agreement, it is my intention to utilize atomic energy to the fullest extent for naval purposes. That utilization will, of course, include atomic power as well as atomic explosives.

The exact manner in which we will use them, of course, is not even well known yet, and I would not be able to disclose in open session even our particular present plans.

At the present time I think that practically any one's idea as to how these things can be used for naval purposes will be more or less conjectural, even on the part of the officers most expert in the knowledge of atomic energy.

The tests of the atomic bomb against naval vessels, which we hope to conduct this coming year, will constitute a general guide toward what we may expect when bombs of certain type utilizing atomic explosives are placed in certain positions with respect to ships.

The CHAIRMAN. I take it, Admiral, you are not going to wait for the actual tests in order to formulate a plan of integration based upon what the physicists tell you they think the tests will be.

Admiral BLANDY. A plan for integration for what?

The CHAIRMAN. Of the atomic bomb into the future Navy.

Admiral BLANDY. That is quite correct.

The CHAIRMAN. My point is that I don't think you ought to wait until next summer until you actually run a test before thinking about how the thing is going to be integrated, but rather, based upon what the physicists tell you now, integrate it as far as possible and improve it by the tests. That is only my reaction, for I would assume you would approach it that way.

Admiral BLANDY. I am glad you brought that point out, Mr. Chairman, because that is exactly what we intend to do. We intend to go ahead and get confirmation of what we now predict will happen when the tests are conducted.

The CHAIRMAN. Have you gone pretty well along on those predictions, Admiral?

Admiral BLANDY. I haven't, personally, but the scientific personnel, both civilians and officers, have done so.

I would like to say one thing, Mr. Chairman, in extension of my reply to a question you asked yesterday. The Planning Committee, which is planning those tests, is composed of officers from all interested branches of both services.

The CHAIRMAN. Including the Army Air Corps?

Admiral BLANDY. Army Air Forces, Ground Forces, Navy Surface Forces, and Navy Aviators.

The CHAIRMAN. Admiral, do you suppose that after we come back in January, and in executive session, it might be possible for you to have here the officers and civilians who have been computing for you, shall we say, the life expectancy of surface ships in view of this thing? Would you have it in shape at that time?

Admiral BLANDY. I would like to have time, Mr. Chairman, to take that under advisement.

The CHAIRMAN. We will keep in touch with you on that.

Admiral BLANDY. I would like to make this comment now, though, in that connection, not directly in reply to your question, but because

there seems to be an impression that the usefulness and the reason for existence of a certain type of vessel or aircraft or weapon is determined by what can destroy it. That is a fallacy which seems to be quite common. Actually what renders a ship obsolete is not what can destroy it, but what can replace its function. Now, so long as that ship is needed to perform an essential function, it makes no great difference what can destroy it. If a badly needed ship is destroyed, we will replace it.

Take the aircraft carrier in the recent war, for instance. The aircraft carrier was a comparatively vulnerable ship, especially with all the gasoline and other inflammables aboard, and explosives in the form of bombs and ammunition. Nevertheless, when our carriers were sunk we replaced them with other carriers, because nothing else could do the job. The same is true of aircraft. Just because they are shot down, we do not stop building them.

Senator JOHNSON. But if the destruction is so effective that a ship cannot perform a useful function, then of course it becomes obsolete; so you do have to take into consideration the element of destruction.

If a navy can be destroyed before it can perform any useful function, then of course it becomes obsolete just as the bow and arrow did. I do not mean to infer that I believe that that is the situation.

Admiral BLANDY. In such case, we would become an entirely continental Nation and have to defend ourselves from our own territory.

Senator JOHNSON. But I don't think that is the situation.

Admiral BLANDY. I would like to point out, Senator, that there are, of course, numerous ways in which ships can be destroyed, but the question of probability comes in, too. The cheapest and easiest way to destroy a ship is, of course, by a match, but in order to do it you have to get the match into the powder magazine. That is fantastic, but ships actually have been destroyed by time bombs placed in their magazines when they were in a navy yard. The British had one destroyed that way in the last war. She got out of drydock and up to Scapa Flow, where she blew up; and the only explanation was a time bomb planted by German agents.

Senator JOHNSON. But of course that brings into play the element of personal failure, and personal failure never will be entirely eliminated, but relatively so, and it has been.

The feeling about such a thing as the atomic bomb is something that no human being can do anything about.

Admiral BLANDY. But the atomic bomb still has to be delivered into close proximity of the ships.

Senator JOHNSON. That is correct.

In connection with your reply, I want to ask if there is any defense against the atomic bomb?

Admiral BLANDY. There is no defense that I know of, Senator, at the present time except destruction of its carrier.

Senator JOHNSON. To intercept the carrier.

I also want to ask, Admiral, if you think there will ever be another great war, a world war, in which atomic bombs will not be used?

Admiral BLANDY. Any answer I would give to that, Senator, would be merely a guess.

Senator JOHNSON. Yes; I am certain of that; but you are an expert.

Admiral BLANDY. That would require not only a knowledge of weapons, but probably a greater knowledge of human nature than I

possess. I would say that the chances are pretty strong that in the unfortunate event of another major war atomic weapons would be used.

Senator JOHNSON. They are so effective that it just seems out of the question to me that if we do get into another war, one side or the other, and perhaps both sides, will not be using them. I cannot picture a world war in which they will not be used because of their vital effectiveness.

Senator HART. Admiral, in connection with Senator Johnson's original question to you, it is perfectly true that, over the vast reaches of the ocean, goods and men are going to be transported in peace and in war, and on the surface of the ocean.

In your estimation that is correct, is it not?

Admiral BLANDY. Yes, sir.

Senator HART. And in the event of war, with that transportation absolutely a necessary part, men will be fighting from, and on, and in, ships no matter what weapons are in existence to destroy them. Is that the case?

Admiral BLANDY. That is my belief, Senator.

Senator HART. Even if there were no surface warships at all, built as such, men still would be fighting from ships by means of guns or torpedoes or whatever can be thrown onto them when hostilities begin. Is that right?

Admiral BLANDY. I think that is highly probable; yes; so long as the sea is used for transportation. It is conceivable that the time might come when we no longer need to use the surface of the sea; but that time is certainly very far into the future.

If the sea were no longer needed as a highway and everything traveled by air, then you would no longer need fighting ships on the sea, because control of the sea would be unnecessary.

But I believe that the potentiality of any nation to make war is dependent on three, and only three, factors: her manpower, her materials, and time. If two opposing nations were equal in those three factors, the one will win which makes the most profitable utilization of all three of those factors.

It may be worth while, in order to gain time, to do what would ordinarily be uneconomical in the utilization of manpower and materials. That is, you may consume them at an extremely rapid rate, but if you gain time in war—which is all important—it might be worth while. It might be worth while, for instance, to transport armies completely by air, when and if that can be done, and keep them supplied by air over large expanses of sea, even though it could be done much more cheaply by surface ship so far as consumption of manpower and materials is concerned. The determining factor in this case would be time.

As I said before, however, this is looking pretty far into the future, and for a long time to come we are going to need to use the surface of the sea. It is and always has been the Navy's primary mission to gain that use for ourselves and to deny its use to the enemy; and that is what we did in the last war. We had to use the sea to get materials and troops to Germany and to the islands in the Pacific, and we had to defeat the German submarine on the one hand, and all arms of the Japanese Navy on the other to gain that use. We also had to deny the use of the sea to Japan in order to keep her from bringing

raw materials into Japan and sending out men and materials to the bastions of her stolen empire.

The CHAIRMAN. I am glad that, when you said the things we need are manpower, materials and time, you didn't say money.

Admiral BLANDY. Well, money is only a medium, I think. The fundamentals are manpower, materials and time. Money is a means of utilizing those things.

Senator JOHNSON. Before you leave that point, I would like to express the hope that the Admiral includes science with the three elements. I presume that is in the manpower.

Admiral BLANDY. That is part of the manpower. That is the brain power that lies in the manpower. There is also the will to win, but I consider that, too, as part of the manpower.

The CHAIRMAN. Admiral, I am not in any sense a military or naval strategist. I know nothing about it, and I approach it from that viewpoint, and when I try to think about it I realize my lack of background.

It does occur to me, however, that when these tests are run, in order to reassure the American people, it might be well to have a civilian board of scientists review the tests before they are run, a board that might be appointed by the President. I just throw that suggestion out, because there is going to be a tendency, you know, for a lot of people to say: "Well, the battleship boys want to keep their battleships. The aircraft boys want to keep their aircraft carriers."

It strikes me it might be a good idea to have some review by this board. What do you think about that?

Admiral BLANDY. Mr. Chairman, I heartily concur, and I shall convey your suggestion to the Planning Committee.

As I said yesterday, I am not doing all the planning for this thing; it is a joint effort of the Army and Navy. The Planning Committee's work hasn't been completed or approved, but I happen to know that they do contemplate a very similar thing, except I believe that the board will be composed of civilian scientists and officers, because it is possible that the civilian scientists alone might draw some incorrect deductions from a military standpoint without the guidance and assistance of some military and naval officers. But they certainly will be included for planning the tests, for conducting the tests, and for appraising the results.

Senator JOHNSON. Mr. Chairman, I don't want to pose as an expert or a crystal gazer, or anything of that kind. However, it does seem to me that it is apparent that atomic energy has driven the ships off the surface of the sea, but at the same time it has provided the means whereby ships below the surface of the sea can operate effectively by giving them the power. I don't see how a ship on the surface can resist the atomic bomb, but that doesn't mean that navies are obsolete provided they will adopt a new technique. If they will go below the surface, they will still be in the picture. If they don't, it will be just too bad.

Admiral BLANDY. There are a lot of people who will agree with you, Senator. I think I will wait for the tests.

Senator JOHNSON. Yes, I will wait for the tests, but the physicists and experts have convinced me that ships on the surface of the sea are going to be ducks on the pond, and I want to see them go down below where they cannot be seen and reached by the atomic bomb.

Senator HART. Mr. Chairman, may I supplement Senator Johnson's ideas in this way: I am thoroughly in agreement with him except I think that he does not realize how big the pond is, how much room there is to cover on this pond, which throws back to the element of probability which Admiral Blandy put in the picture.

You naturally have to take a risk, but if what is to be obtained by taking that risk is commensurate, then you take it and remain on the surface of the sea.

Senator JOHNSON. Yes; I think that is a very strong point and, if I were defending against a foreign power using atomic bombs, I would much prefer them to waste the atomic bomb sinking one ship than I would to have them drop it in the center of New York City, just on the point of effectiveness.

Of course from that point of view, a few ducks on the pond nicely scattered might serve a very useful purpose as a protection to our cities.

Admiral BLANDY. Mr. Chairman, if I may I would like to say one more thing about these tests. Insofar as I have anything to do with it, my own attitude is entirely objective. I don't want to prove anything; I don't want to disprove anything. I want to get the truth so we can come out with the best possible result.

The CHAIRMAN. That is the spirit I want to promote—not to prove anything, but to go at it as a scientist goes at it to analyze the thing and find out objectively, under the best possible conditions, what are the facts.

Admiral BLANDY. In other words, I want it to be a test and not a contest.

The CHAIRMAN. That is very well said, I think, very well said.

I feel as Senator Johnson does. Senator, you are not a naval expert and neither am I, and we probably disagree with Senator Hart. I feel, too, that it is going to be pretty tough on the surface ships—but we obviously cannot take any action on it until the tests prove or disprove that belief.

Senator JOHNSON. And then prove the other belief, too, the constructive belief of building ships that can withstand the atomic bomb, and I believe it can be done.

The CHAIRMAN. You mean surface ships?

Senator JOHNSON. No; I mean go down under where the atomic bomb cannot reach them or cannot discover them.

Senator HART. Then, you will get the submarines into the papers in the next war.

Admiral PURNELL. I might add that it may be the best vehicle for delivering it when it takes a rocket form.

The CHAIRMAN. Are you through, Admiral?

Admiral BLANDY. Yes.

The CHAIRMAN. Admiral Strauss.

Admiral STRAUSS. You were in the midst of Admiral Purnell's testimony when we adjourned yesterday, Senator.

The CHAIRMAN. Admiral, the last thing I remember you said was that you had a pretty easy job because you had a White House priority and backing by Admiral King.

Was it easy because of that, or was it easy because you didn't have very much to do?

STATEMENT OF REAR ADM. WILLIAM R. PURNELL, ASSISTANT
CHIEF OF NAVAL OPERATIONS FOR MATÉRIEL

Admiral PURNELL. It was easy because all I had to do was to ask for it.

The CHAIRMAN. Ask for what?

Admiral PURNELL. For the Navy support to the projects, and I got it, with no questions asked.

The CHAIRMAN. You were the Navy's representative upon the Interim Military Policy Committee?

Admiral PURNELL. That is right, the Military Policy Committee.

The CHAIRMAN. Were you in pretty close touch with that development at Oak Ridge?

Admiral PURNELL. I have been to Oak Ridge, yes, and I knew what they were doing.

The CHAIRMAN. When did you first go down there?

Admiral PURNELL. January 1944, I think it was.

The CHAIRMAN. Did you know before that what was being done down there.

Admiral PURNELL. Yes, sir; I was detailed by Admiral King late in August of '42, and I became a member of the Military Policy Committee when it was formed in September of '42.

The CHAIRMAN. Did Dr. Gunn's requests come to you?

Admiral PURNELL. They came through me, yes.

The CHAIRMAN. And you transmitted the information you got to Dr. Gunn?

Admiral PURNELL. I didn't get any.

The CHAIRMAN. You didn't get any?

Admiral PURNELL. No, sir, it didn't come back to me.

The CHAIRMAN. To whom did it come back?

Admiral PURNELL. There were two different boards of scientists appointed at different times to study the reports from the laboratories, and also, when specific requests were made, I delivered those to the Military Policy Committee, and I think they were delivered to Dr. Bush—either Dr. Bush or Dr. Conant.

The CHAIRMAN. What I am trying to find out, Admiral, is, after you delivered your request to the Military Policy Board, what did they do then?

Admiral PURNELL. They were then passed to these two boards that were appointed, and as I remember it Dr. Briggs was the chairman of one of these boards, and he was also designated as the liaison to pass information to the laboratories.

The CHAIRMAN. Admiral, you were the top fellow in the Navy on atomic energy?

Admiral PURNELL. Yes, sir; I was the senior one.

The CHAIRMAN. You were the senior member?

Admiral PURNELL. Yes, sir.

The CHAIRMAN. Did you receive response to your requests for information that were transmitted by Dr. Gunn through you?

Admiral PURNELL. I received reports at the Military Policy Committee meetings that that was being handled and looked out for by those boards that were appointed and by Dr. Briggs.

- The CHAIRMAN. Yes, but you asked for information; did you get it?
- Admiral PURNELL. The laboratory asked for it, and I delivered the request, because I was the Navy representative on that committee.
- The CHAIRMAN. But did you get it back?
- Admiral PURNELL. Not through me, no, sir. I was told it was being handled by the scientists through Dr. Briggs.
- The CHAIRMAN. They were supposed to give it back through some other channel to Dr. Gunn?
- Admiral PURNELL. Direct, yes, as far as I know.
- The CHAIRMAN. But Dr. Gunn has testified he never got it.
- Admiral PURNELL. Well, it was the understanding, I think, with the Manhattan project that information that was considered by the scientists to be of value to the research laboratory would be passed to them. That was my understanding.
- The CHAIRMAN. So you never got any, so it was never of any value.
- Admiral PURNELL. I never got any, no, sir.
- The CHAIRMAN. Do you know of anybody else who get any?
- Admiral PURNELL. No, except the assurance I got that it would be handled; that is all.
- The CHAIRMAN. But it wasn't handled.
- Admiral PURNELL. Well, I take Dr. Gunn's word for that, yes.
- The CHAIRMAN. You were in constant touch with Dr. Gunn?
- Admiral PURNELL. No, sir.
- The CHAIRMAN. At least he kept asking you or furnishing you with memoranda of things he would like to be provided.
- Admiral PURNELL. They usually came through Admiral Van Keuren.
- Dr. GUNN. And Admiral Mills.
- Admiral PURNELL. They were passed to me in letter or memorandum form and I delivered them to the Military Policy Committee.
- The CHAIRMAN. I can see them going up, Admiral, but I cannot see anything coming back.
- Admiral PURNELL. In the first place, I don't think they would let that information get very far out of the regular channel. The channel that was established for the passing of that information was through Dr. Briggs to the laboratory to Dr. Gunn.
- The CHAIRMAN. Then, in other words, Admiral, you were a one-way street. You took it up, but it didn't come back through you.
- Admiral PURNELL. It didn't come back through me, no, sir.
- The CHAIRMAN. As far as you know, the only way it came back was through Dr. Briggs to people that were interested?
- Admiral PURNELL. That was the established channel for the flow of information.
- The CHAIRMAN. Who were the people who were interested in the Navy?
- Admiral PURNELL. The Bureau of Ships, due to the fact that the Research Laboratory was under the Bureau of Ships at that time.
- The CHAIRMAN. Who was in charge?
- Admiral PURNELL. Admiral Cochrane and Admiral Mills.
- The CHAIRMAN. Where are they now?
- Admiral PURNELL. They are here, sir.
- The CHAIRMAN. We had better hear them.

Admiral PURNELL. Frankly, I think they are in the same position that I am, that they passed them to me and I passed them to the Policy Committee, and then they were studied by the scientists. What happened after that, I don't know, sir.

The CHAIRMAN. In other words, are you saying that Admiral Mills and Admiral Cochrane did not get anything back?

Admiral PURNELL. No, sir; I don't think that channel was established. It was later on in the project.

Senator HART. Mr. Chairman, I was likewise having something of a misconception of what the Policy Committee, of which Admiral Purnell was a member, were doing as regards research. My understanding from what he says now is that it was really a higher level concerned with the production and what was to be done from the military standpoint; and it was rather natural that between scientists the channel should be direct. Is that right, Admiral?

Admiral PURNELL. That was the plan on which we worked; yes.

The CHAIRMAN. I confess—and I may be stupid about it, Admiral—that I have not got the set-up at all clear in my mind, and I want to get it clearly set up.

Dr. Gunn was in charge of the laboratory. He was your chief man in nuclear physics.

Admiral PURNELL. He was on the power end, Mr. Chairman. He was not in the explosive end at all.

The CHAIRMAN. Who was on the explosive end?

Admiral PURNELL. No one in the Navy. That was entirely in the Manhattan District project.

The CHAIRMAN. You had nothing to do with atomic energy for explosive purposes?

Admiral PURNELL. Entirely, but not for power purposes. That is, the Manhattan District devoted very little attention to a development for power.

Senator MILLIKIN. Mr. Chairman, may I make a suggestion?

To avoid confusion both ways, let me suggest that the witness be asked to describe the chain of authority upward for power and upward for weapons, as far as the Navy is concerned, from the laboratory up.

Admiral PURNELL. There was really no organization for the development of power.

Senator MILLIKIN. I am speaking now only of the channel of communication from the laboratory up to wherever it went on the power side and on the weapon side.

Admiral PURNELL. On the power side, it came up from the research laboratory through Admiral Van Keuren to the Bureau of Ships.

Senator MILLIKIN. Who was the Admiral?

Admiral PURNELL. Admiral Van Keuren was in charge of the research laboratory. Then Admiral Mills was detailed to handle it in the Bureau of Ships. He usually brought it personally to me.

Senator MILLIKIN. Then it went to you?

Admiral PURNELL. Yes, sir.

Senator MILLIKIN. Then where did it go?

Admiral PURNELL. I took it personally to the Military Policy Committee. It never went into what we call correspondence channels.

Senator MILLIKIN. Now, if anything were to come back, what happened?

Admiral PURNELL. Then the Military Policy Committee, primarily under the direction of Dr. Bush aided by Dr. Conant, set up boards or committees—I don't recall just what they were called at the time—first, to study the process that was developed at the laboratory, and next to go over the reports of their progress, and then in ordinary conversation at the committee's meetings there would be discussions.

Senator MILLIKIN. You are talking about scientific meetings?

Admiral PURNELL. The Military Policy Committee meetings.

The CHAIRMAN. Of which you were a member?

Admiral PURNELL. Yes, sir.

Senator MILLIKIN. Do you mind if I get clear where that sat in the hierarchy?

Admiral PURNELL. I had better start down from the top, then. The first committee established was the one under the Vice President. I am not sure of the composition of that committee. It was Mr. Wallace, the Secretary of War, General Marshall, Dr. Bush, and I think one other member.

Senator MILLIKIN. That is what you referred to when you referred to the military committee.

Admiral PURNELL. No, sir; that was the Presidential committee.

Senator HART. I think that set-up is described in Dr. Smyth's book.

Admiral PURNELL. That is right.

Senator MILLIKIN. I think we ought to have it here, because we have got so much confusion as to what this channel of communication is.

Admiral PURNELL. Now, under that committee, which passed on very general topics, the Military Policy Committee was set up by the President. Dr. Bush was the chairman, General Styer was the Army member, I was the Navy member, and Dr. Conant was alternate to Dr. Bush. General Groves was executive officer of that committee and in direct charge of the project. The questions of policy, the decisions of processes to be followed, and expenditures, what plants should be built, and the size of them and when they should be added to, a discussion of the reports made, and what we could expect from each one of the processes, and so forth, were the questions that were handled by the Military Policy Committee.

Senator MILLIKIN. Starting then from the laboratory, that went up through you to this Military Policy Committee?

Admiral PURNELL. Yes, sir.

Senator MILLIKIN. Now, if anything were to come down—and I understand nothing did come down—it would come through those same channels?

Admiral PURNELL. No, sir; those were not official correspondence channels. That was merely a way of getting a request from the laboratory to the policy committee.

Senator MILLIKIN. If that policy committee had decided to send something back, what possible channels might it have used?

Admiral PURNELL. The committees to study the reports and the requests from the laboratory were set up by Dr. Bush, I think. I would not say that for sure. General Groves may have set them up, and, I presume, on recommendation of Dr. Bush. I think Dr. Briggs was chairman of both of those committees, except one report which was

very technical and very scientific. I am not sure but what Dr. Tolman was the chairman of that.

Now, Dr. Briggs was the contact between those committees and the Naval Research Laboratory.

Senator MILLIKIN. If the committee wanted to send word back to Dr. Briggs, it would have normally sent it through that contact?

Admiral PURNELL. Yes, sir.

Senator MILLIKIN. And so far as you know, no word came back through that contact?

Admiral PURNELL. No, sir. The only assurance I got was the fact that when information was available that was of value to the laboratory in their work it would be passed to them.

Senator MILLIKIN. Then, may it be fairly concluded that the policy committee to which you referred presumed to determine what the naval laboratory should or should not work on?

Admiral PURNELL. Well, the scientists did, and we approved it.

Senator MILLIKIN. That is what I mean.

Senator AUSTIN. Admiral, do you participate in it?

Admiral PURNELL. In the policy committee, yes sir.

Senator MILLIKIN. Should we trace out the weapon angle of this? As I understand it, the Navy was not interested in the weapon angle; or am I wrong in that?

Admiral PURNELL. We were decidedly interested in it.

Senator MILLIKIN. You did not work on it?

Admiral PURNELL. The work particularly that Commodore Parsons did was, I should say, as important as almost any part of the bomb.

Senator MILLIKIN. Is there any question before the committee, Mr. Chairman, as to whether we should trace out the channels as far as the weapon end is concerned.

The CHAIRMAN. I think not. I think it is pretty clear as to what the situation was there. I was just trying to find out why Dr. Gunn, who had requested information from time to time that would be helpful to him, hadn't gotten it. Apparently the liaison back from Dr. Briggs was never established.

Admiral PURNELL. I don't recall that any specific information was ever requested. It was reports on what the laboratory was doing. Then the scientists judged, knowing what we did, from the Manhattan District whether anything discovered there would help progress at the Naval Research Laboratory.

The CHAIRMAN. Did you ever get anything back, Dr. Gunn?

Dr. GUNN. No official information.

The CHAIRMAN. No official information?

Dr. GUNN. That is correct.

The CHAIRMAN. Did you ever talk to Dr. Briggs about the results?

Dr. GUNN. Many times, and I asked for information from time to time, which apparently we were not to receive, and he said, "Take that up with your naval representative."

Senator CONNALLY. You say you didn't get any official information. Did you get any unofficial?

Dr. GUNN. There was some small amount of information going around which bore on the problem; that is correct.

Senator CONNALLY. Well, it was from authoritative sources, wasn't it?

Dr. GUNN. Not necessarily.

Senator CONNALLY. Well, it wasn't hall talk?

Dr. GUNN. No; that is correct.

The CHAIRMAN. Do you have anything further, Admiral?

Admiral PURNELL. No, sir; I don't think of anything.

Commodore PARSONS. I might give an example of how the information went in the other direction from the Naval Research Laboratory.

We wanted to know something about the separation of isotopes by the method that they were developing, so Dr. Oppenheimer wrote a letter to General Groves saying that this information would be of value to us and requesting that it be obtained.

General Groves turned that request over to Dr. Conant, who, I think, through Admiral Purnell or Admiral Mills, requested the reports. The reports came almost immediately. That was the channel we used.

The CHAIRMAN. Who did the reports go to?

Commodore PARSONS. To Los Alamos.

The CHAIRMAN. You are talking about furnishing them to Los Alamos?

Commodore PARSONS. I am saying I was at Los Alamos, you see. We conceived the need for that report, and that is the way we got it.

Senator CONNALLY. What report?

Commodore PARSONS. It was a report on progress on the separation of isotopes.

Senator CONNALLY. In the Naval Laboratory?

Commodore PARSONS. That is right.

Senator JOHNSON. Mr. Chairman, I want to ask Admiral Purnell a question or two in regard to the liquid thermal diffusion plant at Oak Ridge.

You say you visited Oak Ridge several times?

Admiral PURNELL. No, sir; I have only been there once since the project got started.

Senator JOHNSON. But I understood yesterday from Dr. Gunn's testimony that the Navy was particularly interested in the liquid thermal diffusion process.

Admiral PURNELL. Yes, sir.

Senator JOHNSON. Did you concur in the present status—not saying what the present status is—of the liquid thermal diffusion experiment at Oak Ridge? Did you concur in that, or are you in accord with what is done there now?

Admiral PURNELL. Yes, sir. If you remember Dr. Gunn's testimony yesterday there was a small pilot plant—you would call it that wouldn't you, Doctor?

Dr. GUNN. That is correct.

Admiral PURNELL. There was a small pilot plant here at the Research Laboratory. Later that was expanded. In its relation to Oak Ridge it was still a pilot plant. It was built at Philadelphia at the boiler laboratory on account of the availability of steam.

The design and construction of the plant at Oak Ridge were made directly from the pilot plant at Philadelphia and designed by Dr. Gunn and Dr. Abelson, I think. Dr. Abelson trained the men to operate the one at Oak Ridge, and on that line of the development came directly into the Manhattan project.

The CHAIRMAN. I take it, Admiral, that the output from the Navy was good, but the intake wasn't very much?

Admiral PURNELL. Well, it probably wasn't on the power side, and there was no need for it on the explosive side. We were primarily interested in getting a bomb.

I am not a scientist and I cannot judge it, but I saw no hope whatever of harnessing atomic power during this war, or even for the next war; I don't know. Now, the power development was primarily what the Research Laboratory was studying and working on.

When it became known that they could use the product from the liquid thermal diffusion to increase the output of the electromagnetic process at Oak Ridge, that was when that development was drawn into the Manhattan project.

The CHAIRMAN. I have only one further question.

Dr. GUNN, how many requests did you make in writing?

Dr. GUNN. I don't know how many were made in writing, sir—perhaps three or four.

The CHAIRMAN. How many did you get back?

Dr. GUNN. I think any information that I wanted amounted to zero.

Senator CONNALLY. Is this a post-mortem over who did it between the two services, the Army and the Navy?

I knew they were in a squabble about uniting or being divided, but I didn't think it went to the point of what had happened already.

The main thing was that you got the bomb, didn't you?

Admiral PURNELL. Yes, sir.

Senator CONNALLY. You couldn't have two outfits working on it at the same time very successfully?

Admiral PURNELL. Yes; and I think if there was a slip or if I slipped in passing information—it was not my channel to pass it down—I would attribute it to the fact that we were after a bomb, and we knew that power could be developed in time after the bomb was used.

Senator CONNALLY. Certainly power is secondary or "third-dary" or "fourth-dary" to me. I don't think the power is of any great consequence at the moment, but I hope that the Army and Navy will show a little more spirit of cooperation without fussing at everybody after it is all over and the bomb has been discovered.

I have always supported the Navy and am a big Navy man; but I think they ought to be big too.

Senator JOHNSON. Mr. Chairman, I would like to direct the question which I asked Admiral Purnell to Dr. Gunn.

Without saying anything about the present status of the liquid thermal diffusion process at Oak Ridge, are you entirely satisfied with the present status?

Dr. GUNN. Yes; I think that the operations down there have demonstrated that it is useful. The question that you ask is really two-fold, one a technical one and one a practical one.

I think it is fair to say that the scientists are not satisfied with any method of isotope separation. We think they are all rather expensive, and in that sense we are unsatisfied.

But in terms of what we have, I think utilization at Oak Ridge was entirely satisfactory.

Senator JOHNSON. My question is more whether or not the liquid thermal diffusion process had its day in court?

Dr. GUNN. Yes, sir.

Senator JOHNSON. And had its opportunity?

Dr. GUNN. Yes, sir.

Senator JOHNSON. Thank you, Doctor.

The CHAIRMAN. Admiral Strauss, have you anything to add?

Admiral Strauss. No, sir.

STATEMENT OF REAR ADM. LEWIS L. STRAUSS, DEPUTY CHAIRMAN OF THE ARMY-NAVY MUNITIONS BOARD AND SPECIAL ASSISTANT TO THE SECRETARY OF THE NAVY

Admiral STRAUSS. Mr. Chairman, I think I am the least important of the Navy witnesses. I should perhaps qualify myself for being here, as Admiral Blandy has done. I am not expert in either the strategy or the policy of the matter. My interest in the subject began as early as 1938 when I set up a foundation and started work in a laboratory at the California Institute of Technology that had been turned over to me by the Institute, on the production of isotopes by bombardment of the familiar elements with high-speed particles from a surge generator of special design that I constructed together with some friends of mine; and when the successful experiment in atomic fission took place in Germany a year later, we naturally turned to that as a more direct method of producing the materials we sought, the purpose of which was primarily to facilitate research and eventually therapy in the field of cancer.

When I reported for duty in the Navy in 1941 I had the good fortune to be assigned to Admiral Blandy, whom I served as principal staff assistant when he was Chief of the Bureau of Ordnance. I have since been an adviser and assistant to the Secretary of the Navy in these and related matters.

I relieved Under Secretary Bard upon his resignation as the naval member of the Interim Advisory Committee on Atomic Energy. My function here has simply been to organize this testimony.

I doubt whether I have any information that is of value to your committee; but such as it is, it is at your disposal.

The CHAIRMAN. The Medical Bureau of the Navy has been very progressive in times gone by. Have they done any experimental work, as far as you know, in using this for medical treatment?

Admiral STRAUSS. I am unable to say, sir; but I think it would be an interesting field to explore, and Vice Admiral McIntire, if called before this committee, would be qualified to testify.

The CHAIRMAN. Is there anything else, Admiral?

Admiral STRAUSS. I have nothing to add, sir.

Commodore PARSONS. Some question was raised about the possible squabbles about cooperation between the Army and Navy.

I was naval officer from the middle of Naval Ordnance and sat in the middle of the councils of the Manhattan District as associate director at Los Alamos, and I would say the cooperation was almost ideal. That included the Air Forces, also, the Manhattan District, the Navy, and the Air Forces.

I think Admiral Purnell will bear me out. The whole question was winning the war and getting the bomb into the war as fast as possible.

The CHAIRMAN. I am glad to hear that.

Gentlemen, if there is nothing further to add, we will thank you very much, and will be seeing you again.

The committee will meet again on Wednesday morning at 10 o'clock to hear testimony from some industrialists and engineers who have been in the process of getting prepared.

(Whereupon, at 11 a. m., the committee recessed until 10 a. m., Wednesday, December 19, 1945.)

ATOMIC ENERGY

WEDNESDAY, DECEMBER 19, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Tydings, Austin, Millikin, Hickenlooper, and Hart.

Also present: Edward U. Condon, scientific adviser, and James R. Newman, special assistant to the special committee.

The CHAIRMAN. The committee will be in session.

Mr. Creedon.

STATEMENT OF FRANK R. CREEDON, FORMERLY WITH STONE & WEBSTER ENGINEERING CORP.

The CHAIRMAN. Mr. Creedon, you are from Stone & Webster, and I believe you took considerable part in the Manhattan project.

Mr. CREEDON. Yes, from January 1, 1944, to January 27, 1945, I was the resident manager for Stone & Webster Engineering Corp. in charge of the construction of what we called Y-12. My association with Stone & Webster Engineering Corp. consisted of this special assignment only. I have not been associated with Stone & Webster since January 27, 1945.

The CHAIRMAN. Y-12 is the gas diffusion plant.

Mr. CREEDON. No, that is the magnet plant.

The CHAIRMAN. The electromagnetic?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. Now, sir, I imagine the committee will have some questions to ask you, but I would like to have you go ahead and tell us about what you did, how difficult you thought it was while you did it, and possibly you can give us some estimate as to how long you think it would take any other industrial nation—without being specific about it—to accomplish the same thing.

Mr. CREEDON. Prior to my part in this job, I was the Deputy Rubber Administrator under Mr. Jeffers in charge of the synthetic-rubber construction program, and, prior to that, for the Army engineers, in charge of the construction of all munitions plants. Therefore I had seen a great many of our very large construction efforts during the war.

From the standpoint of complexity and magnitude this was at least 2½ times the size of the largest war project that I know of. As for

complexity of installation, it was also the most complex and the most difficult to install.

Some of the problems and difficult design and installation phases were, I think, that we had to design and install a vacuum system that was more nearly perfect than any vacuum system that I know of that ever was installed on any construction project.

Senator AUSTIN. May I ask a question there for identification?

The CHAIRMAN. Surely, Senator Austin.

Senator AUSTIN. Was this electromagnetic system one where great care had to be exercised about cleanliness and absence of moisture?

Senator AUSTIN. Signs on the floor, "Do not spit here"?

Mr. CREEDON. Yes, sir.

Senator AUSTIN. All right; that just helps to bring the picture back to memory.

Mr. CREEDON. Also the oil system was an extremely difficult problem because of the nature of the oil and the extent of the system. It was very difficult to get a tight system and to get satisfactory circulation.

Some of the very difficult problems involved were the design of what we call magnets, the design of bins or tanks, the design of manifolds, the design of diffusion pumps, the design of vacuum pumps, and it was a matter of designing and installing something that we had never had any previous experience with—and I don't think anybody else did, either.

The CHAIRMAN. Did you have charge of building any of the synthetic-rubber plants?

Mr. CREEDON. All of them, sir.

The CHAIRMAN. Would you give us a comparison of the difficulties encountered in that? After all, that was a somewhat new field, too, although the ground, I believe, had been plowed somewhat in making synthetic rubber.

Mr. CREEDON. Yes; I could say that the design and construction of Y-12 was much more difficult than the design and construction of any of our synthetic-rubber plants in that it was, as I say, embarking on things that had never been done before from an engineering standpoint.

Senator HART. Mr. Creedon, have your experiences led you into touch with the state of industries similar to yours in other foreign countries, so that you have a fair acquaintance with their abilities?

Mr. CREEDON. No, sir.

The CHAIRMAN. Mr. Creedon, is there anything else that you would like to tell us about your experience there? How many men were under you at any one time?

Mr. CREEDON. At the peak?

The CHAIRMAN. Yes.

Mr. CREEDON. Approximately 30,000.

The CHAIRMAN. Roughly, how would you divide those 30,000?

Mr. CREEDON. I would say 6 percent, or thereabouts, administrative, probably another 4 or 5 percent strictly engineering, and the balance would be supervisors, superintendents, mechanics, and laborers.

Senator AUSTIN. May I ask a question at that point?

Were the same men used for operations who were employed for construction of these delicate machines with fine pipes that had to be welded with great accuracy and strength?

Mr. CREEDON. No, sir.

Senator AUSTIN. So that you had to have a construction gang on there first to put them in?

Mr. CREEDON. Yes, sir.

Senator AUSTIN. Now, as to maintenance, they had to be maintained with great care all the time, didn't they?

Mr. CREEDON. Yes, sir.

Senator AUSTIN. Did Stone & Webster handle that?

Mr. CREEDON. That was handled by the operator, Tennessee Eastman Corp.

Senator AUSTIN. Your connection then with that electromagnetic plant ended with the installation, did it?

Mr. CREEDON. Well, we completed the installation and turned an operating plant over to the operator and stood by with mechanics for a short period in order to help tide over and help them take up the maintenance; yes.

Senator AUSTIN. There must have been a period of education in there; that is, from the engineering to the operating transactions there must have been a liaison to understand that plant?

Mr. CREEDON. Indeed, for example, in operating the complicated oil system, their people came in and worked beside our people while we operated the various valves, and so forth and so on, until they became familiar with the system.

Senator AUSTIN. Now, from the laying of the foundation to the putting on of the finishing touches to the plant, how long did it take?

Mr. CREEDON. Approximately 2½ years.

Senator AUSTIN. And during the 2½ years you had the service of how many men on construction?

Mr. CREEDON. Well, our peak on construction was roughly 28,000.

Senator AUSTIN. In this transaction, what factor did research and special skill play? Was it an indispensable thing in the construction of this plant to have men who had the special skills to try the plant out in advance and make a picture of it?

Mr. CREEDON. Yes, they had, of course, to study out and prepare and present basic scientific data.

Senator AUSTIN. Did Stone & Webster handle all of that? Were they the people who furnished the ideas that went into this plant?

Mr. CREEDON. No; they were furnished by the scientists.

Senator AUSTIN. And Stone & Webster did not have them on their pay roll?

Mr. CREEDON. No, sir.

Senator AUSTIN. Thank you.

The CHAIRMAN. In other words, the scientists were the architects, and you were the contractors?

Mr. CREEDON. No, the scientists were not the architects. The scientists furnished the rough basic scientific data, and then Stone & Webster had to take that basic scientific data and convert it into designs and drawings.

The CHAIRMAN. Now, did you have a crew of mechanical engineers to do that job?

Mr. CREEDON. Oh, yes. All drawings for procurement or for construction were by others than the scientists.

The CHAIRMAN. What did you do after you got those drawings made? Did you go back to show them to the scientists and go over them together before you actually proceeded to work?

Mr. CREEDON. In certain drawings the scientists collaborated, and then the operator collaborated very extensively in practically all drawings.

The CHAIRMAN. You do a world-wide business, don't you—Stone & Webster?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. Who is the man in your organization who could give us the best bird's-eye view of the state of engineering and mechanical accomplishments around the world, and the ability of the other firms around the world to compete in the field with you?

Mr. CREEDON. I would say Mr. J. R. Lotz, the chairman of the board.

Senator AUSTIN. I have a question on this organization set-up. Is there any one man in the organization of Stone & Webster who handles all of these different foreign projects?

Mr. CREEDON. They all head up under Mr. Russell Branch, the president of Stone & Webster Engineering Corp.

Senator AUSTIN. For instance, for China you have a person who has charge of the Far East, do you not?

Mr. CREEDON. I do not know.

Senator AUSTIN. And for European service, Spain, for example, you have somebody who attends to that particular activity of Stone & Webster in Spain?

Mr. CREEDON. I do not know.

Senator AUSTIN. You also have many different subsidiary companies that handle the different activities in the foreign fields?

Mr. CREEDON. I do not know.

The CHAIRMAN. I wonder if you would talk with Mr. Lotz and Mr. Branch, Mr. Creedon, and tell them that we will be interested in hearing from them after the Christmas recess.

I think, Senator Hart, that is what you would like particularly, and you, Senator Austin—a sort of over-all view.

If you will talk to them and tell them we will be in contact with them, we would appreciate it. Ask them to come down; it won't take them very long.

Senator AUSTIN. Does Harry Arthur have anything to do with these activities in foreign fields?

Mr. CREEDON. I do not know.

Senator MILLIKIN. After your consultation with scientists, then you would lay this out in the form of drawings and specifications? That would be your own function?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. And then of course the job would be to translate that into actual machinery?

Mr. CREEDON. Yes; that is correct, to place orders against those designs.

Senator MILLIKIN. In a normal large construction job, of course, you try to conform to standard materials as much as possible?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. And that greatly facilitates the job if the standardized materials are available?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. I think you have made it rather clear, but I would like to emphasize it if it isn't clear, that the design of this particular plant to which you have been referring got almost completely outside the field of standard design and standard materials. Is that correct?

Mr. CREEDON. That is correct, sir.

Senator MILLIKIN. And when you get outside of that field, I assume that you have special problems of metallurgy, for instance in the making of a valve. Is that correct?

Mr. CREEDON. Generally speaking we used standard valves.

Senator MILLIKIN. I don't care to name any particular machine, but aside from a few standard things of that kind, the main features of your plant were especially designed and required unstandard materials; is that correct?

Mr. CREEDON. That is correct, sir.

Senator MILLIKIN. And that in turn involved an enormous amount of specialized know-how, didn't it?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. Ramifying, you might say, through almost all of our industrial specialties in this country?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. Is there any country in the world today that has available to it that specialized know-how and the industry that would be available to make these specialized products?

Mr. CREEDON. Answering your question this way, I don't think that this project could be built without several great industrial companies; for example, to name three of them, General Electric Co., the Westinghouse Co., and Allis-Chalmers Co.

Senator MILLIKIN. Is there any country in Europe that either has in its own organization or has available to it in Europe in any one or more countries of Europe the know-how that we have been describing, and the specialized industry that could provide or set up a plant of this kind without great long delay?

Mr. CREEDON. So far as I know; no, sir. As to whether or not anybody in a foreign country could do, for example, what it was necessary for General Electric to do, or for Allis-Chalmers to do, I think that the representatives—which I believe are present—from those concerns could answer that better than I can, sir.

Senator MILLIKIN. Let me get your opinion on this: Supposing that X country in Europe wanted to assemble a plant of this kind. Could it, by shopping around, do an assembly job, get something, let us say, in Y country and something else in Z country and something else in A country? Would it be feasible to shop around and finally assemble a plant?

Mr. CREEDON. You mean including shopping around in the United States?

Senator MILLIKIN. Let us exclude shopping in the United States for the time being.

Mr. CREEDON. I don't believe that a plant similar to this could be built in a foreign country without the aid of concerns in the United States.

Senator MILLIKIN. You have in mind Switzerland, France, Belgium, Holland?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. And what is left of Germany?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. Sweden?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. Could Great Britain do the job?

Mr. CREEDON. Without the United States, no, sir.

Senator MILLIKIN. Could Great Britain do the job with the aid of other European countries?

Mr. CREEDON. I don't believe so.

Senator MILLIKIN. Thank you very much.

Senator AUSTIN. How about Canada?

Mr. CREEDON. I don't believe so, not without the aid of our great concerns in America.

Senator MILLIKIN. I assume you would qualify your answer to this extent: That given limitless money and limitless time they probably could build up the necessary techniques and the necessary industries to do the job?

Mr. CREEDON. Oh, yes; certainly.

Senator MILLIKIN. Could you put a time factor, or is there a time factor in your own mind as applicable to the various hypothetical situations that I have portrayed to you? Supposing any continental country in Europe started out to reproduce this plant. Supposing it had the money to reproduce it, and suppose it could shop around in Europe, continental, and Great Britain.

How long would it take to make a fair replica of what you have created here?

Mr. CREEDON. I don't know enough about the situation in foreign countries to give an intelligent answer to that question.

Senator MILLIKIN. Then you judge it would take a long time?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. Have you traveled extensively in Europe?

Mr. CREEDON. No, sir.

The CHAIRMAN. Have you ever been in Europe?

Mr. CREEDON. No, sir.

The CHAIRMAN. Have you ever done any construction work outside of the United States?

Mr. CREEDON. No, sir.

The CHAIRMAN. You really haven't much of a basis for those answers, Mr. Creedon, have you?

Mr. CREEDON. I believe that is correct, sir.

Senator AUSTIN. Let me interpose at that point: I understood your answers as such that you can apply them to the United States. It would take a long time to begin at the beginning and reproduce one of these plants right in the United States with all our facilities, would it not?

Mr. CREEDON. Yes, sir.

Senator AUSTIN. About how long?

Mr. CREEDON. You mean to reproduce one of these plants in America?

Senator AUSTIN. Yes, starting at scratch here. Suppose we had wiped them out and they no longer exist, and we want to start over. How long would it take to reproduce a plant for this electromagnetic process?

The CHAIRMAN. Knowing what he knows now?

Senator AUSTIN. Yes, exactly, with your advantages now.

Mr. CREEDON. An all-out effort on the part of America and American industry?

Senator AUSTIN. Oh, no. I cannot imagine another war. We are going to stop that, so we probably wouldn't get an all-out effort.

But in peacetime, suppose that we had been so wise or unwise as a Congress that we decide we will just efface these things, we will wipe them out. By and by we are provoked to start afresh in peacetime without all that propulsive power of war. How long would it take us to erect an electromagnetic plan equally as efficient as the one that you did?

Mr. CREEDON. Oh, approximately 4 years.

Senator TYDINGS. May I ask a question, if you have finished, Senator?

Senator AUSTIN. Yes; I have.

Senator TYDINGS. Assuming that in the next year or two some country would come to your concern and to other concerns associated with you and make an attractive contractual offer to do similar work as the work which you have just described, how much would you lengthen your estimate of the time necessary to complete the plant, assuming there was reasonable cooperation and availability of the materials necessary to a foreign country?

Mr. CREEDON. And reasonable cooperation in getting, for example, materials that were needed from America?

Senator TYDINGS. Well, my question envisages a situation where you would have all the cooperation which a foreign government could give you, a great power that was in a position to make attractive offers to those who might want to supply the information, the technical and scientific knowledge, and was in a position to buy that in the world market so that there would be a reasonable flow of information that you might want to get to do this?

Mr. CREEDON. I should think it might take—

Senator TYDINGS. A year or two more, would you say?

Mr. CREEDON. Probably 7 or 8 years total.

Senator TYDINGS. In other words, to condense my own question, if your concern was hired to do this work in a foreign country and there was reasonable availability of material and science, you feel that you could do the work in 6, 7, or 8 years?

Mr. CREEDON. Perhaps 8 years, yes.

Senator TYDINGS. Now, assuming that there is unlimited money behind this project in a foreign country, what impediments do you see to completing such a plant if the foreign nation in mind could buy the advice, the scientific and engineering skill that it required to construct the plant?

Mr. CREEDON. The difficulty would be in that event the procurement of the necessary equipment, and so forth.

Senator TYDINGS. Well, suppose, for example, that I was the foreign agent having charge of this, and I would come to your concern and say, "I would like to employ your firm to do a particular job, one of the jobs or all of the jobs connected with this operation, and I will give you cost plus 15 percent profit and would arrange the exchange so you can take your profit back to your own country by deposits in your own country from month to month."

Would you undertake it?

Mr. CREEDON. I couldn't answer that. It would have to be either the chairman of the board or the president of the company.

Senator TYDINGS. Assuming that you were the chairman of the board or the president of the company, would you undertake it?

In other words, my question is simply this: What is to stop a foreign country from hiring your concern or any other concern at attractive prices to do the work?

Mr. CREEDON. If I were the chairman of the board or the president of the company, I would not take it; no, sir.

Senator TYDINGS. You would not take it for patriotic reasons?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. But assuming that the government didn't ask you, that the government simply said, "You are not in a position to turn over any information that you have learned in connection with this project, but you are at liberty to build in accordance with any blueprints or specifications that are furnished you in advance."

Would you then take it?

Mr. CREEDON. No, sir.

Senator TYDINGS. Is there any conceivable circumstance where you feel you would take it?

Mr. CREEDON. No, sir.

Senator TYDINGS. Suppose there is an agreement for the control of peacetime atomic energy, an international agreement, and our Government consents to the exchange of information for the manufacture of peacetime atomic energy, and that you were then offered this proposition to build a plant in accordance with that agreement. Would you then take it?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. It has been testified here in public hearings that a large percentage of the difficulties of manufacturing the atomic bomb are eliminated by the manufacture of peacetime atomic energy. Do you follow me?

Mr. CREEDON. That is correct, sir.

Senator TYDINGS. Now, that being so, and if there was an international agreement for the control of peacetime atomic energy, would you then take it—assuming there was an international treaty which permitted you to do it?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. There wouldn't be any reason why you shouldn't, as far as the Government had established the policy?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. Just as a layman and as an engineer and as a citizen, do you think it would be wise that knowing the devastating potentialities of the atomic bomb we should make such a treaty for the peacetime manufacture of atomic energy?

Mr. CREEDON. Well, if plants will be built to manufacture atomic energy in peacetime, it would take very little to convert them, and I would be a little worried about that.

Senator TYDINGS. I take it your answer means this: That if you consent to the peacetime manufacture of atomic energy on an international basis or treaty arrangement, that in effect you have consented to the possible manufacture—60, 70, 75 percent, or some place in there, let us assume—of the bomb itself?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. So that if you are opposed to the manufacture of the bomb and you invade that field of peacetime atomic energy, you really have given up three-quarters of your opposition to the manufacture of the atomic bomb, have you not?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. Do you know how long it might possibly take from the time the manufacture of atomic energy for peacetime purposes was completed to taking up the remaining processes necessary to manufacture the atomic bomb?

Mr. CREEDON. Approximately a year, or 15 months, or something like that.

Senator TYDINGS. So that if the manufacture of peacetime atomic energy is permitted, you are within a year or less of the manufacture of the atomic bomb, should any nation desire to do so?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. So I would take it from all your answers that in your opinion, if we have an agreement for the peacetime manufacture of atomic energy, we come pretty close to the possibility of the manufacture of the atomic bomb?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. As a policy, have you given any thought as to whether or not we should try to stop the manufacture of peacetime atomic energy, having in mind the potential development of the atomic bomb from such a preliminary step?

Mr. CREEDON. No, sir.

Senator TYDINGS. You haven't given it any thought?

Mr. CREEDON. No, sir.

Senator TYDINGS. That is all, Mr. Chairman.

Senator JOHNSON. Mr. Chairman, may I ask the witness one question following Senator Tydings' questions?

The CHAIRMAN. Yes, sir.

Senator JOHNSON. Under what restrictions and limitations are you operating at present as to the engineering know-how, other than your sense of patriotism?

Mr. CREEDON. I don't know the answer to that question, but I could find that out.

Senator JOHNSON. You don't know whether you are free to reveal or divulge any of the know-how?

Mr. CREEDON. I am practically certain that we are not to divulge anything whatever.

Senator TYDINGS. Either at home or abroad?

Mr. CREEDON. Yes, sir.

Senator JOHNSON. And that is a restriction placed on you, perhaps, by General Groves?

Mr. CREEDON. Yes, sir.

Senator MILLIKIN. I would like to ask whether that is by way of verbal instructions or written instructions?

Mr. CREEDON. I am unable to answer that. I don't know.

I know this much: That Stone & Webster would not give any information of any kind to anybody without getting clearance.

Senator MILLIKIN. Of course, I know you would not, but I think that Senator Johnson has opened up a very pertinent inquiry. Personally, I would appreciate it if you would—if it is agreeable with

the chairman—write the chairman whether your instructions to that effect do rest in writing or just verbal understandings.

Senator TYDINGS. And for how long a time they are to run.

Senator MILLIKIN. And it might not be a bad idea to send the instructions themselves.

Senator JOHNSON. Yes; we would like to know what all the conditions are.

Senator MILLIKIN. Has your concern made any studies on the dispersal of industry?

We have had a lot of testimony that we are so concentrated industrially in this country that we are subjected to extra-high hazards so far as the use against us of the atomic bomb is concerned.

Mr. CREEDON. To my knowledge, Stone & Webster have not made studies pertaining to dispersal of industry.

Senator MILLIKIN. Is there an engineer or any concern that might be able to give us expert testimony on that?

Mr. CREEDON. Offhand I can not think of any.

Senator MILLIKIN. It is a very speculative subject, of course, and I should not be surprised if it were a virgin field.

Senator HICKENLOOPER. Senator, I wonder if Mr. Creedon made himself completely clear in answer to your question as to whether or not Stone & Webster had made any surveys.

As I understood his answer, he said, "To my knowledge they have not."

Now, did you mean that you have knowledge that they have not, or that so far as you know they have not?

Mr. CREEDON. So far as I know.

Senator MILLIKIN. You were not indulging in a double negative.

The CHAIRMAN. Mr. Creedon, several of these integral parts were manufactured by General Electric, Westinghouse, and Allis-Chalmers?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. And Chrysler Corp.?

Mr. CREEDON. Not on our project, not Chrysler; but the first three were on our project; yes, sir.

The CHAIRMAN. Chrysler did great work in another one of the methods?

Mr. CREEDON. On the Carbide & Carbon project, I believe.

The CHAIRMAN. Of course these are great plants employing thousands and thousands of workers?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. Some of the items that they manufactured are large, and some of them, I take it, are small in size?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. Capable—many of the important ones—of being lifted up and taken away in a man's overcoat pocket; is that true?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. Do you know anything about the care that is taken at these three plants to see that that does not happen?

Mr. CREEDON. No, sir; I have not been connected with the project since January 27 of this year. I don't know just exactly what is done.

The CHAIRMAN. During the time of your connection with it, were you acquainted with any precautions that were taken at these three great plants with thousands and thousands of employees to prevent the contingency that I spoke about happening?

Mr. CREEDON. People walking out of the plants? Yes. To get out of the project you had to go through a gate where there was a guard.

The CHAIRMAN. You are talking about the Manhattan project now?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. I am talking about back at these plants where they were manufactured.

Mr. CREEDON. I don't know the situation at Allis-Chalmers, General Electric, or Westinghouse, sir.

The CHAIRMAN. That, to say the least, would be a source of "information," would it not?

Mr. CREEDON. Yes, sir.

The CHAIRMAN. To any unfriendly person who was trying to get that information, and also trying to get a sample.

Mr. CREEDON. Yes, sir.

Senator TYDINGS. I have one more question.

Mr. Creedon, without qualifying yourself as an expert or world traveler, you are in the engineering field and, of course, have a pretty fair comprehension of the engineering ability and technique and thoroughness of other countries, because sometimes you do compete; isn't that correct?

Mr. CREEDON. Yes, sir.

Senator TYDINGS. Without naming them, and assuming the money was available, over a period of 8 years, what countries would you conceive from an engineering standpoint of being capable of manufacturing atomic energy—assuming the money was available, that they had the basic technique, and so on, and knowing the fact that this can be produced. How many countries do you assume would be capable of making atomic energy, if the money were available?

Mr. CREEDON. I don't believe I am qualified to answer that question.

The CHAIRMAN. Anything else, Mr. Creedon, that you would like to tell us?

Mr. CREEDON. No, sir.

The CHAIRMAN. Thank you very much, sir, for coming down.

We are now to hear from Mr. H. E. Thompson, vice president of the Carbide & Carbon Chemicals Corp.

STATEMENT OF H. E. THOMPSON, VICE PRESIDENT, CARBIDE & CARBON CHEMICALS CORP.

The CHAIRMAN. Mr. Thompson, Senator Austin would like to put in the record some facts concerning your qualifications.

Senator AUSTIN. In what capacity did you serve through Carbide & Carbon Chemicals Corp. in the erection of the plant or plants for the gas diffusion project?

Mr. THOMPSON. My work in connection with the K-25 project concerned itself with the engineering from the time we came into the project and agreed to act as operators of the plant when it was completed. That date was in December of 1942.

Senator AUSTIN. What had you been doing before this project was undertaken that gave the Government access to you as especially qualified to enter upon this project? What had you been doing with respect to the national defense?

Mr. THOMPSON. I entered this project as a member of Carbide & Carbon Chemicals Corp., but I believe that we were considered in

connection with this project in part because of our contribution to the synthetic-rubber program.

Senator AUSTIN. What companies, other than the parent company, were involved in the construction of the gas diffusion plant or the operation of it?

Mr. THOMPSON. The gas-diffusion plant was engineered by a subsidiary of the M. W. Kellogg Co., known as the Kellex Corp., organized purposely for that job.

We were selected as the operators, but coming into the program early in its development, we were asked to join with Kellex and work with them in the engineering to approve the drawings as they were made, and assist in other ways, so that when we finally got the plant it would be also our idea of what such a plant should be.

Our Bakelite Corp. also had quite a bit to do with one of the important phases of the gas diffusion process.

Senator TYDINGS. Let me ask you there if the Bakelite Corp. is a subsidiary of yours.

Mr. THOMPSON. The Bakelite Corp. is a subsidiary of Union Carbide & Carbon Corp.

Senator TYDINGS. Is that the one Dr. Baekeland was president of?

Mr. THOMPSON. Yes; Dr. Baekeland is now dead.

Senator TYDINGS. But his son carries on.

Mr. THOMPSON. Yes.

Senator AUSTIN. What did the Bakelite Corp. have to do with this?

Mr. THOMPSON. The Bakelite Corp. worked particularly on the diffusion member that in many respects forms the basis of the diffusion process.

Senator AUSTIN. Did Carbide & Carbon Chemicals Corp. enter into this project?

Mr. THOMPSON. Yes; through its work with Kellex in engineering and designing the gas diffusion project and plant. Other subsidiaries of Union Carbide & Carbon Corp. were involved in other phases of the entire project, however.

Senator AUSTIN. Now trying to visualize them all, I would like to know with what authority you speak here as a witness. Were you an advisory engineer in all these activities?

Mr. THOMPSON. No, I was not. My engineering work was principally in connection with the K-25 project.

Senator AUSTIN. And that is the gas diffusion plant?

Mr. THOMPSON. Yes.

Senator AUSTIN. Its business was to separate 235 from 238, was it?

Mr. THOMPSON. Yes, sir.

Senator AUSTIN. And that was a method that was pursued throughout the effort to produce the bomb, wasn't it?

Mr. THOMPSON. Yes, sir.

Senator AUSTIN. It was one of the four known methods of separating 235 from 238?

Mr. THOMPSON. That is correct.

Senator AUSTIN. Now, did you have anything to do with the material end of this transaction, such as with the United States Vanadium?

Mr. THOMPSON. Oh, other units of the corporation had a great deal to do with other parts of the program.

The United States Vanadium Corp. was responsible for a very large part of the raw material. The Linde Air Products Co. developed means and carried out processes for conditioning that raw material so that the desired final product could be obtained.

Senator AUSTIN. In this canopy of the parent company, did the electrometallurgical activity also come?

Mr. THOMPSON. The Electro Metallurgical Co. made, I believe, a large part of the uranium metal that was used in the project, both the Tennessee project and the west coast project.

Senator AUSTIN. In addition to that, is it true that your parent company had to do with the graphite production that was used in this process?

Mr. THOMPSON. It is true. The National Carbon Co. developed and made huge quantities of the graphite that was used in the Hanford plant and the electromagnetic plant.

Senator AUSTIN. Speaking only in a general way, what do you say the contribution of Union Carbide & Carbon was to the production of the bomb?

Mr. THOMPSON. My feeling is that without the joint effort of all of those companies we would not have had the atomic bomb.

Senator AUSTIN. That is all.

The CHAIRMAN. Will you go ahead and describe to us further, if you wish, the work that you did.

I might ask you this first, Mr. Thompson: Have you engaged in any foreign work at all personally?

Mr. THOMPSON. No, sir; except to the extent of working with some of our Canadian subsidiaries.

The CHAIRMAN. Has Union Carbide & Carbon Corp. plants in foreign countries?

Mr. THOMPSON. Yes; some.

The CHAIRMAN. Where?

Mr. THOMPSON. Our Carbide & Carbon Chemicals Corp. has a plant in Canada.

The CHAIRMAN. Any in Europe?

Mr. THOMPSON. No, sir.

The CHAIRMAN. Any in South America?

Mr. THOMPSON. No, sir. Some of the other companies have plants abroad for the manufacture of batteries in many parts of the world, for the manufacture of carbide and ferro-alloys in Norway, and for the manufacture of some other products with which I am not acquainted; I think some carbon and graphite activities at certain points.

The CHAIRMAN. You mean subsidiaries of your parent company have plants in Europe in which they manufacture certain articles?

Mr. THOMPSON. That is correct.

The CHAIRMAN. Are they rather extensive operations?

Mr. THOMPSON. No, sir; they are not. The carbide plants and alloy plants in Norway, I believe, are the largest.

The CHAIRMAN. Do you know how many men, approximately, they employ or have employed?

Mr. THOMPSON. I do not.

The CHAIRMAN. Were they taken over by the Germans during the occupation?

Mr. THOMPSON. They were, sir; in occupied territories.

The CHAIRMAN. Who has them now?

Mr. THOMPSON. We have them, I think.

The CHAIRMAN. Now, that the Norway Government is back again?

Mr. THOMPSON. Yes, sir.

The CHAIRMAN. Have you traveled extensively yourself around the world?

Mr. THOMPSON. I have never been abroad except to Canada.

The CHAIRMAN. You have been educated as an engineer. What college did you graduate from?

Mr. THOMPSON. I graduated from the University of Illinois in engineering in 1914, and joined the Linde-Air Products Co. as a research engineer at Buffalo in 1917.

The CHAIRMAN. I believe there have been some estimates given by the contributing companies to the War Department as to the time that they believe that this job could be done in other countries in the world. Did you participate in that estimate to the War Department?

Mr. THOMPSON. No; I did not.

The CHAIRMAN. Did you know about it?

Mr. THOMPSON. I heard about it afterward. Within the past week someone asked me if I had answered that question. I had not been asked.

The CHAIRMAN. Mr. George Harrison, of New York was the chairman of the committee that gathered that information, was he not?

Mr. THOMPSON. I believe so.

The CHAIRMAN. The chairman of the New York Life Insurance Co.

Mr. THOMPSON. Yes.

The CHAIRMAN. But you do know that your company furnished such an estimate to that committee?

Mr. THOMPSON. No; I really don't. The gentleman I was speaking to was with a different company; he had been asked.

The CHAIRMAN. As I understand it, Mr. Thompson, General Groves at our request contacted you personally?

Mr. THOMPSON. Yes, sir.

The CHAIRMAN. I might say for the record that General Groves suggested these witnesses, Mr. Creedon and Mr. Thompson, and also the other two witnesses who will be before us.

Have you had access to that information specifically that was given to that committee?

Mr. THOMPSON. No, sir.

General HART. Mr. Thompson, in connection with those subsidiaries which do business in Europe in particular, is there any engineering or development done by those plants, or do they get all of their know-how from America?

Mr. THOMPSON. All of it comes from America.

Senator HART. They do no research and no engineering whatever in those countries?

Mr. THOMPSON. That is correct.

Senator HART. Are any of those companies in any sort of affiliation with industries owned by the countries in which they are located?

Mr. THOMPSON. So far as I know, none of them is so connected.

Senator HART. It is entirely a matter of competition, and they have no connection whatever?

Mr. THOMPSON. That is correct.

Senator JOHNSON. Did I understand you to say, Mr. Thompson, that Carbide & Carbon Chemicals Corp. was selected to handle this

work because of their experience in the manufacture of synthetic rubber?

Mr. THOMPSON. I said that I felt that perhaps our accomplishment in the synthetic-rubber program had had something to do with considering us as the operators of the gas diffusion process.

Senator JOHNSON. Did you yourself have something to do with the manufacture of synthetic rubber?

Mr. THOMPSON. Yes. Our company's contribution to the synthetic-rubber program was the production of butadiene from ethyl alcohol. Our principal operation was the plant at Institute, W. Va.

Senator JOHNSON. The United States might be classified as a "Johnny-come-lately," so far as the manufacture of synthetic rubber is concerned, might it not?

Hadn't other nations such as Germany and Russia reached a high state of perfection in the manufacture of synthetic rubber?

Mr. THOMPSON. I think that is true. I believe that for various reasons they were in the synthetic-rubber program or business long before we were. We got into the synthetic-rubber program as a matter of necessity.

Senator JOHNSON. If they were expert in the manufacture of synthetic rubber, they are well on their way toward an important step in the diffusion process, the gas diffusion process?

Mr. THOMPSON. No; I rather question that. I don't believe there is any connection between the two.

Senator JOHNSON. Mechanically or scientifically or otherwise?

Mr. THOMPSON. No, sir.

Senator JOHNSON. That is, knowing how to manufacture synthetic rubber would be of no assistance in the manufacture of the gas diffusion process?

Mr. THOMPSON. No, Senator. I think that the real point there was that Carbide & Carbon Chemicals Corp. had set up a schedule for bringing butadiene plants into production that seemed almost impossible of fulfillment; yet their experience in building processing plants was extensive enough so that they carried their program through completely on schedule.

My reference to the rubber program was not based on any process similarity between producing butadiene from alcohol and the gas diffusion process.

I believe that the experience we had in putting over the butadiene-from-alcohol program, which was one of the biggest the country had ever seen in the process industries up to that time, qualified us to give service in this gas diffusion process.

Senator JOHNSON. Not because of the similarity or know-how, because of your record for getting the job done?

Mr. THOMPSON. Yes, sir.

The CHAIRMAN. You were up to your neck in this synthetic rubber process?

Mr. THOMPSON. That was the principal Government plant activity of the Chemicals Co. until the work on this project came along.

The CHAIRMAN. Now, I have it in the back of my head that the know-how on that was developed in Russia. Were they not the first country to develop synthetic rubber out of alcohol?

Mr. THOMPSON. It is interesting that some of the early patents on the production of butadiene from ethyl alcohol were Russian and that

some of the first research work in that field had been done by Russian scientists.

The CHAIRMAN. And they were in production on that before we were, were they not?

Mr. THOMPSON. That is correct.

The CHAIRMAN. That is a tremendously complicated piece of business in itself, is it not?

Mr. THOMPSON. On the other hand, the production of butadiene from ethyl alcohol is not a process which is particularly complicated.

The CHAIRMAN. You would think so if you looked at a picture of one of those plants.

Mr. THOMPSON. Well, the business of getting a high yield and of producing high quality material, of course, is something different again. I believe the plants that we built were much more efficient than any that had gone before.

The CHAIRMAN. Have you ever seen a tire made in Russia out of this process?

Mr. THOMPSON. No.

The CHAIRMAN. Have you ever seen a sample of the rubber?

Mr. THOMPSON. No.

The CHAIRMAN. Did you make use of those basic patents in any way in the operation of your plants?

Mr. THOMPSON. Not in the work that we did. Our process for producing butadiene from ethyl alcohol was developed by our own research group. It involved new catalysts and new operating conditions and gave considerably higher yields than the published processes before that time.

The CHAIRMAN. But the Russians had rolled their vehicles on their own rubber tires made out of the ethyl-alcohol process before we went into production on them?

Mr. THOMPSON. That is correct; yes.

Senator HART. May I carry that on a little further?

Do I understand, Mr. Thompson, that although the Russians did have the basic patent and were perhaps the first in the field, that as compared with our own accomplishment they still were in a rather crude stage although they were producing rubber? Is that a correct statement?

Mr. THOMPSON. I think I would modify it to a certain extent. You may remember that the United States sent a group to Russia to learn about their synthetic-rubber operations and they sent a group here. The exchange of information was not too extensive, but the Russian plants were certainly operating and they were making good butadiene; and they used that as a raw material to make good synthetic rubber.

I may say that the work of our company in that field concerned itself with the raw materials, butadiene and styrene, rather than with the process of making the copolymers or the finished rubber articles.

The CHAIRMAN. Considering the difficulties of making rubber through this process, in order for the Russians to have even engaged in the production that they did they must have had some accumulation of engineering personnel and scientific personnel to put that together. That would naturally follow; would it not?

Senator JOHNSON. I would like to ask to hear that question again.

The CHAIRMAN. I say the knowledge that we have that they were first in the field and they did make them, whether efficiently or not,

presupposes that they had a group of engineering brains, engineering men with capability, gathered together in order to do that job?

Senator JOHNSON. Yes; undoubtedly.

Senator AUSTIN. Did the Linde Air Products Co. contribute to this gas diffusion process at all?

Mr. THOMPSON. They contributed a great deal to it, not only in the matter of personnel, but in the matter of additional work on the very heart of the gas diffusion process, the diffusion membrane, if you will.

Senator AUSTIN. That is one of the key elements in the plant; is it not?

Mr. THOMPSON. It is the basic one, without it, there would be no gas diffusion process.

Senator AUSTIN. How are they related to the Carbide & Carbon Chemicals Co.?

Mr. THOMPSON. All of these operating units that I have mentioned are subsidiaries of Union Carbide & Carbon Corp., which is the parent company.

Senator AUSTIN. Did they have to do with the vacuum system?

Mr. THOMPSON. The Linde group did not have to work with that particularly. The chemical group, the operators of K-25, were the ones that worked on that problem.

Senator AUSTIN. Looking at it as an over-all picture, then, Union Carbide & Carbon dealt with both the research, the design, and the engineering?

Mr. THOMPSON. Yes, sir.

Senator AUSTIN. On the gas-diffusion system?

Mr. THOMPSON. Yes, sir.

Senator AUSTIN. Did Chrysler Corp. produce anything for this gas-diffusion system?

Mr. THOMPSON. They did. They produced the diffusion units, called "diffusers," of which there were a great many of great complexity, a job that required all of the skill and the art of American line production such as is used in making automobiles, and Chrysler did an excellent job.

Senator AUSTIN. In the operation, after the plan had been erected, what part did Carbon & Carbide Chemicals Corp. contribute to the output of the plant?

Mr. THOMPSON. Are you referring to the Tennessee plant for diffusion?

Senator AUSTIN. Yes; the Tennessee plant. I have that in memory, as I visited it with this committee.

Mr. THOMPSON. The operation of the K-25 project at Tennessee was entirely under Carbide & Carbon Chemicals Corp. from the very beginning to the very end.

Because of the arrangements that were made with respect to Kellogg and Carbide & Carbon working jointly from the very start, Carbide & Carbon Chemicals Corp. was busily engaged at Knoxville long before there was much of a plant there to operate. Our work started when ground was broken, practically, and continued until the final unit of the first part of the project was in operation.

That contribution required selecting from our various groups operating men of the right qualifications, not only to operate the plant

but to see that it was in shape and ready for proper operation when that time came.

Senator AUSTIN. Who is the man who is in charge of that plant down there all the time; who stays on the job?

Mr. THOMPSON. The one in charge of that entire operation is Dr. George T. Felbeck. The man in charge of the entire contribution of our corporation to all phases of the atomic energy project is Mr. J. A. Rafferty, vice president and a member of the executive committee of the parent corporation.

Senator AUSTIN. You are a vice president of that corporation?

Mr. THOMPSON. In charge of engineering; yes, sir.

Senator AUSTIN. Are you also vice president of Carbide Chemicals Corp.?

Mr. THOMPSON. Yes, sir.

Senator AUSTIN. If you hold any other position in this set-up, what is it?

Mr. THOMPSON. I am also a vice president of Bakelite Corp.

Senator AUSTIN. I want to say to you that the contribution that your great company made to the production of this bomb was a very great contribution, in my opinion.

Mr. THOMPSON. Thank you, Senator Austin.

Senator HART. As an engineer, Mr. Thompson, does that Tennessee plant, K-25, as far as its magnitude and complexity are concerned, represent about as large a task as you ever undertook in your professional capacity?

Mr. THOMPSON. Yes, Senator; it is; and I would like to say a few words on that subject, because I believe that it is an outstanding accomplishment in the whole field of engineering as it applies to major process industry plants.

There are many kinds of engineering that have been carried out on gigantic scales successfully, and they vary greatly in the character of the work and the character of what is produced. It is one thing to spend a lot of money building roads or traffic systems, and quite a different kind of thing to build hydro-power plants and the things that go with them. It is another kind of thing to build multiple-part plants like automobile plants.

The process industry phase of engineering, I believe, is something in which we in the United States have perhaps had more experience than in most places. The growth of our chemical industry has been rapid in recent years. The growth of our refining industry has been equally rapid, and the development of those industries has called for a type of engineering which involves hundreds of thousands of individual parts, procured in thousands of different places, all of which must be at the site at the right time and in the right order. They not only have to be there, but they have to be properly warehoused and stored so that when you want a certain one of them you know where to go to get it.

We have been carrying out rather good-sized engineering jobs in Carbide & Carbon Chemicals Corp. for sometime with quite a bit of success, and as time has gone on, we have, I think, improved our system. The best test that we had of it was in our contribution to the raw materials for the rubber program. It worked beautifully there.

But what did we have there? We had well worked out research back of what we were about to do; we had built a pilot plant that had been

making a ton a day of butadiene for several months; we had been able to modify our design and engineering in the light of all the information gained in that way, so that the results we achieved in putting those plants into operation were more or less in the bag. We knew that, provided that we could get the materials and parts. I mention that as background.

I should like now to speak of this gas diffusion process for separating U-235 from U-238. Here was a case where research and development engineering and design were all going ahead at the same time. It is true that from a standpoint of scientific background that work had been started, I guess, in 1940 or '41, but at the time we were invited to act as operators of K-25 at the end of December in '42, while there was a lot of good theory back of that project, there wasn't the type of research and development that big plants are built on quickly.

Nevertheless, there was put together there a group which functioned and produced in a better way engineeringwise than any group I have ever seen. The project involved more money by far than any of the projects with which any of us had worked before.

You were called upon to design a diffusion plant before you knew what the diffusers looked like. You were called upon to lay out a plant that had thousands of pumps or blowers in it before you knew that you could get pumps and blowers to work under the conditions that were imposed because of the nature of the materials you were dealing with.

We were called upon to go out and build whole plants, such as the Allis-Chalmers plant to make these blowers, such as the Houdaille-Hersey plant to make barriers, such as the Chrysler plant to make diffusers, after you had the material; and here was this complicated thing proceeding on all fronts at the same time.

I think it is quite remarkable, the record that was made, and it is a record that goes to the credit of a vast number of contributing companies and to the Army. Their skill in getting material for this project was one of the most remarkable things in the war effort.

Actually, ground was broken for the power plant on June 1, 1943. The first boiler was in operation in March 1944.

The ground was broken for the diffusion plant on September 1, 1943, and the first process gas was put into that unit in February 1945.

In that time all the basic materials and pieces of equipment for that tremendous plant were being worked out. Not only that, but here was a plant that was to operate at a reduced pressure, with the dangers of leakage of air and moisture, and all those things. I might say that chapter X of the Smyth report gives a very interesting account of the facts surrounding the gas diffusion process.

So far as the scientific background and the early problems being faced, that plant was brought into operation requiring standards of tightness that had never been heard of before, tightness in a system that had as much as 600 miles of welding on pipes.

Senator HART. Rather large pipes, too?

Mr. THOMPSON. Many of them 30-inch and 24-inch pipes.

Strangely enough, too, there were times in that program when we were at the deadline with respect to some particular important fundamental part, and that part simply hadn't been produced, yet just before we hit the deadline—and this occurred not once but several times—we had not one solution but sometimes two or three.

We had in all of that many things. We had good procurement on the part of the Army. We were given priorities that I think ruined plenty of other fields of activity but helped us, and we had a fine engineering organization. To do that sort of a job required an engineering force of 2,000 men. Of that number, about one-half were of the service type, clerical, stenographic, accounting, purchasing, and guards; and of the remainder, there were about 600 in what we call engineering and design, about 200 field engineers, and about 200 engineers in the laboratories where research work was going on.

Perhaps one of the most important parts of the engineering organization concerned itself with procurement and expediting. The business of getting the thing that you need at the point at which you need it at the right time involved a whole force of men throughout the country ready to go into different plants, actually check the records of the vendors to see that they had ordered the things they needed to make what they were making, and in the event they hadn't ordered them, find out why, and sometimes carrying that to the second and third position, and following that up periodically.

Sometimes it required moving carloads of material from one plant to another to relieve log jams in machining operations, and so on, but all of that was carried out. The completion date scheduled for the last part of the diffusion plant, the K-25 portion of it—not including the K-27 project, which was added and is now being built—was August 23, 1945. The plant was actually completed August 5, 1945.

This achievement was the result of a major group effort, and a long list of names of those who contributed in a major way could be given. Limiting such a list to a bare minimum, one should mention Mr. P. C. Keith, executive in charge and technical head for the Kellogg Corp., Dr. George T. Felbeck, whom we had made top so far as Carbide & Carbon Chemicals Corp., was concerned, Mr. Keith's assistant, Mr. Albert L. Baker, and Dr. Felbeck's assistant, Mr. Hartsel Kensey. They and those under them should be mentioned as putting over the biggest engineering job that any of us had ever seen in the quickest possible time.

Senator HART. Mr. Thompson, in speaking in these superlatives, and so on, what would you say was the greater accomplishment—under size or under complexity?

Mr. THOMPSON. Complexity, I would say.

Senator HART. At the same time the dimensions of it are about as large as anything with which you have ever been concerned?

Mr. THOMPSON. By far the largest.

Senator HART. You are vice president and engineer of a company that engages in a very large business in this country?

Mr. THOMPSON. Yes.

Senator HART. Mr. Thompson, you have given us the figures of how long it took. What is your idea of the ability of any other country in the world being able to accomplish the result at all?

And if they were able to do it at all, about how long?

Suppose we assume that the know-how, insofar as that one vital membrane of which you spoke, was at their disposal, that they knew what it was. Is there any country in the world that could produce that plant at all, and if so, what is your guess as to how long it would take?

Mr. THOMPSON. The answer to that question, as you suggest, gets into the field of guessing. It is a matter of trying to put yourself in the position of the engineers in the other country to see where they would be in comparison to where we were during the period of our work.

To answer your question, I might say first that I am not acquainted with the methods abroad and their set-ups, although obviously those of us in my profession are aware of the accomplishment in other countries, and I am certainly not of the mind to underrate the ability of the engineers or the production groups in foreign countries.

I think it is also clear that now that the atomic bomb is a known reality the business of building up to it becomes somewhat simpler.

So first, to answer in a generalized way, I am satisfied that foreign countries would be able to produce the atomic bomb and would be able to go through the K-25 project. We are speaking now particularly of the K-25 gas diffusion project and you assumed that they had the diffusion matter solved.

Senator HART. That they knew what it was and would have to develop their own process of manufacturing it.

Mr. THOMPSON. Well, in answer to the first part of your question, I am satisfied that these foreign countries could produce after some time something that would be equivalent to our K-25 gas diffusion process.

I am inclined to think that starting even now, with all the funds they might need and with plenty of incentive, if they felt perhaps somebody else was going to use measures against them—with all those things, it would still take much longer than it took us to do the job.

I would say, just guessing, that it would take them twice as long as it took us to do it.

Senator HART. That would mean 5 or 6 years?

Mr. THOMPSON. Yes; and when we say how long would it take to do that job, of course that really needs definition, because we know that from the standpoint of research and exchanges between the scientists working in this field that something had been started in 1940; so that this August completion date in 1945 makes it a 5-year project from the concept to the operating plant. But you were not thinking of that.

Senator HART. You would not be beginning back as far as 1940.

Mr. THOMPSON. That is right; but it would seem to me that from the standpoint of taking scientific knowledge as it exists today and going into the problem of building an organization, to put over such a project with unlimited means back of you and plenty of incentive to do it, it would take other countries twice as long as it took us.

Senator HART. Mr. Chairman, I have one or two questions to ask the witness along other lines. Perhaps in the interest of continuity, other members would like to question along this line.

Senator MILLIKIN. I would like to question along the line of Senator Hart's question.

Assuming that we give some foreign country—the best-equipped foreign country to do the job, whatever it is—our blueprints, our specifications, our formulas from beginning to end, how long would it take, in your judgment, for that best-equipped country to do the job?

Mr. THOMPSON. Just to be sure that I have that question accurately, we are going to give them the blueprints, we are going to give them all the information?

Senator MILLIKIN. The specifications, formulas, and all of the information. We will put it in their laps, and they are to proceed.

Mr. THOMPSON. When we say we are going to give that to them, we mean not only with respect to building what is down there at Oak Ridge, but also with respect to these plants for building the parts that go into it?

Senator MILLIKIN. We will tell them everything we know, except that we won't help them in any way whatsoever to build the plant. They must find whatever they need outside of the United States.

Mr. THOMPSON. That includes the membrane and all of the things—the complete information?

Senator MILLIKIN. It also excludes their use of our personnel. We keep our personnel. We keep everything that we have in this country, but we turn over the blueprints, specifications, the formulas, and everything we can tell them about the know-how.

How long would it take the best equipped country that there is, outside of the United States, to do the job?

Mr. THOMPSON. To put it that way, Senator, I think if you went to the best equipped country, one skilled in that type of construction, that they would have a plant in two and one-half to three years.

Senator MILLIKIN. Let me ask you what, in your judgment, is the best equipped country, outside of this country, to do that kind of a job—excluding, of course, Germany and Japan?

Mr. THOMPSON. Well, I really cannot answer that question. I just don't know.

Senator MILLIKIN. Is there any yardstick whereby men in your business measure the rating of countries chemically and industrially?

Mr. THOMPSON. Oh, yes.

Senator MILLIKIN. Give us a general rating, then, of a half dozen countries of the world that occupy the top rank?

Mr. THOMPSON. Well, I think ratings of that kind you would put on the basis of the tonnage of their different products, and in a given field.

Senator MILLIKIN. Does Great Britain have a general chemical field, for example? Do they produce everything, generally speaking?

Mr. THOMPSON. Of course, they are not one of the strong chemical-producing countries, but they have a chemical industry and it is growing; they have done some fairly good work in hydrogenation of coal and producing synthetic petroleum, and so on, but it is not particularly a chemical-manufacturing nation.

Senator MILLIKIN. How about Belgium?

Mr. THOMPSON. I think that is perhaps too small.

Senator MILLIKIN. Holland?

Mr. THOMPSON. That again is over on other side.

Senator MILLIKIN. Sweden has some great specialities.

Mr. THOMPSON. We can open up there a little bit in certain types of operation, yes.

Senator MILLIKIN. Does Switzerland have any large general chemical industry?

Mr. THOMPSON. I don't believe so. I think they are more in the physical sciences.

Senator MILLIKIN. How does France rate in that kind of comparison?

Mr. THOMPSON. I don't think particularly strong.

Senator MILLIKIN. Does Russia have a general chemical industry, generally developed and ramifying rather widely?

Mr. THOMPSON. No, I would say not. Russia finds its name in the chemical literature frequently in an important way, but so far as the carrying-out of chemical manufacture is concerned, it of course is not developed to a large extent so far.

Senator MILLIKIN. Is there anything to the south of us of any great importance?

Mr. THOMPSON. I don't believe so.

Senator MILLIKIN. As of today we are by all odds many times over the most important chemical nation of the world, are we not?

Mr. THOMPSON. That is right; excluding Germany.

Senator MILLIKIN. I intended that to apply all the way through.

It would take a great long time, would it not, for for any other nation to catch up with us?

Mr. THOMPSON. Yes, sir.

Senator MILLIKIN. Again excluding Germany?

Mr. THOMPSON. Yes.

Senator MILLIKIN. Thank you.

Senator HICKENLOOPER. I would like to ask one question in connection with the subject Senator Hart raised.

Assuming our position in 1941—that is, whatever know-how and plans we had at that time—but assuming that we were not at war and assuming further that we thought we might have to get into war sooner or later, although it was not immediately imminent on that day or that month—we were merely in a state of rather intensive preparation in peacetime—starting from that point in 1940 or 1941, how long do you think, from an engineering standpoint, it would have taken us in peacetime, even under some urge, to have perfected these plants to the point that they were perfected in 1945?

Mr. THOMPSON. Your question assumes peacetime, a reasonable urge, but not the same urge that applied to this project.

Senator HICKENLOOPER. Let us suppose we start 3 years from now, or even today, with the idea that perhaps we are going to have to fight somebody very soon, that it is reasonable to believe that, or that we were vitally interested in preparing an unbreakable defense for our country.

Senator Millikin suggests a valuable addition to this question. Suppose we didn't have it, but we had the know-how we had in 1941 and did know that somebody else had the bomb and had done the job, but assuming peacetime conditions and not the full emergency of the presence of war.

Do you think, for instance, that we could have built the plants in the time that we did build them—or that we could build the plants in the time we did build them under our social, political, and economic peacetime situation and the industrial demands of peacetime, and so on?

Mr. THOMPSON. I think that under the conditions stated in your question, it probably would have taken us about 50 percent longer to have built those plants.

First, the preference rating and priority that was put back of this project was the like of which no one had ever seen before. There was never a time in peacetime when you could get things that you wanted as promptly as you could get them for this project. That is the first thing, and so I am assuming that in peacetime it would have been quite a bit more difficult to get what we have put into this plant than it was during wartime.

Senator HICKENLOOPER. In other words, Mr. Thompson, in peacetime—even admitting that you had the priorities and the authority of the Government to go after them and get them—still probably the peacetime demands on these vast hundreds of thousands of other operations that were producing materials that you needed might have slowed this thing down quite a little; whereas they would just cut through all red tape, all conditions of other business and other activities, in order to meet this intense emergency of war.

Mr. THOMPSON. That is correct, and I also think that even under the conditions stipulated in your question, you would not have gotten the drive on the part of the personnel working on this thing that you did get under wartime conditions. They were simply all out.

Senator HICKENLOOPER. That is the human element, the natural human element?

Mr. THOMPSON. Yes.

The CHAIRMAN. Do you think, Mr. Thompson, that the conditions stated in Senator Hickenlooper's question, namely, that some other country had the bomb, might be the compulsion that would exist to hurry your estimate of time necessary or to shorten the estimate of time necessary?

Taking you as an American engaged in this proposition and informed that other countries or another country had the bomb, have you given any thought to the fact that that proposition might hurry you in your efforts?

Mr. THOMPSON. There is no doubt that that fact alone produces tremendous incentive on the part of the other fellow.

The CHAIRMAN. It would produce that incentive in you, would it not?

Mr. THOMPSON. Unquestionably.

The CHAIRMAN. And the fact that it was peacetime or wartime or in-between time would be disregarded by you, would it not, in your efforts to get this thing into production?

Mr. THOMPSON. I think that is correct.

Senator JOHNSON. Mr. Thompson, the reasons we made such speed were, first, that we had a totalitarian war government; and second, we had the patriotic urge.

Now, can't you picture some other country, a totalitarian country, that would proceed with all the priorities which we had, and they might substitute—if they didn't have the patriotic appeal that we might—the emotion of fear; and don't you think they could speed up and perhaps reach the stage of efficiency which we displayed, other things being equal?

Mr. THOMPSON. I think that the question of their speeding up to their maximum within their capabilities and aptitudes unquestionably would be produced in other places under the conditions you mention.

I wonder, however, if there is any other country that has quite the grouping of aptitudes plus experience in their fields that we have

here. I am thinking of the whole business of multiple production, the same thing that made the automobile and the output of war airplanes. No other outfit has that to the same degree that the United States has developed it now.

That figured in a big way in making all sorts of underlying parts, the work of Chrysler and Allis-Chalmers in this field, the work of General Electric and Westinghouse in the project that Mr. Creedon spoke about, and the parts that went into our project—although special plants were not built for them. I mean to say that the business set-up, with experience back of it, able to translate over to making special things almost on a week's notice, is the type of thing that we have that I think no one else has.

Senator HICKENLOOPER. We have one other thing, in pursuit of Senator Johnson's question: The enemy was shooting at us; the bullets were flying. It wasn't a question of "we are pretty sure there will be a war next week, next month, or next year." We were right in the midst of the war, and the battle was on.

I think that may not be a completely controlling element, but it is a very substantial element in the ability to coordinate all of this know-how and the willingness of all our resources to at least make this thing a priority thing and devote its genius to that.

I think the presence of war is quite a thing in this or any other effort.

Senator JOHNSON. Yes; of course, plus the element of totalitarian approach. That is what we had.

Senator HICKENLOOPER. You can get the totalitarian approach in peacetime, you can get the orders issued in various ways in peacetime, but that last urge of the fellow over there on the other side of the hill shooting at you is something that comes only in wartime, right in the presence of war.

Senator HART. Mr. Thompson, are you disposed to alter your estimate of taking 5 or 6 years for any other country to achieve what we achieved in K-25?

Mr. THOMPSON. I still feel that is a good estimate, Senator.

Senator HART. There is one possible difficulty you didn't touch in that splendid statement about the accomplishment, which was in the field of metallurgy. Were there any great difficulties in that field?

Mr. THOMPSON. There were, and again the fact that in this country our metallurgy was well advanced and a living thing that merely had to be assigned to these special problems resulted in a great gain to the project.

Senator HART. What about the availability of the basic metals which came into the picture?

Mr. THOMPSON. The basic metals, of course, were of two kinds: (1) The material out of which the 235 was manufactured and (2) the materials of construction used in the plant itself.

I believe there is quite a bit of security requirements and secrecy thrown around the metal itself.

Senator HART. I didn't mean to bring in anything outside of construction.

Mr. THOMPSON. In the matter of construction, our metallurgy was most perfect, and it got into this project in several ways.

As to the materials of construction for the parts going into the diffusion plant itself, some were corrosive, which, if allowed to accumu-

late at a certain point, would become fissionable, which were highly poisonous; the metallurgy there was difficult and was only solved because of the groups we had to draw upon.

Again, in the metallurgy of certain phases of elements of the plant, the availability in this country of a trained and going metallurgical group solved those particular problems.

Senator HART. And when we asked you about other countries accomplishing that and you gave an estimate, did you have in mind the possible difficulties which they would encounter in the metallurgical field?

Mr. THOMPSON. I would say not specifically. I was trying to look at it in a general way, considering where they would be trying to do all of the things we did.

Senator HART. Mr. Thompson, you operated this K-25 plant. Is there anything you would like to tell us about the magnitude of difficulties in maintenance?

Mr. THOMPSON. I might say that there were a great many unknowns about the operation of the diffusion plant before it was put in operation. After all, it was impossible in the laboratory to test out in an effective way the effects that were to appear in time. There was no way of accelerating. There was the question, for example, of the diffusion members plugging up, and there was the question of their not being strong enough.

Most of those questions had to be answered by building the plant and putting it to work. Knowing that the failure of some of those things would be fatal to the project, the design incorporated every protection that seemed reasonable.

The operation of the plant might have been perfect from the standpoint of separation, but its life might have been too short. Fortunately, our experience so far has indicated that those matters that have to do with the life and the need of replacing and changing and taking out, and so forth, were well solved, or they were not going to appear, because we have a plant that is operating much better and will operate with much less maintenance than we suspected in the first place.

Senator HART. Then, from a practical standpoint, it has been neither troublesome nor expensive to keep up the maintenance?

Mr. THOMPSON. That is correct.

Senator HART. In the field of operation, is any great number of highly skilled personnel required once it was going, and were there any great difficulties in training them and getting them to carry along the work?

Mr. THOMPSON. In answer to that question, I want to say strongly, "Yes." Without getting into details that probably shouldn't be talked about, I think the approved and published statements thus far have indicated that this operation is one in which you have thousands of steps set one on top of another.

The kind of a separation you are making, you see, is a very sharp one. It is a delicate sort of a thing. It is more or less like running a distilling column, a rectifying column, with thousands of plates in it instead of 20 or 30; and if you disturb that complex unit, and not extensively, but every once in a while, at some point or another you

may never get it out of equilibrium. You might have a perfect plant and get a plant that wouldn't separate 235 from 238.

That comes down to control. The control that was worked out for this project was one of the big things that has been most successful. I believe that one of the problems that some other group, attempting to do what was done in K-25, would be brought face to face with would be the difficulty of operation and of maintaining that complicated system in equilibrium so that you can get your end product out at the right purity.

Senator MILLIKIN. Would it be fair to say that it was sort of touch and go as to whether, after this whole thing got into its rhythm and got to operating—as to whether what you wanted would appear at the other end? Of course, you expected it, or you wouldn't have built the plant.

Mr. THOMPSON. Senator Millikin, I think the matter was this: It was realized that running a complicated system of that kind had to be based on good control, and the control end of it received a tremendous amount of attention.

Senator MILLIKIN. But if somewhere along the line, as you pointed out, there had been some little failure, you would have gotten that whole gigantic thing going and nothing would appear.

Mr. THOMPSON. I want to correct that a little bit. I may have made a statement that sounded that way.

Actually, we can cut out quite a portion of it without upsetting the whole thing. The point I wanted to make was this: If your operation was ragged enough so that you had a disturbance at the lower end one day, the next afternoon one at the upper end and the next afternoon one in the middle, and you had that accumulation of disturbances, it wouldn't be a matter of touch and go, it would be a matter of eliminating, that series of disturbances before you produced.

Senator MILLIKIN. It seems to me you produced a perfectly marvelous result, not having a pilot plant to work with.

Mr. THOMPSON. Those of us who worked with it felt that that was so. It was the only time, of course, that anybody had ever spent sums of money like those without a full pilot plant back of you.

Senator HICKENLOOPER. I want to say first, Mr. Thompson, that I think your statement that it is a rather delicate operation is a masterpiece of understatement. I think that probably no one but you expert engineers and scientists can have any appreciation of the extreme delicacy of this operation.

But I did want to ask your opinion on this, to see whether or not this is a correct assumption: I assume, leaving Germany out of the picture because it was a diversified chemical, engineering, and manufacturing country, and at least for a substantial period of time it will be completely out of the picture, isn't it safe to say that our country all through this process, both before the war, afterward, and now, has by far the greatest diversification of industrial know-how, including chemistry, science, engineering, and all of the factors, of any country in the world; and that that is backed up by basic research in these major fields that in the aggregate and for all practical purposes in this thing was far in excess of any other country in the world?

Mr. THOMPSON. I am sure that is right.

Senator HICKENLOOPER. And it was that backlog of basic research over a long period of industrial development in this country that enabled you to know that if something were needed, even though it were new in design and even though it were just being conceived, that there was a segment of our industry that at least had gone far in research into the general basic fields involved in the production of that article?

Mr. THOMPSON. I am sure that is right.

Senator HICKENLOOPER. And you could call upon that in the most tremendously diversified industrial plant in the world, which was this country?

Mr. THOMPSON. There is no question about it.

Senator HICKENLOOPER. If you hadn't had that diversification, in other words if there had been certain new pioneering fields where we had no basic research on some of the fundamental problems, it would have been a more difficult problem to do this job. You would have to go out and build up that backlog of research, and things of that sort were in many sciences already available.

Mr. THOMPSON. I am sure that is correct.

Senator HICKENLOOPER. Although the research might not have been available to that particular problem, but to the type of problem that was available.

Senator HART. I think we might state for the record that to Mr. Thompson "basic research" doesn't mean exactly what Senator Hickenlooper may have had in mind.

You will recall in his testimony he was talking about engineering research after the basic research is completed, and then the engineers take over and make it work.

Senator HICKENLOOPER. Yes; I appreciate that. I probably didn't get my question down to a specific outline as well as I could, and perhaps I can't express it as I tried to conceive it in my own mind. I am no engineer and no chemist, and I cannot go into those things accurately.

The CHAIRMAN. Mr. Thompson, you could put every scientist off the Oak Ridge property and not let them come on there for the next 6 months and operate this plant, could you not?

You have a going plant operated, as it still is, by your company with an engineering and production personnel. The job now is to maintain it in production and operation. That is an engineering job.

Mr. THOMPSON. The answer to your question, as you put it, is "Yes"—definitely.

I might clarify, however, by saying that in the operation of a plant of that kind there are parts of the operating end of it concerning the laboratory phases in which we have Ph. D.'s trained in chemistry, and so on. Now, you are not thinking of men trained in chemistry as scientists. You are thinking of the research background. That is behind us, so far as the K-25 goes. Those gentleman are no longer needed.

The CHAIRMAN. That is right. In other words, you can make fissionable material with your organization today?

Mr. THOMPSON. That is correct.

Senator HICKENLOOPER. The need of the top-flight scientists today, as I take it, is for advance research on other and different methods, or other fields, and so far as the present operation is concerned, their job is done.

Mr. THOMPSON. That is correct.

The CHAIRMAN. Are there any further questions?

I have one question that I would like to ask of you and Mr. Creedon in executive session, which will take just a few minutes.

The committee will meet tomorrow morning in open session at 10 o'clock.

(Whereupon, at 12:15 p. m., the committee retired into executive session; to reconvene in open session at 10 a. m., Wednesday, December 20, 1945.)

ATOMIC ENERGY

THURSDAY, DECEMBER 20, 1945

UNITED STATES SENATE
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Austin, Millikin, Hickenlooper, and Hart.

Also present: Edward V. Condon, scientific adviser, and James R. Newman, special assistant to the special committee.

The CHAIRMAN. Mr. Winne.

STATEMENT OF H. A. WINNE, VICE PRESIDENT AND MANAGER OF ENGINEERING IN THE APPARATUS DEPARTMENT, GENERAL ELECTRIC CO.

Mr. Winne, you are the vice president and manager of engineering in the General Electric Co.?

Mr. WINNE. Yes.

The CHAIRMAN. Mr. Winne, according to the staff's information, guided a large portion of the development and manufacturing work done by the General Electric Co. for the Manhattan District program. He is the author of articles on electric furnaces and electrical precipitation and steel mills. He has been employed by General Electric since 1910.

Mr. Winne, will you proceed to tell us what you think of the difficulties of the work that you did for the Manhattan District project, and something about it?

Mr. WINNE. I will be glad to endeavor to, Senator.

I suppose to clarify the situation it might help if I outlined briefly first the manner in which we participated, that is, very generally, the equipment which we furnished.

The CHAIRMAN. That is an orderly way to do it.

Mr. WINNE. I presume whatever I say here is public, so no classified information should be revealed.

The CHAIRMAN. That is right.

Mr. WINNE. Our connection with the project involved work for two of the main processes as described in the Smyth report, that is, the electromagnetic and the gaseous diffusion, so that my remarks will be confined primarily to those two methods.

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Of course, due to the way in which General Groves rightly kept the different parts of the project compartmented, we did not have knowledge of all phases of even one of those two methods.

We supplied some standard equipment as well for the Hanford plant, but that was practically all of a standard nature. The major part of the equipment we furnished was that for the electromagnetic project which we termed the Stone & Webster job, because the over-all construction, and so forth, was handled by Stone & Webster.

I would like to emphasize that all the way through this project was given top priority in our organization. We put effort and people on it way beyond what we normally would on a project of the same dollars of magnitude, because General Groves had impressed upon us so thoroughly the importance of it.

For the electromagnetic project, we supplied among other things some high-voltage rectifiers, or cubicles as we termed them, a lot of transformers, switch gear, motors, and so forth. As an example of probably the most difficult part of our participation in that project, I might cite the high-voltage cubicles.

Each one of those was the size of a small room, and there were a great many of them. Each one involved around 7,500 different electrical components. I don't mean just screws, nuts, and bolts—that would run into the hundreds of thousands, probably, but different pieces of electrical equipment, such as instruments, tubes, transformers, motors, and so forth.

While, as I say, this was only a small part of the project, nevertheless it was necessary for us in our organization to use the facilities of practically every one of our works—the Pittsfield works, Schenectady, Lynn, Bridgeport, Fort Wayne, Philadelphia, Bloomfield, and our various research and general engineering laboratories. We even called on our subsidiaries, the General Electric X-ray Corp., which furnished a lot of vacuum tubes, and the Edison General Electric Appliance Co., which furnished a lot of heaters, and so forth.

In addition to that there were some 2,000 items which were obtained from outside contractors for each one of these numerous high-voltage cubicles.

The point I wish to make there is that we had—and this is typical, I think, of all American industry—the organization and the manufacturing facilities, and especially the background of technical knowledge, which enabled us to really contribute to the job and to get it through in the time it was required.

As illustrative of the necessity for that technical background, we found that when some of this equipment first went into service, we immediately had our hands and laps full of trouble, as was to be expected with anything as new and radical as this equipment was. We called upon one of our laboratories which had had, over the past 15 or 20 years, a very unusual background of experience along the line of this particular trouble, and there were about 25 engineers and test men who worked for several months carrying on a series of tests and investigations, as a result of which—just to show you the magnitude of the thing—the report covering the tests involved some 500 pages of typewritten matter and over a thousand what we term oscillograms, which are records made on very high speed recording equipment, and through which we found the sources of the trouble and were able to correct them in the equipment which was supplied.

Of course, one of the difficulties was that all the while this trouble was occurring, in order to meet the shipping schedules, we had to keep the equipments rolling out of the back door even though we knew that they would have to be changed afterward; but it was the only way possible to do the job in the time required, and when we found the trouble we had to go out in the field and correct it.

As another example, there was one particular phase of the equipment which we supplied which required very close control. Now, the type of control of which I speak—commercially, we think of an accuracy as within 1 percent as pretty good—we had to shoot for and obtain an accuracy of one-fiftieth of that, that is, 50 times as good, you might say. The only reason we were able to do that, I think, is because we had previously supplied from one of our laboratories a number of equipments to another branch of the armed services which were of an extremely special nature and were developed only after a lot of mental and manual travail, you might say, and we used elements from that particular specialized equipment to save the day on this Manhattan project and on this particular phase of it.

Again, what I am trying to emphasize is the fact that to do the job in the time that we did it—and I think when I say “we” I can say that I am speaking for all of the industries which participated, and certainly for General Electric—it was necessary that we have available that background of technical experience extending back over many years of engineering, design, and development, and production, as well as the facilities and the manpower to do the job.

On the gaseous diffusion plant, we supplied a lot of equipment in the way of turbines, a number of turbines, which were more or less special, and, again, to indicate right there the necessity for an already functioning industry, one of the first of those larger turbines was taken from another job which was partially completed. It was taken from that other job, some changes were made in it, and adapted to this job. Others were already in the schedule and coming along, which were diverted to this job.

Then, there were a number of transformers, switch gear, and so forth, but our main engineering contribution and the most difficult one was in connection with the instrumentation for the gaseous diffusion plant, and that we turned over almost entirely—as far as the engineering development work was concerned—to what we term our General Engineering Laboratory, which is an organization dating back a good many years with a very specialized personnel and facilities. They were called upon in a number of cases to invent, and in others to take ideas which were in the nebulous stage and bring them through the development stages into actual production. The result there was a large number of very special devices particularly adapted to this job which we would not have been able to produce in the time that we did had we not had this already functioning organization and facilities.

In addition, for the job we supplied a considerable amount of consulting service from scientists in our research laboratory, from technicians in our works laboratories, on such matters as welding and metallurgy, brazing, and that sort of thing.

While I think very high tribute, of course, is due to the scientists who initiated the work from which this project resulted, the actual consummation of the project—the production of the material and of the bombs—was in my opinion only made possible because we had American industry, American engineers, American equipment ready to function. The scientists had built experimental equipment for use in their laboratories, but to operate them they had, you might say, hundreds—and I think that is literally true—of Ph. D.'s and similarly trained people. Industry had to take these ideas and put them into commercial equipments, in quantities, which could be operated by girls with high-school training or less, and with a minimum of maintenance and with as nearly as possible continuous operation.

A great deal of credit is due not only to the industrial manufacturers but also the organizations, such as Stone & Webster and Kellex, with whom we had principal contact, and there were many others, such as Tennessee Eastman, and so forth, for their work on the over-all project. I think the highest of praise is due to General Groves and his organization for the way in which they coordinated and pushed this whole project forward. I have sat in meetings with the General in which the personnel ranged from the scientists to the hard-boiled construction people, and he did a marvelous job of shoving the whole thing forward and getting it done.

Mistakes were made; we made mistakes. I think probably everybody connected with the project made mistakes. Because of the necessity for speed, it was done in a way that we normally would never think of doing an engineering and development job.

To take these high-voltage cubicles, for example, the ordinary way to proceed with that in our ordinary work would be to build one and put it in operation and see how it worked, and work the bugs out; and then from that build up the commercial designs for the remaining quantities, and go ahead and build them. But in order to meet the time schedule we had to start from the drawings on the paper and turn them out the back door, and then make such changes as were necessary later. While we can look back on it now and say we could start over again and do the job at less expense and perhaps in less time if we had the same urge—we couldn't do it in anything like the time we did without the urge of war, in my opinion; but looking at it from the other end, from the start, I do not know how the over-all job could be done any better than it was. I think it was a tribute to the Army, to American industry and everyone concerned with that—and I say that with due modesty for our part in it.

Senator AUSTIN. To what extent, were you dependent on the Army for materials?

Mr. WINNE. We very often had to call on the Army personnel to help us in expediting material from suppliers or component parts which we were getting from the outside. They were a great deal of help to us in that way.

Senator AUSTIN. You mean manufactured articles made by other concerns?

Mr. WINNE. That is right.

Senator AUSTIN. Were you dependent on the Army for raw materials?

Mr. WINNE. Well, I cannot answer that question definitely as to whether we ever had to call on them to help us get such things as steel

and copper. I am not sure, but I rather think we did; but I cannot say that with absolute certainty.

I know we called on them a great many times for component parts from other manufacturers, and, of course, we had to call on them to arm us with directives or AAA priorities where needed, and that sort of thing, so we could help ourselves to get the material.

Senator AUSTIN. In peacetime, that situation where you could depend on the Army would not probably exist, would it?

Mr. WINNE. That is very true.

Senator HART. Mr. Winne, this background of industrial knowledge, know-how, and ability to produce is also a part of a good many other firms in this country with which I assume you have a certain amount of acquaintance; is that true?

Mr. WINNE. That is correct.

Senator HART. Going back, you, I understand, have been with General Electric for 35 years. Going back to 1910, when you began, and which covers the period of our very great industrial advance which has put us out ahead of the world, what were the circumstances as you now see it which so impelled us that we did set up in this country this marvelous industrial establishment in the heavy industries? What were the compelling and impelling circumstances?

Mr. WINNE. I would say offhand the profit motive of industry, the natural desire of all industry to improve its products, to expand its field, and thereby expand its business and carry on development work. You perhaps know our slogan: "More goods at less cost for more people," which is a slogan which we have tried to live up to right along. I think that is perhaps the greatest motive. It is probably trite to say, but the free-enterprise system had a great deal to do with it, I feel.

I don't know whether that answers your question, sir.

Senator HART. Not altogether. Which particular field of industry do you look back upon as having developed the fundamentals of mass production, rapid production of various difficult articles? Would it be the electrical field, or some other?

Mr. WINNE. Well, I think in general we think of the automobile industry as having more or less led the way in quantity mass production.

Senator HART. Have you been able to keep in touch with the state of industry in other parts of the world, particularly in Europe, over the last generation or so?

Mr. WINNE. Only in a very general way, speaking of my personal knowledge.

Senator HART. Have you any idea as to how it happened that with the possible exception of Germany the rest of the world fell behind our ability in production, in our heavy-industry ability to produce? Where did the rest of them fall behind us so badly?

Mr. WINNE. That is a very difficult question to answer, sir.

Senator JOHNSON. Did they fall back or did we lead out?

Mr. WINNE. I don't think that any of them have fallen back. I think practically all countries have gone ahead, but I think we have gone ahead faster than the majority of the other countries.

Senator HART. Aside from the possible sociological aspect of the free-enterprise profit system, and so on, we must have had other advantages in order to have gone out ahead of the world so fast, don't you think?

Mr. WINNE. Of course, we have had the advantage of raw materials, I think, to a considerable extent, at least over many countries. Of course, there are other countries which are not yet so far developed as we which have also quite large resources of raw materials. But taking the more highly developed countries, such as England, unquestionably, of course, our store of raw materials is much greater than theirs. That undoubtedly has had considerable to do with it.

Senator HART. Looking into the future, Mr. Winne, what country in the world is most likely in your opinion to be able to overtake us if there is an urge to get into production of heavy industry?

Mr. WINNE. Judging by what one reads, and so forth, I should think the probable answer is Russia.

Senator HART. I believe your company has a good deal of representation in Russia, or has had?

Mr. WINNE. We have had some representation in Russia. So far as I know, we have no one there now.

Senator HART. Did you gather from those representatives any measure of Russia's ability to overtake us?

Mr. WINNE. No, I have not, sir. I am not in a position to give any valuable information on that point.

Senator HART. Thank you.

Senator HICKENLOOPER. Mr. Winne, may I ask your opinion on this: Suppose we started right now with the knowledge we had in 1941 or at the very beginning of this enterprise, and we knew that some other country had an atomic bomb actually completed, that they could make it, had the know-how and the process, and we wanted to start out to make an atomic bomb.

As I say, beginning with the information we had in 1941, in peacetime and not in the presence of war, what is your opinion as to the length of time it would take industry to do the job under those conditions?

I may go a step further and say that the point of my question is: Could we get the cooperation; could we get the intensive union of all industry, engineering, and so on, together to finally produce the thing in the time that we did—in peacetime?

Mr. WINNE. Of course, you must realize that my answer to this must be simply a matter of opinion, as obviously it cannot be based on actual facts.

Of course, on this project, the funds available were practically unlimited to get the job done.

Senator HICKENLOOPER. Let's assume that they are now.

Mr. WINNE. You are assuming also, then, that funds would be made available?

Senator HICKENLOOPER. That funds are available and priorities—or at least top orders for priorities—are just as strong as they were during the war.

Mr. WINNE. As I said, it is difficult to weigh what the effect on us would be of the knowledge that another country had atomic bombs ready to use if they wished to. It might put almost as much impetus behind us as actual war itself, but my belief is that it would not. I think it would probably take once and a half to two times as long, or something like that, under normal peacetime operations to do this job even with the funds available.

I just cannot conceive that in peacetime either the Government or industry would go ahead on the basis as I say we had to here, because of the urgent life or death nature of this job, almost, and be producing equipment while it was still in the very early developmental stages. That is entirely contrary to all normal industrial production.

Now, if you get enough urgency behind it, if we knew that atomic bombs were going to start coming over in a short time, if we didn't get something to combat them with, then you might possibly get speed of the same order of magnitude as we got in this case. There are so many intangibles.

Senator HICKENLOOPER. I am merely speaking to you as an engineer who has had a lot of experience in the human end of production. That is, you have to get human cooperation before you can turn out these things, and I am wondering whether a condition doesn't exist psychologically or otherwise in the presence of war, that is, in time of war, that probably enables these jobs to get done which even under the threat of war wouldn't be accomplished quite so fast?

Mr. WINNE. I think that is very definitely true. I think it would certainly take longer simply under the threat of war than it took us in actual war, and with the thought that possibly our opponents were only a jump behind us, or maybe not even a jump.

Senator HICKENLOOPER. In other words, when they are not actually shooting at you, there is a human tendency to be a little more certain about what you are doing—not to procrastinate, but to take a little more time and prove your theories.

Mr. WINNE. I think that same thing would apply to Congress in the allocation of funds to a thing like this. Don't you think so?

Senator HICKENLOOPER. Well, I have read the papers. I think it is true that in any human organization there are times when the urge and speed of accomplishment are a great deal more than at other times.

Mr. WINNE. I think, over-all, unquestionably it would take longer under any other conditions than it did under the war conditions, and it might be in the order of once and a half to twice as long, or something like that.

Senator HICKENLOOPER. Let me ask you this: Insofar as you have any knowledge or opinion on this, is there any country today—considering, of course, the devastation of German industry and its complete destruction—that can compare with our country in the whole field of basic research, engineering, over-all historical know-how in industrial and scientific fields of this kind?

Mr. WINNE. I think not, Senator, when you particularly bring in the manufacturing facilities and the engineering and technical background for producing the equipment necessary to produce the atomic bomb.

It is my personal opinion that there is no country today which could approach us on that.

Senator HICKENLOOPER. I am referring to the over-all picture now. Some might be able to make just as fine a piece of individual equipment as we could make here, and it is entirely possible that some country might make a finer piece of individual equipment than we are prepared to make here, but I am speaking of the over-all picture, because as I understand it, this operation is an over-all ramified operation in which all factors must be completely coordinated and must completely operate.

Mr. WINNE. That is my opinion, Senator; yes.

As I say, we had to call not only on practically all of our own organization, but on many other organizations in the country to supply parts just for the part which we supplied, and ours was only a portion of the total equipment used in the project.

Senator HICKENLOOPER. That leads me to just one more question. When a problem came up that you knew had to be solved in a comparatively unknown field, isn't it true that there did happen to be a segment of our engineering, or design, or industry, some place that had had some basic knowledge in that whole field upon which you could rely to develop this special thing?

Mr. WINNE. Very definitely so, Senator, especially within our own organizations. As I say, we called on our Pittsfield high-voltage laboratory when we ran into trouble in one place. We called on the General Engineering Laboratory. We called on other organizations. There was one particular part of this control in which we needed a very special vacuum tube. We happened to know that another company had a tube which might fulfill that requirement, and we found that they did; not all of the tubes they made did, but by selecting a comparatively small percent out of a great many they manufactured, we got the tubes that we needed to accomplish the desired results.

Senator HICKENLOOPER. In any event, if they had not had the particular tube, they had had some experience in the broad field of production that you wanted, and they very likely had the know-how to go ahead and develop the thing you would want.

Mr. WINNE. That is right, and we called on our General Electric X-ray Corporation for some very special tubes. We used the existing buildings, but we equipped and manned and put into operation a complete new factory for building large quantities of quite large-sized vacuum tubes that were required on this electromagnetic project.

Senator HICKENLOOPER. In other words, many other countries might have a certain portion of this field developed very highly, and yet on certain essential things they might find themselves at this point: "Well, we have no part of our industry that has ever explored that field very much; we have to start out and develop the whole thing."

Mr. WINNE. That is entirely possible, and I think probable. I could not say definitely.

Senator HICKENLOOPER. That would be a great factor in the final completion of this project?

Mr. WINNE. That, and also the mere magnitude of industry necessary to turn out the equipment required to do the job.

Senator HART. May I ask one more question?

Mr. Winne, comparing our industrial ability with others, and how we happened to get so far ahead, is it your opinion that our superiority has not been so much in the field of basic research as it has been in development research and our consequent superiority in working out designs for apparatus which lent themselves to production? Did our superiority lay in that, or are we also superior in our basic research?

Mr. WINNE. Well, Senator, I doubt if we have been greatly superior, at least in our basic research, to some other countries, but I do feel that we have been superior in our technical developments, our development of production methods and facilities for manufacturing highly technical and complex equipments.

As far as basic research is concerned, it is my feeling that we have not been much, if any, ahead of some other countries.

Senator HART. Is engineering research the proper term for the field in which we have been so superior?

Mr. WINNE. Well, you can term it engineering research, or engineering and technological development. There is a great deal of difference in definition as to the terms "research," "engineering," and so forth.

In our company we apply "research" primarily to fundamental searching into the unknown, you might say; whereas our "engineering development" is taking the results of research and putting those into practical use, and in developing the manufacturing facilities, and so forth, is where we primarily have been superior.

Senator HART. In your opinion, what other countries were on a level with us in basic research?

Mr. WINNE. Again, I have to rely largely upon reading, and so forth, and not from my personal investigation of their facilities, their work, and so forth, but Germany, in general, had done a very good job of basic research. England has carried on some outstanding basic research, and I think Russia has. Our Dr. Langmuir was over there a short time ago and was quite impressed with some of the research work they had been carrying on. I believe he outlined that to some extent to this committee.

The CHAIRMAN. Mr. Winne, have you traveled extensively abroad?

Mr. WINNE. No, I have not, Senator. I have not done any traveling abroad, that is, off this continent.

The CHAIRMAN. If you wanted to know the state of advancement of industries comparable to the one you represent, where would you go to find out?

Mr. WINNE. Do you mean geographically?

The CHAIRMAN. The various countries of the world. That information is probably better compiled in the Department of Commerce than any place else, isn't it?

Mr. WINNE. Well, of course, in prewar time we had, as a part of our general organization, what we called the International General Electric Co. which had representatives in most foreign countries and knew in a general way at least of the technological development in those countries. We cannot, of course, use those today, because we don't have the men abroad to the same extent, but we would have used that organization to find out what other countries were doing as well as we could.

The CHAIRMAN. Do you know about the facilities or the extent of the information in the Department of Commerce as to the development of industry in other countries of the world?

Mr. WINNE. I am not especially familiar with it, Senator, no.

The CHAIRMAN. It has occurred to me that they might be the best coordinator of that information.

Did you, as representing your company, make any estimate of the time that other countries might be expected to require to duplicate this performance to the George Harrison committee that was set up in the War Department to receive that information?

Mr. WINNE. No; I did not, Senator.

The CHAIRMAN. Do you know who in your company did make that estimate, or if anybody was called upon?

Mr. WINNE. I don't know that anyone has been called on, although they may have been. I don't know of any information of that nature that has been given to that particular committee, Senator.

Senator JOHNSON. Following the line of questions which have been submitted by the Senator from Connecticut, Admiral Hart, isn't it true, Mr. Winne, that the atmosphere here has been wholesome for the development of industry? Our educational program, the number of college graduates, and the number of technical schools and graduates from those technical schools, our free enterprise system together with the profit system, which is a reward for merit, and the attraction that our freedoms—the freedom of speech and the press which have permitted the friction of minds—have attracted scientists and technicians from all over the world to come to our country.

Haven't all of these things combined to make it possible for our industry to step ahead of the rest of the world, and isn't it really the combination of these things that has created the wholesome atmosphere for the advance of industry?

Mr. WINNE. I think I can wholeheartedly endorse that statement. Of course, as far as the technical colleges and industry are concerned, those two are interrelated. As industry has grown, its needs for the technically educated men have grown, and that has helped to increase the number of men in the colleges and the number of colleges. The two have more or less come up together.

Senator JOHNSON. The people in this part of the world may have what some folks call the creative mind or instinct, but don't you think that instead of having any superiority or any advantage over other peoples just as men were born naturally, that it had been because of these conditions?

Mr. WINNE. I think environment has a tremendous amount to do with that. That is, there are creative and brilliant minds in a great many other countries, as you all know. Of course, the brilliant people from other countries, many of them, have come to this country. I think the environment in this country—as you say, the free enterprise system, the profit motive, and so forth—has been primarily responsible for our progress. That is a rather trite statement, I know, but I think it is true.

The CHAIRMAN. Mr. Winne, radar was developed in England, wireless in Italy, fission in Germany, jet planes in Germany, V-2's in Germany, penicillin in England, synthetic rubber out of alcohol in Russia, and all of those things were put into production.

I am pretty proud of this country, too, but I do not want to get so proud as to believe that everything that has been done that is worthwhile in modern advanced technology and science has originated within the four corners of the United States, because it just isn't true.

Mr. WINNE. I would not claim that at all, Senator. That is why I said, in answer to the Senator's question, that there are brilliant minds in other countries as well as in this country. We have no monopoly on brains.

The CHAIRMAN. They have been able to translate their inventions into mass production, haven't they?

Mr. WINNE. I think not to the same extent that we have here.

Senator JOHNSON. That is the very point.

The CHAIRMAN. But you don't need mass production of atomic bombs, do you?

Mr. WINNE. No; but to produce a plant which in turn can produce atomic bombs in a short time you need essentially mass production facilities.

The CHAIRMAN. We did it in four different methods.

Mr. WINNE. That is right.

The CHAIRMAN. You, of course, would assume that any other country, the four methods having been proved, possibly would select one of those methods.

Mr. WINNE. I think any other country starting today has the advantage, Senator, that they know to some extent what we have done. They know we have been able to make these methods work. They possibly can analyze to determine which one, two, three, or all four are best, and to that extent would have a better start than we had.

There has been enough published on the basic researches, and so forth, to give other countries an advantage over what we had at the start of this project, it seems to me.

The CHAIRMAN. Keeping in mind that they would select one method, that they know that method would work, that they have been capable of doing these other things that I have mentioned, do you care to give any estimate for the record of how long you think any other country—being specific or not—could get into production on fissionable material?

Mr. WINNE. Of course, any such estimate is purely a guess.

The CHAIRMAN. I appreciate that.

Mr. WINNE. And purely a personal one. I feel that to do what we did in the time we did called for such diversified effort on the part of so many of our different industrial organizations—not from personal visitations or anything but simply from reading, as I said—no other country today can approach us in industrial facilities available; and therefore I feel that even granting that they would have somewhat of an advantage in the start it would take any other country considerably longer than it took us.

Now, whether that would be twice as long—and it might be on that order of magnitude I might think—again I want to emphasize that there are very few facts on which I am basing this. It is just a guess and a personal opinion. It might be once and a half; it might be three times as long—I don't know. I feel it would certainly be longer.

The CHAIRMAN. How long would you say it took us?

Mr. WINNE. Well, again, I can only cite our own experience.

We were given specifications on this equipment, and those specifications—I would emphasize—in turn were the result of long experiments in laboratories, and so forth. We were given specifications as to what it was felt was needed from us in either December of '42 or January of '43.

Now, again, that is only our part of the job. Of course, those specifications were changed many times as we went along, but that was really when we started to put the pencil to the paper to make designs for the equipments which we furnished about January of '43.

The CHAIRMAN. Are there any further questions?

Mr. Winne, thank you very much. I think your company made a great contribution to this project, and it was very kind of you to come down and talk to us today.

Mr. WINNE. We are glad to be of any help that we can.

The CHAIRMAN. Mr. Brown.

**STATEMENT OF EDWIN H. BROWN, VICE PRESIDENT IN CHARGE
OF THE ENGINEERING AND DEVELOPMENT DIVISION, ALLIS-
CHALMERS MANUFACTURING CO.**

The CHAIRMAN. Mr. Brown, you have been connected with the Allis-Chalmers Co. for 35 years, I notice, and you had some considerable experience with the Manhattan District project.

If the committee has no preliminary questions, I will ask you to go right ahead and tell us about your company's connection with the project and more particularly yours.

Mr. BROWN. The company had different orders and contracts with the Manhattan District and its representatives and contractors in excess of some 60, ranging from a very few dollars up to very large amounts.

The equipment furnished included nearly all of our standard products that went into the various projects. How much more equipment went into the mining industry, and others that were involved, we don't know.

Among these contracts there were two that I feel are pertinent to the subject of your committee in particular. One of them was for equipment having to do with the electromagnetic process, as described in the Smyth report, and the other had to do with electrically driven mechanical equipment for diffusion separation of gaseous products, both for equipment installed at the Clinton Engineer Works, Oak Ridge, Tenn.

Of the electromagnetic process equipment, we were the fabricators, the makers, the installers, and the developers of the manufacturing processes. We did not develop nor design the equipment. It was developed and designed, so far as we know, under the direction of Stone & Webster Corp. If I recall rightly, it was to them that we reported on the work in our plants. The principal electromagnetic equipment was of the heaviest type made by heavy industry. Its fabrication represented a difficult problem in our works, when we handled things up to the largest dimensions for machining, welding, and all the various shop operations, involving difficulty even in shipping and installation.

The actual manufacturing processes required the development of new methods. Some of them were beyond the scope of our experience, particularly in certain tolerances for welded products of the dimensions of this equipment.

This equipment, after shipment and installation with all the care that had been exercised by the various companies engaged at Oak Ridge, was contaminated by foreign matter, had to be taken out, returned to our plants, rebuilt with some additional fabricating development work being done, and returned.

The other particular contract which pertained to the processes of fission was for rotating pumping equipment for gases, electrically driven. On that work we were required to develop the apparatus, the design, as well as to manufacture, and we had to construct a plant in which to build the equipment. The difficulties I don't believe can be exaggerated. They drew on all the resources of the company, all of its personnel, all of its staff. I believe that for 8 months during

1944 our president probably took the job home to bed with him and woke up with it in the morning.

It involved the development of parts with surfaces, the accuracy and tolerance of which were measured in millionths of an inch, and the production of them by shop people in relatively large quantities. The basis of the design was worked out in laboratories with which we were not familiar. We were supplied initially with information, we understood, from Columbia and other places, perhaps some in Chicago, which was delivered to us, and we went on from there.

We have estimated at times that there must have been a corps of two or three hundred people in laboratories in different parts of the country supplying information regarding the results of the development we were carrying out. The job required the development of new welding, brazing, and soldering processes. It required repeated changes of material to get some parts that drew on the metallurgical knowledge of the country; to obtain metal parts that are accurate to tolerances measured in millionths of an inch and can be produced in a short time and be stable in operation. Some phases of metallurgy had to be learned as that job was carried forward.

There was a right-of-way for the company to obtain those services and to obtain material. There was complete freedom to make changes in material when it was necessary in order to get the job done.

The manufacture of this equipment required, in a large part of an appreciably large machine shop, maintenance of surgical cleanliness in connection with the work. The same problem of maintained cleanliness entered into the shipment of equipment; whether it could be shipped by truck, whether it could be shipped by railroad, whether it would have to be under temperature control. The erection and servicing of it at Oak Ridge required development there and the transfer of the knowledge from our shops and staff to groups there for maintaining and putting the equipment in service. This was a strain on everyone connected with this part of the project.

I believe, Senator, I have summarized the general conditions that pertained to these things. I want to assure you that I have not over-emphasized the difficulties that were experienced, the number of people that had to be drawn in to solve them—the complete staff of our company; we don't know how much of the staffs of steel mills and laboratories throughout the country were thrown into the work.

Senator AUSTIN. Mr. Brown, is it true that you were a trouble-shooter for operation of this machinery that Allis-Chalmers Co. produced after it was installed in Manhattan District at Oak Ridge, Tenn.?

Mr. BROWN. Yes, sir; during the manufacture, development, and the initial efforts to put the plant into operation.

Senator AUSTIN. In your work, are you at liberty to say what type of trouble you found down there with respect to machinery that had to be corrected generally? I don't care for details.

Mr. BROWN. Practically all of the trouble was diffusing knowledge, spreading knowledge out over people. There was failure to know how to maintain temperatures, to prevent corrosion, to start and stop things, to condition them properly before starting them up. We had learned some of it in our plants. It had to be transferred there. The

solution was undertaken by the sending of men who had been trained in our place, the sending of laboratory men, the staff of the Kellex Corp., and others to try quickly to extend this knowledge.

Senator AUSTIN. Speaking of the metallurgical side of the problem, did you find that you had to make material changes in the structure of this machinery, particularly the pumping equipment for gases after it had been installed at Oak Ridge?

Mr. BROWN. Yes, sir; it was started up with one material in one particular part that I recall. That material was changed even while they were operating—taking them out of service and changing them—more than once, and I think that the last of the units is being equipped with the final material now.

Senator AUSTIN. Did that process prolong the period required for the production of the bomb?

Mr. BROWN. Our knowledge was so limited, Senator, that I really cannot say as to that. That is, we didn't know what material our machinery was to handle. That had an advantage—it didn't let us diverge from curing the troubles with which we were faced.

Senator AUSTIN. Thank you.

Senator HART. Mr. Brown, in which of those two plants, the electromagnetic or the gas diffusion plant, as you now look back upon the history, did you have the greater difficulty in the production, looking back over the completion of the designs and the eventual supply of the apparatus?

Mr. BROWN. The greatest difficulty was that for the diffusion process.

Senator HART. Was that the pumps?

Mr. BROWN. Yes, sir.

Senator HART. Had anyone in this country ever made pumps that were as difficult to make and which were called upon for as hard a task as were those pumps?

Mr. BROWN. The general type of pump, Senator, was of known standards, but to suit it for this purpose it became different from anything that had ever been built, so far as I know, in the world. Certain parts and appurtenances were developed and applied to it that weren't in existence before, I believe.

Senator HART. The number of those pumps was great enough so that the production was decidedly a mass-production problem; is that correct?

Mr. BROWN. Yes, sir; that is correct.

Senator HART. Mr. Brown, in your long service with Allis-Chalmers, have you acquired much knowledge of the state of heavy industry in other countries?

Mr. BROWN. From time to time, I have, Senator, rising chiefly around circumstances or conditions in connection with our power-generating equipment, particularly.

Senator HART. Did your company, before the war, have representatives all over Europe, for instance?

Mr. BROWN. We had an office, as I recall, in London—a sales office, and also a sales office in Paris.

Senator HART. But that was for selling only?

Mr. BROWN. We had some arrangements for manufacturing our products in some European countries—I believe, France and England.

Senator HART. Did you, yourself, have much knowledge of what was going on in those offices or plants in Europe?

Mr. BROWN. No; not those particular plants. My European knowledge was based on visits to people regarding heavier types of apparatus.

Senator HART. I will ask you the same question I asked Mr. Winne.

To what circumstances do you ascribe the fact that the United States went so far ahead of the rest of the world in the production of heavy machinery, or all kinds of heavy industry?

Mr. BROWN. I can only answer for myself, Senator. I have an opinion, but I can't say that it coincides with that of my associates or my boss.

I think that this country has progressed industrially to the extent that it has because we primarily manufacture for our own use and under a system that enables a person with imagination or desire to meet a need or even create a need or change a desire into a necessity, such as has been done here with the automobile, the electric appliances, and everything like that.

Senator HART. Does that mean that it is altogether in your estimation a difference in markets, domestic markets?

Mr. BROWN. Again, may I repeat that I am expressing my own opinions and not those of my company.

Manufacture for export, of which we do a large amount in our company, involves such capital lay-out, credit arrangement, organization, and foreign connections that it doesn't enable someone with limited means, a good idea, and energy to meet or create demands for goods.

Manufacture for a home market enables a country industrializing itself, so I think, to create a need, by the reduction of prices, for its own equipment.

Senator HICKENLOOPER. In other words, Mr. Brown, we produce ample raw materials upon which to work, and we have an ample market for the genius of a free industry to operate, given the rewards of his effort?

Mr. BROWN. Yes, sir.

The CHAIRMAN. Mr. Brown, is any of the research that you use in your company done abroad?

Mr. BROWN. Well, we have some license agreements and some work within my experience where we have utilized research that was done abroad, engineering research particularly.

The CHAIRMAN. Out of what country did that arise?

Mr. BROWN. England primarily; they originated or developed the steam turbine. We have had consultants in Germany advising us on designs.

The CHAIRMAN. Switzerland?

Mr. BROWN. Yes, we have had connections with Switzerland which were quite close, in fact, at times.

The CHAIRMAN. Did you draw anything of benefit out of those connections in the way of improving your product?

Mr. Brown. Beyond question, I believe we did, Senator.

However, in dealing with licenses—take Switzerland for example—foreign licensors frequently want you under a license to do things exactly the way they do it. I don't believe most American companies do that when they have a license, and I know we do not.

The real benefit is shaded by the modifications we apply to such information and knowledge as we acquire from foreign sources.

The CHAIRMAN. Are there any further questions?

Thank you very much indeed, Mr. Brown.

The committee will now go into executive session.

(Whereupon, at 11:35 a. m., the committee retired into executive session.)

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ATOMIC ENERGY

HEARING

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

SECOND SESSION

PURSUANT TO

S. Res. 179

A RESOLUTION CREATING A SPECIAL COMMITTEE TO
INVESTIGATE PROBLEMS RELATING TO THE
DEVELOPMENT, USE, AND CONTROL
OF ATOMIC ENERGY

PART 4

JANUARY 24, 1946

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II

ATOMIC ENERGY

THURSDAY, JANUARY 24, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Byrd, Austin, Millikin, Hickenlooper, and Hart.

Also present: Senators Peter G. Gerry, Francis J. Myers, and Leverett Saltonstall; Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director of the committee.

The CHAIRMAN. The committee will come to order.

Admiral Blandy is appearing for the Navy this morning, to tell the committee about the proposed atomic bomb tests on some units of the fleet.

Will you proceed, Admiral?

STATEMENT OF VICE ADM. W. H. P. BLANDY, DEPUTY CHIEF OF NAVAL OPERATIONS FOR SPECIAL WEAPONS

Admiral BLANDY. Mr. Chairman, this statement is to describe the atomic bomb tests against naval vessels to be held this spring, in the Pacific. One of the most important problems in connection with these tests will be the maintenance of proper balance between public information and security. It is our hope to make available to science and to the public all appropriate information derived from this historic test.

By direction of the Joint Chiefs of Staff and with the approval of the President, the Army and Navy and qualified civilian scientists have been joined for this purpose to form a unit which is now known as Joint Task Force One, of which I have been named the commander. I desire to emphasize the fact that this is a joint effort in every sense of the word. My staff includes Maj. Gen. W. E. Kepner, United States Army Air Forces, deputy for aviation; Rear Adm. W. S. Parsons, United States Navy, deputy for technical direction; Maj. Gen. A. C. McAuliffe, Ground Forces adviser; Dr. R. A. Sawyer of the Manhattan district, technical director; Capt. J. A. Snackenber, United States Navy, chief of staff; Capt. R. Brodie, United States Navy, assistant chief of staff for personnel; Brig. Gen. T. J. Betts, United States Army, assistant chief of staff for intelligence; Capt.

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C. H. Lyman, United States Navy, assistant chief of staff for operations; and Brig. Gen. D. H. Blakelock, United States Army, assistant chief of staff for logistics.

All of these officers have had distinguished records during the recent war and are thoroughly qualified to serve in these respective capacities.

The chart entitled "Joint Task Force One Staff Organization" shows the general organization of the staff. I would like to call attention here to the Evaluation Board, which will be composed of two civilians, two officers from the Army, one of whom will be from the Army Air Forces, two officers from the Navy, one of whom will be an aviator, and one member, officer or civilian, from the Manhattan district. This board will be appointed by the Joint Chiefs of Staff, the nominations being made by the Secretaries of War and the Navy for the purpose of appraising the results of the test. That is, it will be the duty of my task force to collect all information, and the duty of this Evaluation Board, which is not under me but is directly under the Joint Chiefs of Staff, to evaluate or appraise the results.

I have a liaison with the commander of the Manhattan district, Maj. Gen. Leslie Groves, who has technical direction of my deputy task force commander for technical direction.

The rest of the chart I think is self-explanatory.

Admiral BLANDY. The mission of Joint Task Force One is primarily to determine the effects of the atomic bomb upon naval vessels in order to gain information of value to the national defense. The ultimate results of the tests so far as the Navy is concerned will be their translation into terms of United States sea power.

Secondary purposes are to afford training for Army Air Forces personnel in attack with the atomic bomb against ships and to determine the effect of the atomic bomb upon military installations and equipment, both air and ground.

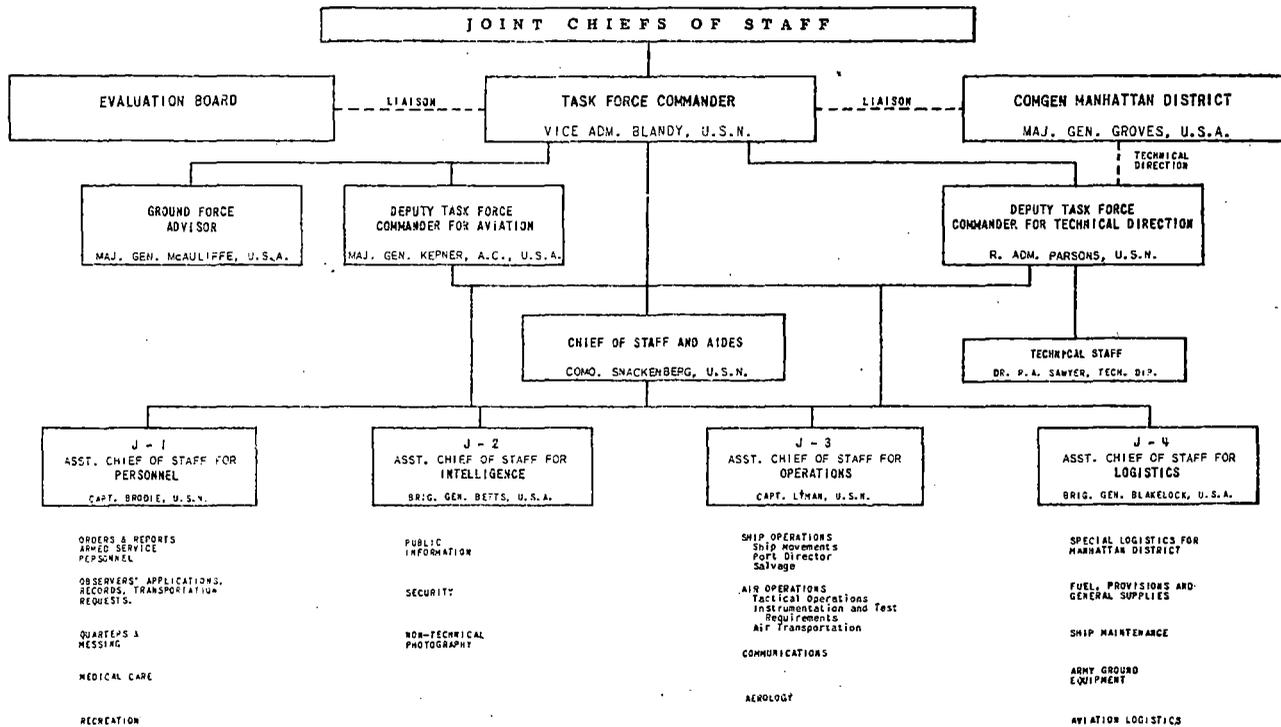
The Army Air Forces, in addition to making the actual air drop, will participate actively in the operation, with regard to air transport, collection of data, observation of results, and test of air force equipment. An Army Air Force general officer, Maj. Gen. W. E. Kepner, has been designated as deputy task force commander for aviation.

The Army Ground Forces will be given opportunity to test equipment, both on board the target ships and ashore. A general officer of the Army Ground Forces, Maj. Gen. A. C. McAuliffe, has been appointed special adviser to the task force commander for this purpose. The reason they will have equipment aboard the target ships is that it will not be possible to place the ships very close into shore, due to the shallow water in the location where the test will be held. Therefore, we will place tanks, artillery, vehicles, and so forth, of Army Ground Forces equipment on the decks of the ships to get them closer to the bomb.

The total strength of personnel of the joint task force will reach an aggregate of about 20,000, the naval crews of the operating and target ships constituting the majority.

I would like to show now the organization of the task force itself. There will be eight groups, task groups, under the task force commander. The first is the bomb and instrumentation group, which will include the bomb preparation unit and the instrumentation unit.

JOINT TASK FORCE ONE STAFF ORGANIZATION



(The chart referred to reads as follows:)

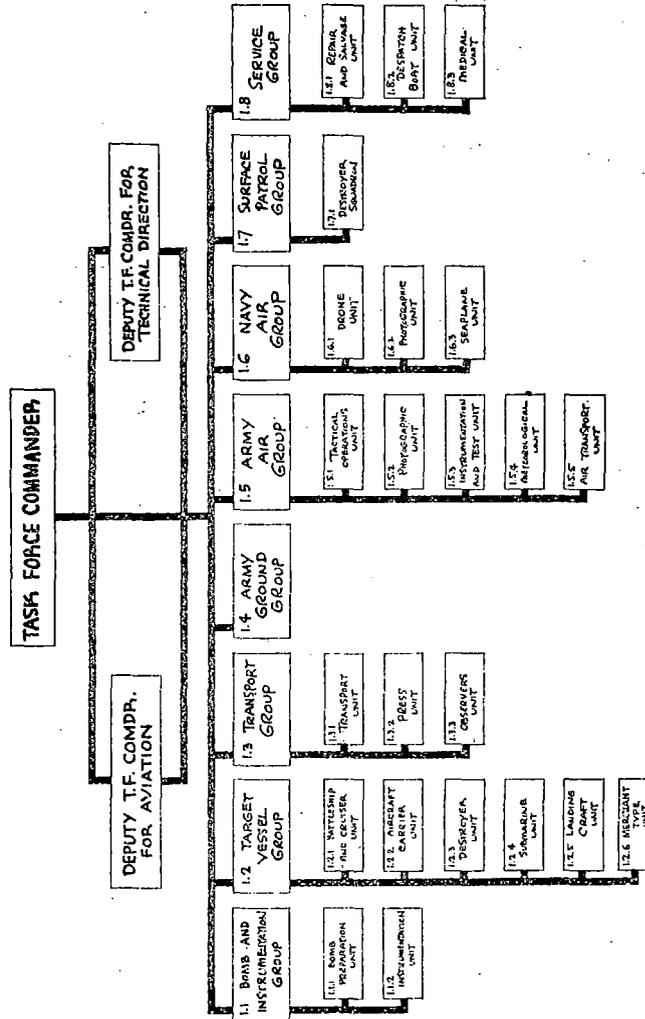
ATOMIC ENERGY

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That instrumentation unit will comprise several hundred personnel from the Manhattan district, the Bureaus of Ordnance and Ships of the Navy Department, and various personnel from the Army Ground Forces and Air Forces.

JOINT TASK FORCE ONE FORCE ORGANIZATION



The target vessel group—I will give the actual list of ships later—comprises a battleship and cruiser unit, an aircraft carrier unit, a destroyer unit, a submarine unit, a landing craft unit, and a merchant type unit. They are not merchant ships but are merchant type ships. They will actually be ships of the transport type in the Navy. I used that term to avoid confusion with the actual transport unit in the transport group.

The next is the transport group, which comprises the transport unit, which will take the crews off the target ships and house them until they can go back on board such ships as survive; the press unit, and observers unit.

The next is the Army ground group, having charge of the assembly and placing of the Army ground equipment.

The Army air group comprises a tactical operations unit, photographic unit, instrumentation and test unit, meteorological unit, and air transport unit.

Next is the Navy air group, with a drone unit, a photographic unit, and a seaplane unit. I will explain later what the drone unit is.

The surface patrol group includes a destroyer squadron, the duties of which will be principally to patrol the area to keep ships out of the area for their own protection, and also keep them away from contaminated water, water containing radioactive substances after the test as that water drifts westward, and last a service group, including a repair and salvage unit, a despatch boat unit, and a medical unit which will include two hospital ships for general purposes and also any need arising from the test itself.

The schedule of target dates for this operation, which will be known by the code word "CROSSROADS"—and I would like to explain that we have chosen that merely for brevity in dispatches and other communications, and we chose it with an eye to its possible significance—now calls for the first test to be accomplished early in May, over target ships at an altitude of several hundred feet.

The second test is tentatively scheduled for July 1, and will be a burst at the surface of the water among target ships.

I might say here that that second bomb is placed on the surface rather than under the water, because the scientific personnel assure us that it will create more damage on the surface than it will at the bottom, and we are seeking to obtain the maximum effect of the bomb. The reason for their belief is that they think that very high waves, possibly 100 feet in height from trough to crest, will be created by the explosion on the surface, whereas if it were placed under the surface it would throw a great deal of spray into the air and would not be deep enough to get proper tamping to get the full effect of the bomb.

As they state it, placing the bomb on the bottom would be equivalent to placing an ordinary naval mine containing a few hundred pounds of TNT in about 2 feet of water. In other words, this lagoon which is 30 fathoms deep would be only a shallow dish for the atomic bomb. They also expect in that surface shot to get blast effect and some underwater pressure and shock damage.

The site of the test will be Bikini Atoll in the Marshall Islands. A complete description of this site and of the problems in preparing for its use is now available. Bikini is approximately 4,000 miles from San Francisco, about 2,100 miles southwest of Pearl Harbor, and also about 2,000 miles from Tokyo, and about 1,400 miles east of Manila.

This chart [indicating] shows the location of Bikini in the Marshall Islands group. It is about 300 miles northwest of Kwajalein, which will be our operating base for such operations that cannot be performed at Bikini. For instance, it will be used as an Army air base, because there is no landing field at Bikini. It is 200 miles east

of Eniwetok, which will probably have to be abandoned temporarily for the test, because the general flow of both air and water is to the westward, and from the air shot the contaminated cloud can get over Eniwetok in a matter of a few hours, being only 200 miles away.

In the case of water travel, the current may carry the radioactive substance in the water to Eniwetok in a matter of days or weeks.

This chart [indicating] shows Bikini Atoll. The maximum depth is about 30 fathoms. This green area [indicating]—and this is copied from a Japanese chart—shows water which has been wire dragged by the Japanese to determine the exact location of coral heads which project upward from the bottom in all of these Pacific atolls. That being insufficient in this area, I am requesting that the entire eastern half of the lagoon be similarly surveyed, and we will probably have to blast out the coral heads in certain spots so as to get the ships exactly where we want them.

The list of ships which we plan to use for this test includes the battleships *Arkansas*, *New York*, *Nevada*, and *Pennsylvania*; the heavy cruisers *Pensacola* and *Salt Lake City*; the aircraft carriers *Saratoga* and *Independence*, the latter being one of the cruiser type aircraft carriers built on a light cruiser hull.

I won't name all of the destroyers, but there are 16 of them, 8 submarines, and the following captured enemy ships: The German heavy cruiser *Prinz Eugen*, the Japanese battleship *Nagato*, and the Japanese light cruiser *Sakawa*.

The total number of target ships is 97, the remaining ships which I have not named being transports, landing ships of the tank type (LST's), landing craft, infantry type (LCI's), landing craft tank type (LCT's), and smaller landing craft—LCM's and LCVP's—which means landing craft mechanized and landing craft for vehicles and personnel.

Some of the latter small boats and larger landing craft will be beached; some will be afloat.

The total operating ships in the force, exclusive of the target ships, will number about 50, so the entire force comprises about 150 ships.

The target ships will be anchored and placed in a manner calculated to give effects varying from probable destruction to negligible damage among the various ships of each type so as to determine the effect of the bomb on various ships at various distances. The target ships will, of course, be unmanned.

Observers will include representatives from the United States armed services, Members of Congress, press, and United States civilian scientific groups.

The question of inviting representatives of foreign nations and foreign news services is under discussion by the Joint Chiefs of Staff and the Secretaries of State, War, and Navy.

The staff of the deputy task force commander for technical direction, Rear Adm. W. S. Parsons, who reports also to Maj. Gen. Leslie R. Groves, United States Army, of the Manhattan district, will include officers and civilian scientists experienced with the atomic bomb. In this regard, Dr. N. E. Bradbury of the Los Alamos Laboratory is primarily concerned with the bomb itself and Col. Stafford Warren of the Manhattan district is organizing radiological measurements and prescribing safety factors. So far as the tight schedule permits,

use will be made of all modern scientific techniques and equipment to observe, measure, and record the effects of the bomb. For example, "drone" aircraft—they are unmanned, radio-controlled—will be used to obtain close-up recordings of radioactivity; automatic motion picture cameras will record the explosions visually from ingenious heavily shielded shelters on the island ring which surrounds the lagoon.

Adequate measures will be taken to insure the safety of the personnel engaged in the test, the observers, the inhabitants of nearby islands, and chance travelers by sea or air.

The CHAIRMAN. Admiral, how many miles is it across the lagoon?

Admiral BLANDY. The lagoon is 21 miles long from east to west, and a little more than half of that north to south. Observing ships will not be in that lagoon at the time of explosion. We will be well outside at a safe distance from the atoll.

Repair and salvage facilities will be provided to effect repairs to target ships after the first test, to make seaworthy such targets as are to be returned to the United States after the second test, and to destroy such as would be hazards to navigation.

I wish to emphasize that this undertaking is not a combined or international operation, but rather a scientific experiment by the United States Government alone.

Furthermore, it is a scientific test and not a contest between the armed forces.

A test contemplated for a later period is a deep-water test in the open sea. The technical difficulties in conducting such a test will not permit its accomplishment in 1946.

(Admiral Blandy submitted to the committee the following letter, which was made part of the record:)

DEPARTMENT OF THE INTERIOR,
FISH AND WILDLIFE SERVICE,
Washington 25, D. C., January 23, 1946.

Rear Adm. W. H. P. BLANDY, United States Navy,
Deputy Chief of Naval Operations,
Special Weapons Branch, Washington 25, D. C.

DEAR ADMIRAL BLANDY: In accordance with the suggestion of the Secretary of the Interior, November 21, and the cordial invitation of the Secretary of the Navy of December 14, 1945, for representatives of the Department of the Interior to present information and advice concerning the areas where tests of atomic bomb against naval vessels may be conducted with minimum injury to fishery resources, our representative designated in my letter of December 21, 1945, has reported to me the tentative site for the experiment which the Navy Department has selected.

We have considered the possible dangers to the fisheries from the atomic bomb experiment, and have reviewed all available information concerning the importance of the fish supply in the area during the period of the year in which the experiment will be conducted. I am now reporting to you our conclusions based on these considerations.

While there are many aspects of the problem concerned with the damages resulting from concussion, from wave action, and from the release of radioactive materials, on which little information is available at the present time, but which we understand will be fully investigated, special consideration was given to the possible total damages from all of these effects on the whale and tuna fisheries of the central Pacific.

The records indicate that the site of the experiment tentatively selected lies outside of the normal migration routes of whales in the Pacific Ocean, and that whaling interests, therefore, will not be affected by the explosion. Information regarding the tuna fishery is much more meager, since the exact spawning areas of the tuna are not known. But such information as is available from

scientific literature and from recent explorations by fishery experts indicates that the proposed site of the experiment is not in a critical area with respect to tuna propagation, nor does it lie in important migration or nursery areas of other valuable food fishes.

It is recognized that the explosion of the bomb at or beneath the surface of the ocean will undoubtedly kill all forms of life in an area which, with reference to the specific locality, would be regarded as large, but in comparison with the vast extent of the waters of the central Pacific, would be very small. Such local losses must be regarded as trifling compared with the value of the strategic and scientific information that will be secured.

We are convinced, therefore, that not only has an area for the experiment been chosen where the fisheries resources are negligible, or are only of extremely local importance, but that in view of the safeguards which will be employed the fisheries of the Pacific Ocean at large, and particularly those of our Pacific coast, will suffer no appreciable damage whatever from the undertaking.

Sincerely yours,

IRA N. GABRIELSON, *Director*

Senator JOHNSON. I have two or three questions which, if they should be in executive session, just skip, Admiral.

Will any ship be equipped with the normal supply of explosives?

Admiral BLANDY. I can answer that question, Senator. Practically all of the ships will be loaded with some ammunition, but not the full supply. We wish to obtain the effect of the bomb upon the magazines and ammunition contained therein, but if we placed one ship in the group entirely full of ammunition, and that ship were to windward of the others, the fire started by that ammunition and by oil from the ships would undoubtedly obliterate all visual evidence at the time of the test, so I think we can get the necessary information without the full amount.

In that connection I would like to invite attention to the fact that there being no crews on board these ships, having the ships entirely full of ammunition would be equally artificial with having them empty as regards ammunition, because many a ship during the war had magazine fires start, but with the crew on board they were able to extinguish those fires by flooding the magazine before the fire could spread to all magazines.

Senator JOHNSON. You say the vessels will not be manned. Will any form of life be used, such as goats or guinea pigs, or other animals?

Admiral BLANDY. That question is now under debate. Some of the scientific personnel hope that they can get all the information required from instruments placed on board the ship which would indicate what would happen to the crews of the ships.

Senator JOHNSON. Such as temperatures and other data?

Admiral BLANDY. Temperatures, radioactivity, and so forth. But, as I say, that question is still under discussion.

Senator JOHNSON. This next question may be an executive question. Will the test be made with the plutonium bomb or with uranium-235?

Admiral BLANDY. It will be the Nagasaki-type bomb.

Senator JOHNSON. That is all, Mr. Chairman.

The CHAIRMAN. Admiral, do you know what the size of the naval building program is for this spring?

Admiral BLANDY. I do not have that information currently, Senator. I have had no direct connection with that.

The CHAIRMAN. But the Navy is completing certain surface ships, is it not?

Admiral BLANDY. I believe that to be the case.

The CHAIRMAN. There are some members of the Naval Affairs Committee here at our invitation, and, of course, some of the members of the committee are members of the Naval Affairs Committee. Senator Byrd, is there any extensive naval program?

Senator BYRD. In our opinion, yes.

The CHAIRMAN. It hasn't been acted upon?

Senator BYRD. No.

The CHAIRMAN. If no Senator has any other question, we will have the session closed, as we will want to talk with you some more, Admiral, in executive session.

The committee will now go into executive session.

(Thereupon, at 10:30 a. m. the committee retired into executive session.)

X

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ATOMIC ENERGY

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

SECOND SESSION

PURSUANT TO

S. Res. 179

A RESOLUTION CREATING A SPECIAL COMMITTEE TO
INVESTIGATE PROBLEMS RELATING TO THE
DEVELOPMENT, USE, AND CONTROL
OF ATOMIC ENERGY

PART 5

FEBRUARY 15, 1946

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III

ATOMIC ENERGY

FRIDAY, FEBRUARY 15, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Byrd, Johnson, Austin, Millikin, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The hearing will come to order.

We have invited Major de Seversky to appear today. All of the members of the committee, I think, have read an article which he wrote and which was published in a magazine of extremely wide circulation bearing upon the effects of the atomic bomb. We have also invited here General Farrell, Dr. Philip Morrison, Col. Stafford Warren, and Mr. Nitze, vice chairman of the United States Strategic Bombing Survey, perhaps the most expert of the Government people who have assessed the bomb damage.

Now Major, I presume that you can go ahead.

STATEMENT OF MAJ. ALEXANDER P. DE SEVERSKY

Major DE SEVERSKY. I have not prepared any statement, because the committee asked me to come, presumably to ask me some questions with reference to my article in the Reader's Digest. The only thing I have brought with me is a copy of the manuscript of the article from which the condensation was made.

The CHAIRMAN. Do you care to give us for the record a brief condensation in your own words of this article?

Major DE SEVERSKY. Yes; I certainly can relate to you the observations of my trip to Hiroshima and Nagasaki where the atomic explosions had taken place.

I went down there at the direction of the Secretary of War as a special consultant to the Secretary of War to study the effect of air power in the Pacific theater of operations. It wasn't any detailed study.

The CHAIRMAN. When did you go?

Major DE SEVERSKY. I left on the 25th of September and I got back on the 15th of November. I spent about 6 weeks in the Pacific theater. I visited Guam, Tinian, Iwo Jima, Saipan. I flew about

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five times over Japan, back and forth, viewing practically all of the major cities of Japan from the air. I visited a score of cities on the ground. I flew about five times over Hiroshima and about five times over Nagasaki, because I was interested in certain aspects of the picture. I spent 2 days in Hiroshima, and 2 days in Nagasaki. Of course, that is not enough time to make a detailed study, but it was enough time to get a general picture, in view of my background and my previous experience. Just before that, I spent 5 months in Germany in the European theater of operation where I saw an awful lot of demolition of all sorts, and of course I saw some demolition even in the last war—World War I.

When the atomic bomb exploded I was in England. I was testing single-seater jet planes, because I was ready to go to the Pacific in a consultant capacity, particularly on that score. The reports that I read on the atomic explosions swept me off my feet, of course, as they would anybody else. I was very much interested to go and see what exactly happened out there. I am glad I went, because if I hadn't gone there I think I might have a distorted idea.

The picture that I drew from the usual information that was available to us through the press and radio was that the whole city was dissolved and went into dissolution in about one-millionth of a second and nothing was left but a crust of molten glass. But when I arrived out there, after seeing a great many other Japanese cities, the general appearance of Hiroshima—from the air at least—did not look any different from other Japanese cities that were burned out. Of course, the remarkable part of it is that it was done by one bomb, but I think the credit ought to be shared between the exceptional efficiency of the bomb and the exceptional flimsiness of the Japanese target.

I think it was very cleverly used at that particular point, because—using the military vernacular—it was the right force applied at the right time in the right place. I don't think that the same devastation and destruction would have occurred if the same bomb had been dropped in the same manner over a modern steel and concrete city.

Well, I conveyed this impression primarily because I felt that there was considerable misrepresentation and unwarranted hysteria going on in connection with what had happened or what could immediately happen. People began to feel as though the fission of hydrogen and oxygen might happen tomorrow; that our planet was going to be blown to pieces and therefore there was no use having any sort of defense, that we might just as well abolish all of our national-defense institutions, because the next war would be fought by a push button from some scientific laboratory. That was all talked about as though it were about to happen tomorrow, and that is the reason why I felt that I ought to convey my impressions as I saw them to make people realize that though the atomic bomb is a great development, a great achievement, it is not as fantastic as some or rather the majority of people imagined, and that we ought to keep our feet on the ground and approach the subject in a more sensible and cool way. This is the reason why I was prompted to write an article in the Reader's Digest.

This is, roughly, my statement as to my trip, what I saw, and the reason I wrote the article.

The CHAIRMAN. Now, do you care to highlight for us some of the statements of fact that you made in the article?

Major DE SEVERSKY. Is there any particular statement?

The CHAIRMAN. I will ask Senator Millikin.

Senator MILLIKIN. If I might, Mr. Chairman, I would like to ask a preliminary question.

Major, you have had a lot of experience with demolition and with demolition caused by bombs from airplanes. When that bomb lands and explodes, what are the physical forces that cause the demolition? I assume there is a blast.

Major DE SEVERSKY. Of course, there is a blast.

Senator MILLIKIN. Tell us about that in laymen's language.

Major DE SEVERSKY. Which bomb—just any bomb?

Senator MILLIKIN. Well, the B-29.

Major DE SEVERSKY. It depends on the bomb. If it is an incendiary bomb, it fires the substance; if it is a demolition bomb, there is a blast and heat. There is direct damage by the fragments, and of course the blast affects in a different manner different substances.

In the case of an atomic bomb, in addition to the blast and heat, there is also apparently some radioactivity, because the New Mexico experiment showed that there was.

Senator MILLIKIN. I am speaking now of the normal bomb intended to achieve destruction by blast and fragmentation. If you have that kind of bomb, aside from the damage done by fragmentation, you have damage done by blast, and possibly, I assume, by vacuum, suction and heat. Those things are measurable in terms of energy?

Major DE SEVERSKY. They certainly are.

Senator MILLIKIN. Could you say as a generality that you can translate the whole thing into terms of energy and force?

Major DE SEVERSKY. Well, it depends upon what you try to show. Yes; you can translate it into energy and force.

Senator MILLIKIN. And that is measurable, I assume, to men who are acquainted with the components of the bomb.

Major DE SEVERSKY. Unquestionably.

Senator MILLIKIN. Now, if you use a conventional bomb for demolition, you release a certain amount of energy, and the same thing happens, does it not, if you release an atomic bomb?

Major DE SEVERSKY. That is right.

Senator MILLIKIN. The atomic bomb, as you have mentioned, has some special features of its own.

Major DE SEVERSKY. That is right.

Senator MILLIKIN. By way of a particular kind of radiation, and not a particular kind of heat but, I assume, a very intensified heat over the normal bomb which is a part of the energy that is released. Would you go with me that far?

Major DE SEVERSKY. Yes, certainly.

Senator MILLIKIN. Now, in referring to this article in the Reader's Digest, I assume we are referring to the article of February 1946, called Atomic Bomb Hysteria. That is the article to which you are referring?

Major DE SEVERSKY. That is right.

Senator MILLIKIN. I have been very much interested in your statement which appears on page 121 of the issue of the Reader's Digest, and I quote:

It was my considered opinion, I told correspondents in Tokyo, that the effects of the atom bombs—not of future bombs, but of these two—

The two referred to, I assume, were the one on Hiroshima and the one on Nagasaki?

Major DE SEVERSKY. That is right.

Senator MILLIKIN (continuing to read):

had been widely exaggerated. If dropped on New York or Chicago, one of those bombs would have done no more damage than a 10-ton blockbuster; and the results in Hiroshima and Nagasaki could have been achieved by about 200 B-29's loaded with incendiaries, except that fewer Japanese would have been killed.

If you dropped an atomic bomb of the type used at Hiroshima and Nagasaki at the same level that you dropped the kind of normal bomb that you are speaking of, would the results be the same as you have mentioned here?

Major DE SEVERSKY. No. The probable results from the atomic bomb would be greater.

Senator MILLIKIN. Greater in proportion to the energy released?

Major DE SEVERSKY. Yes; provided energy was released in the proper direction. You can release the energy in the wrong direction, and you don't get any results.

Senator MILLIKIN. But I am assuming that we drop a normal bomb at X point at Y elevation and we drop an atomic bomb at the same point and same elevation. The damage, roughly speaking, would vary in proportion to the respective energies released; is that not correct?

Major DE SEVERSKY. Roughly; yes. But the result will not sometimes be even roughly the same.

Senator MILLIKIN. Now, would you be good enough to give us your calculations on which you assume that a 10-ton blockbuster, if dropped on New York or Chicago, would have done as much damage as at Nagasaki? Were you speaking here of the Nagasaki or the Hiroshima bomb?

Major DE SEVERSKY. I had spoken about both.

Senator MILLIKIN. Well, taking either one of them, would you mind giving us your calculations on which you have come to that conclusion?

Major DE SEVERSKY. I haven't made any calculations. It was my personal observation, based on experience. For example, we can ask an architect what is the dimension of this room. He probably can pretty well tell you within maybe 10 percent the length and width of this room. But if you want to know exactly, he has to bring in the instruments and measure it exactly to one millionth of an inch if you wish. That wasn't my purpose or my assignment. I am leaving such detailed study to the United States Strategic Bombing Survey, who are more expert in this field than I can consider myself. They worked in the field and undoubtedly will furnish us with the results that will leave no question as to the causes and effects.

My statement was based simply on my observations and my experience, just as I could say that this room perhaps is 25 or 30 feet wide, within a certain approximation. My purpose was primarily to show the American people that if an atomic bomb were dropped on New York or Chicago, these cities would not be wiped out to the ground completely and everybody in the cities be killed.

The CHAIRMAN. That isn't what you said, however, Major.

Major DE SEVERSKY. When I said it, I had in view one illustration I saw in one paper—whether American or English, I don't remember.

There was a circle drawn around New York that was similar in diameter to the devastated area of Hiroshimo and which took in Manhattan, Bronx, Brooklyn, the boroughs of Greater New York. The article said this area would be lying in complete ruin and devastation and not a single person would live.

Senator MILLIKIN. I am probing what you said, not what somebody else said—

Major DE SEVERSKY. I am leading to that.

Senator MILLIKIN. Let me complete my statement, please.

Major DE SEVERSKY. All right.

Senator MILLIKIN. You said that in your judgment a single bomb of the type that you describe dropped on New York or Chicago would loose the same amount.

Major DE SEVERSKY. In the same manner; yes.

Senator MILLIKIN. Now, you state that that is a matter of judgment and you illustrate that type of judgment by saying that a man can look at this room and approximate its dimensions. But to do that, at least to put it in terms of feet or some other unit of measurement, he must know by feet or units of measurement.

Major DE SEVERSKY. That is right.

Senator MILLIKIN. Now, therefore, I assume that you had made calculations from which you would produce a statement of that kind, and that is why I ask you for those calculations.

Major DE SEVERSKY. No; when the reporters asked me that question, I certainly didn't pull out my slide rule and pencil and begin to calculate. I told them exactly my rough impression of the thing, and I think it served the purpose perfectly, because if some newspaper asked me if it were true that the Atomic Committee hearings were held in a room 10 miles wide and 50 miles long, I might say, "No; I don't think so." I might say, "It is about 50 feet wide and maybe 100 feet long," which is roughly twice its size.

Now, I might have made a mistake, but that certainly is nearer to the truth than stating that the room was 50 miles long and 20 miles wide; and it is the latter kind of exaggeration that I tried to correct. Somebody said that the atomic bomb was 20,000 times more powerful in its destructiveness than a single blockbuster. I don't agree with that.

Senator MILLIKIN. Wasn't the statement made that it is 20,000 times more than certain units of TNT? Hasn't that been the statement?

Major DE SEVERSKY. As I remember the statement, it was 20,000 times more powerful than one of our blockbusters.

Senator MILLIKIN. Major, again I would like to come back to the fact that I am not questioning someone who has said something except Major de Seversky. I am just trying to check Major de Seversky as to what he has said.

It is fair to summarize your statement here that one 10-ton blockbuster would do the same amount of damage in New York or Chicago as a mere matter of judgment on your part, unsupported by calculations?

Major DE SEVERSKY. Yes, sir; for a man of my experience in observing of demolition over long periods of time, I think it is fair. But if the committee later on will want to have any more accurate substantiation of my statement, I am perfectly willing to furnish it. If my calculations are going to show that it is equal not to one or two or three blockbusters, I still feel I was perfectly right in making the statement.

Senator MILLIKIN. Do you challenge, Major, the estimates of the various scientists as to the proportion of this power in relation to normal TNT power? Do you challenge that?

Major DE SEVERSKY. Of course not.

Senator MILLIKIN. You think they are correct in that?

Major DE SEVERSKY. Why, certainly.

Senator MILLIKIN. Would the application of that proportion to an atomic bomb dropped at the same place, at the same elevation, as against a normal bomb of the type that you describe dropped at the same place and same elevation bring you to the answer of 200 B-29's?

Major DE SEVERSKY. Well, that is an entirely different thing. When I talked about fire effect, I said that Hiroshima could have been burned in the same fashion as it was burned by a single atomic bomb by a raid of 200 B-29's loaded with incendiaries.

Senator MILLIKIN. Then you intended in that statement to limit your comparison to the incendiary effects, but not the general demolition effects?

Major DE SEVERSKY. Well, I think if out of these 200 B-29's 50 were loaded with high explosives and pin pointed on the main section of Hiroshima, which still stands intact, I think they could have done even a better job.

Senator MILLIKIN. If you are speaking in terms of fire, don't you believe that an atomic bomb, if the amount of heat attributed to it is correct, would do infinitely more damage in terms of fire if it were dropped on New York or Chicago than a single 10-ton blockbuster?

Major DE SEVERSKY. Well, it depends where it would have exploded. It depends on the altitude at which this bomb exploded. If it exploded at the same altitude as it exploded over Hiroshima, I don't think the fire hazard directly from the bomb would be very great.

I visited all the tall buildings in Hiroshima, and I found the paint on the railings and wooden doors of those penthouses was not even scorched. I saw a great many fragile objects. I saw sirens painted with silver paint which wasn't scorched. The appearance of the roofs of those high buildings in Hiroshima and some in Nagasaki, as far as I could see—and I have pictures of them which you may be willing to see later on, colored photographs that I took of those details—did not show to me any particularly high temperature.

Senator MILLIKIN. Well, in terms of comparison of temperature, if you released a 10-ton blockbuster at the same altitude that the Hiroshima and Nagasaki bombs were released, what would be the effect of these on large cities of the type you are speaking of, New York and Chicago?

Major DE SEVERSKY. I don't think you interpret my statement exactly right. What I tried to compare was the atomic bomb as it exploded over Hiroshima with a direct hit of a blockbuster.

Senator MILLIKIN. To your mind, is that a fair comparison?

Major DE SEVERSKY. Yes, it is. I am not comparing the weapons: I am comparing the results. I was trying to transplant the results of what had happened in Hiroshima if that bomb exploded in Chicago or New York in the same manner; it would not produce any more damage, or approximately the same damage, as a 10-ton blockbuster which scored a direct hit on a section of Chicago.

Senator MILLIKIN. Yes, Major, but would there have been any damage at all had you released a 10-ton blockbuster at the same altitude?

Major DE SEVERSKY. There would be some blast effect.

Senator MILLIKIN. What was the altitude of release at Hiroshima and Nagasaki?

The CHAIRMAN. That is secret.

Senator MILLIKIN. It was a considerable altitude, was it not?

Major DE SEVERSKY. It must have been. In New Mexico, where all the tests were conducted as in a laboratory, the scientists and engineers certainly had a very wonderful opportunity to measure all the forces, temperature, and everything else, so they could not be very much mistaken as to what actually takes place when the bomb explodes. The discrepancy between the two results is due to the fact that the bomb in Japan exploded much higher than it exploded in New Mexico, and apparently as in any explosion the results are dependent on the distance at which the explosion takes place.

Senator MILLIKIN. Just for our information, let's put the thing on a comparable basis, and I will guess some altitudes. Let us suppose that you exploded an atomic bomb of the type we are talking about at 3,000 feet in the air, and you exploded a 10-ton blockbuster at 3,000 feet in the air. What would be the respective effects?

Major DE SEVERSKY. Well, the atomic bomb will be immeasurably more powerful.

Senator MILLIKIN. Let us bring it down to the surface of the earth. Let us suppose you explode a 10-ton blockbuster in the heavier part of lower Manhattan, and at the same point you explode the type of atomic weapon that we are talking about. What would be the proportions of destructive energy released by the two weapons?

Major DE SEVERSKY. Well, the energy would be released exactly as it was calculated, but the effect on the target depends on the nature of the target. It is quite different whether you release this energy within a flimsy half-dry-rotted Japanese village or release the same energy within a steel and concrete city. The difference in one case in actual damage would be perhaps 200 times more or 500 times more; it all depends on how you are going to measure the results—in the number of dwellings or buildings destroyed, in area, in people killed.

Senator MILLIKIN. You have gotten away from my point, Major. I am not talking about two things that are not analogous. I am trying to bring the two bombs to the same spot in lower Manhattan. Would you challenge the statements that have been made as to destructive energy released from the one type of bomb against the other?

Major DE SEVERSKY. Of course not.

Senator MILLIKIN. So that this 200 B-29 statement of yours relates, on the one hand, to destruction of a city of the type of Hiroshima or Nagasaki?

Major DE SEVERSKY. That is right.

Senator MILLIKIN. And you are making a comparison of that with the heavy construction of a city of the type of New York or Chicago. Does that appear to you as a logical basis for making comparisons?

Major DE SEVERSKY. Those are two entirely different statements.

Senator MILLIKIN. I don't want to pursue anything that I have made any mistake about myself. [Reading from Major de Seversky's article in the Reader's Digest:]

I told correspondents in Tokyo, that the effects of the atom bombs—*not of future bombs but of these two*—had been wildly exaggerated. If dropped on New York or Chicago, one of those bombs would have done no more damage than a 10-ton blockbuster—

Major DE SEVERSKY. That is one statement.

Senator MILLIKIN. Then you go on to say:

and the results in Hiroshima and Nagasaki could have been achieved by about 200 B-29's loaded with incendiaries—

Major DE SEVERSKY. No, that is not all—there is something else.

Senator MILLIKIN (continuing to read):

except that fewer Japanese would have been killed.

Major DE SEVERSKY. In other words, the atomic bomb; as far as the loss of life is concerned, is infinitely more destructive than the ordinary bomb.

Senator MILLIKIN. Now we have got two things we are talking about. We are talking about the incendiary effect of the type of bomb at Hiroshima and Nagasaki. That is one thing. We are talking about the effect of two types of bombs dropped on Chicago or New York.

Major DE SEVERSKY. In other words, one is demolition action—that is one statement; and then I compare it with Chicago and New York. But the incendiary action, I compare with 200 B-29's in Nagasaki and Hiroshima. Those are two different statements.

Senator MILLIKIN. Let us put our minds solely on the heavy structures such as we find in Chicago or lower Manhattan. What is the basis of your calculation, assuming that the atomic bomb and the 10-ton blockbuster are dropped at the same place and from the same elevation? What is the basis for your statement that one bomb would produce as much damage, one blockbuster would produce as much damage as the atomic bomb?

Major DE SEVERSKY. I didn't say it produces more.

Senator MILLIKIN. I quote:

If dropped on New York or Chicago, one of those bombs would have done no more damage than a 10-ton blockbuster.

Major DE SEVERSKY. I just simply want to be accurate. I didn't say more; I said "no more." It means about the same; it doesn't mean more.

Senator MILLIKIN. Well, it says very clearly—

If dropped on New York or Chicago, one of those bombs—
that is one atomic bomb?

Major DE SEVERSKY. That is right.

Senator MILLIKIN (continuing to read).

would have done no more damage than a 10-ton blockbuster.

Major DE SEVERSKY. That is right. It doesn't mean the 10-ton block-buster produces any more, but "no more" means about the same, doesn't it?

Senator MILLIKIN. Would you tell us the relative amount of damage that would happen if you dropped an atomic bomb on New York or Chicago, or if you dropped a 10-ton blockbuster?

Major DE SEVERSKY. Do you want me to speculate? In the article I was comparing the damage results of the atomic bomb as it was dropped, to the damage results of a TNT blockbuster's direct hit. But I am perfectly willing to speculate because I don't think I will be too far off. It again depends upon what part of New York it will be dropped—whether it will be dropped in the midst of steel and concrete buildings, or not.

In view of what I saw in Hiroshima and Nagasaki, and particularly in Hiroshima where whole buildings were standing perfectly upright and had very little structural damage, and provided both bombs exploded down below, scoring direct hits, so to speak, I think that the damage from the atomic bomb will be only slightly more than that of a blockbuster. It probably will shatter glass and will bring down some of the brick buildings within a greater distance than the TNT bomb, but I think the blast in that case will be localized by other tall buildings, so the damage will be local and not as widespread as it was in Hiroshima.

Certainly, if the atomic bomb dropped in Hiroshima exploded in the same manner over New York or Chicago, it would not wipe out New York or Chicago. We would have to drop a great many atomic bombs of the same kind in the same manner before we could wipe out New York or Chicago. That is my opinion.

Senator MILLIKIN. When you say "if dropped on New York or Chicago, one of those bombs would have done no more damage than a 10-ton blockbuster," you were assuming that the blockbuster would be exploded at the normal place where a blockbuster is exploded, and you were assuming that for that purpose the atomic bomb would be exploded up in the air as it was at Hiroshima and Nagasaki?

Major DE SEVERSKY. Exactly, because we never explode TNT bombs 2,000 feet in the air.

Senator MILLIKIN. Of course you don't.

Major DE SEVERSKY. Naturally those were ordinary actions that I assumed everybody would take for granted.

Senator MILLIKIN. Let me ask you again whether you consider a statement of this kind going out as a fair analogy when on the one hand you drop a blockbuster at the place it is normally dropped, and on the other hand you are making a comparison with a bomb that is exploded very high up in the air over an entirely different kind of target?

Major DE SEVERSKY. It is not an analysis. That is the whole difference. I have been testifying here that my article was not written to give any detailed analysis. It was to calm down the hysteria that was unwarrantedly spreading all over our land. I tried to counteract that hysteria and to answer the claims and information that did not come from any official sources, but was spread all over our land by

some pseudo-scientists who had not even been within 5,000 miles of Hiroshima and Nagasaki. The statements I made were intended to show by way of illustration that in my candid opinion if that bomb exploded the way it did in Hiroshima and Nagasaki over one of our big cities, it wouldn't have done very much more damage than the damage caused by a direct hit by one of our TNT blockbusters. In other words, it would not wipe out New York or Chicago in the same manner as it wiped out Hiroshima and Nagasaki. That was the purpose. It was not an analysis. It was my personal impression as I saw things, and conclusions I drew from my observations.

Senator MILLIKIN. Let me take you to what perhaps will be an analogous comparison between the effect on a heavy structure area of a large city like Chicago or New York between the explosion of the atomic bomb and the explosion of a 10-ton blockbuster. Let's come back now to my suggestion that we put them both at the same place.

Now, how many blockbusters would you say would be required to achieve the same effect as might be expected from the Hiroshima or Nagasaki bomb?

Major DE SEVERSKY. Well, it is very complicated and an ambiguous subject, because it depends on the kind of target, the disposition of the target, and a great many other conditions which really have to be analyzed and investigated. I think you are going to get a much better answer if you ask some of your specialists, like some of the United States Strategic Bomb Survey people who I think are more capable of giving you a better answer than I could give you offhand.

Senator MILLIKIN. Then may I summarize the effect of your testimony, that you did not intend in your article to make any comparison between a 10-ton blockbuster dropped in a heavy structure city of the type we are talking of and an atomic bomb dropped at the same point?

Major DE SEVERSKY. No, of course not.

Senator HART. Major, your article begins with a statement in which you say that you conveyed your professional findings to the Secretary of War. In view of your answers to Senator Millikin, may I ask you what you consider your profession to be in that regard?

Major DE SEVERSKY. I am an aeronautical engineer, and like any aeronautical engineer, I have a certain amount of understanding of structures. I devoted all my life as a military man to the tactics and strategy of aerial warfare. I deal in the realm of aeronautics and perhaps armament.

As you perhaps know, I designed the first automatic bombsight, and have a basic patent on this device.

Senator HART. May I interrupt you, Major. I do not mean to carry you so far in that. Actually that bombsight was not adopted, was it?

Major DE SEVERSKY. Well, it was adopted by the United States Army. The order was placed.

Senator HART. But not built?

Major DE SEVERSKY. It was built.

Senator HART. But it did not go into production, did it?

Major DE SEVERSKY. No.

Senator HART. Well, I did not wish to go so far afield as that, Major.

Later in your article you said you conveyed to the country that the bomb over Nagasaki was only one-fourth as effective as the one which

was dropped over Hiroshima. Can you tell the committee what it was that you based that statement on?

Major DE SEVERSKY. Simply by measuring the actual area of destruction between the two.

Senator HART. Did you make those observations from the air only?

Major DE SEVERSKY. No; from the ground, too.

Senator HART. Then your statement is that instead of destruction about 2 miles on a side as was the case at Hiroshima, the destruction at Nagasaki was only 1 mile on a side?

Major DE SEVERSKY. Those figures I used were official figures furnished to me by the Air Forces.

Senator HART. Furnished you by the Air Forces?

Major DE SEVERSKY. Yes, sir.

Senator HART. And it was on that alone that you sent this statement out over the country that the bomb at Nagasaki was only one-fourth as effective?

Major DE SEVERSKY. Yes.

Senator HART. You said that measuring by the area of destruction in Nagasaki, the area destroyed in Nagasaki was roughly on the basis of those figures, one-quarter of the area destroyed in Hiroshima. May I ask if you have examined the official reports on the subject and find yourself in concurrence and find they are in concurrence with what you say?

Major DE SEVERSKY. Which reports, Senator?

Senator HART. That comparison as between the area in Hiroshima and in Nagasaki. Do the official reports on the subject bear out your statement?

Major DE SEVERSKY. You didn't see any reports before my statement? Were any reports made before my statement outside of those furnished by the Strategic Air Forces?

Senator HART. Well, before or since, I don't know.

Major DE SEVERSKY. No, I haven't seen anything different as to the size of the devastated area of those towns.

Senator HART. Then what you obtained from the Army Air Forces was not the official figure, you mean?

Major DE SEVERSKY. I don't understand.

Senator HART. You mean to say, Major, you based that statement on data which you obtained from the Army Air Force officers?

Major DE SEVERSKY. It was published in all the papers. It was available.

The CHAIRMAN. Major, you said that you were somewhat surprised at the fact that 15 concrete buildings—I think there were some 15—were still standing in the Nagasaki square mile of main damage. Now, was there any damage done to those buildings?

Major DE SEVERSKY. Yes, there was some damage. As a matter of fact, damage in Nagasaki to concrete buildings was perhaps somewhat greater, I think, than in Hiroshima.

The CHAIRMAN. General Groves has testified before the committee that—

The effects of the explosion in the industrial area were probably more spectacular and startling than Hiroshima; for example, the complete destruction of the huge steel works by blast and fire, and the destruction of the torpedo works by blast alone. Within a radius of 2,000 feet from the point of detonation,

heavy industrial buildings, gas storage tanks, and many reinforced concrete structures were destroyed. The steel frames in all buildings in all cases were pushed away from the point of detonation.¹

Do you agree with that statement?

Major DE SEVERSKY. Well, I wouldn't say that all of them were pushed away in the same direction from the point of the explosion. Some of them, as I remember now, did not follow the same direction. As far as the steel plant is concerned, I didn't see anything remarkable in its appearance. A great many Japanese plants looked exactly like that after they were bombed by high explosives and then consumed by fire.

The CHAIRMEN. Of course, this was one bomb, Major, wasn't it— one atomic bomb?

Major DE SEVERSKY. No; the steel plant was bombed by General Kenny's Air Force 6 days before the atomic bombing with eight direct hits on that plant.

The CHAIRMAN. I see. [Reading:]

For a radius of 8,000 feet, Japanese workers' homes were completely demolished. Up to a radius of 2 miles, workers' homes had collapsed; roofs and walls were smashed, but were left partly standing except in isolated cases where exceptional shielding was given by local topography.²

Do you agree with that statement?

Major DE SEVERSKY. Well, some parts of Nagasaki had wooden houses I think much closer than 2 miles with no damage. That is immediately south of the steel plant. I don't think that distance is 2 miles; I think it is about a mile. There are whole sections of Nagasaki only a mile from the center of the explosion which remained intact; even those flimsy wooden houses were intact.

The CHAIRMAN. Is it your contention that the atomic bomb dropped, we will say, in the Wall Street area would do no more damage than one blockbuster?

Major DE SEVERSKY. It depends on how it is going to be dropped.

The CHAIRMAN. You didn't say that in your article, though, did you?

Major DE SEVERSKY. No; on the contrary, I think it is clear throughout the article that I am comparing the damage that might have been done by the atom bomb, as it exploded in Hiroshima, with a direct hit by a blockbuster. I have repeated it here time and time again, but I couldn't repeat it in every paragraph of my article. If I did, it would not be a good article. No one would read it.

The CHAIRMAN. There is only one way to drop a blockbuster, and that is the way it is being dropped now?

Major DE SEVERSKY. That is right.

The CHAIRMAN. Assume one blockbuster dropped in the traditional way were dropped in the Wall Street district in New York. Is it your contention now that it would do no more damage than an atomic bomb dropped as one was at Hiroshima?

Major DE SEVERSKY. The material damage to steel and concrete buildings would not be greater, but the loss of life might be greater due to gamma rays.

The CHAIRMAN. But the property damage would be no greater in your opinion?

¹ See statement of Maj. Gen. L. R. Groves, pt. 1 of the hearings on atomic energy, p. 33.

² Ibid.

Major DE SEVERSKY. Well, roughly not. If I am mistaken, it may be that the atomic bomb would do more damage, but judging from the condition of buildings in Hiroshima, I doubt it.

The CHAIRMAN. There would be no greater blast?

Major DE SEVERSKY. I think I mentioned that the glass, for example, would be blown out over a wide area, because if the blast in Hiroshima was able to knock out panels in the hospital nearly a mile away, there is no reason why the glass in New York would not be blown out 1 mile away, too. That phenomena would take place unless the propagation of the blast is impeded by a series of tall buildings which would probably localize the blast a little bit more. So, if in Hiroshima the glass was blown out 1 mile away, in New York, if the explosion is shielded by tall buildings, the blast effects may be limited to half a mile.

The CHAIRMAN. Now, you stated in your article that if the temperature of an atomic bomb is superhigh, then the heat must have been dissipated in space.

I believe that was the statement you made in the article.

Major DE SEVERSKY. Not, exactly; no. I think I said that apparently they exploded so high that the effect of this heat had been diminished, or something to that effect.

The CHAIRMAN. Do you know Maj. Gen. J. F. C. Fuller, the English general who was supposed to be an expert on ordnance?

Major DE SEVERSKY. Well, I have heard of him.

The CHAIRMAN. Have you, by any chance, read his article, "The Age of Annihilation," in the Army Ordnance magazine for January and February?

Major DE SEVERSKY. No; I did not.

The CHAIRMAN. In it, he makes this statement:

We have also been told: "Theoretically, provided it can be manufactured in sufficient quantity, the atomic bomb has multiplied the destructive power of the American bomber fleets about 3,000 times."³

Do you agree with that?

Major DE SEVERSKY. Providing it can be done?

The CHAIRMAN. Providing you can manufacture enough atomic bombs, the Air Force as it was constituted on VJ-day could have done 3,000 times more damage equipped with atomic bombs than with blockbusters.

Major DE SEVERSKY. Well, of course, I cannot answer precisely his figures. There is no question that the atomic bomb would enhance the power of our Air Forces a great many times.

The CHAIRMAN. He goes on to say:

"Equipped with the new weapon, a fleet of 800 Superfortresses such as recently raided Japan would have the blasting effect of 2,500,000 such airplanes carrying TNT."

Eight hundred equipped with atomic bombs, such as dropped on Nagasaki, could do as much damage as 2,500,000 airplanes loaded with blockbusters.

Major DE SEVERSKY. If he calculated that, probably his figures are correct, provided his assumptions are correct.

³ See the January-February 1946 issue of the magazine entitled "Army Ordnance," the official journal of the Army Ordnance Association, a society of American industrialists and engineers; published in Washington, D. C.

The CHAIRMAN. That would be rather inconsistent with your statement that one blockbuster would do more damage in New York than one atomic bomb.

Major DE SEVERSKY. I don't see any inconsistency. You cannot take those figures and divide and multiply them. You cannot use plain arithmetic. There is a cumulative effect of a raid, too, which ought to be taken into consideration. Very often two bombs, dropped simultaneously on the target, do damage equal to that of three or four dropped separately, one by one. There are a great many factors entering into this business of demolition.

The CHAIRMAN. The blockbuster emits no lethal rays of any kind, does it?

Major DE SEVERSKY. No, it does not.

The CHAIRMAN. Now, the atomic bomb does, doesn't it?

Major DE SEVERSKY. So I understand.

The CHAIRMAN. And many people were killed in Nagasaki and Hiroshima by the rays?

Major DE SEVERSKY. Yes.

The CHAIRMAN. That is true, isn't it?

Major DE SEVERSKY. Apparently. I came evidently too late to see any victims. I couldn't find any but one, I think, but there is no reason for doubting that it does take place, because the experiment in New Mexico certainly proved beyond doubt that there is.

The CHAIRMAN. But in the article you state that the radiation burns were rare. I believe you pointed out that the radioactivity after the blast was not of a dangerous sort, but in any event you stated that the deaths caused by radiation were very rare, in this article.

Now, you have no foundation in fact for that statement, have you?

Major DE SEVERSKY. Well, I would rather you read my unabridged statement to that effect.

The CHAIRMAN. Unfortunately 15,000,000 have read the condensation.

Major DE SEVERSKY. I will stand by what that article states.

The CHAIRMAN. But the testimony before this committee has been, as I recollect it, that thousands of people were killed by burns.

Major DE SEVERSKY. If they were, then apparently the witnesses whom I interrogated did not furnish me with the right information. I personally visited the hospital in Hiroshima. I talked to the Japanese doctors, and they couldn't give me any information that would indicate such fact. Maybe I came too late, but I was looking for the victims, and I couldn't find any.

But, as I say, radioactivity is something that is completely beyond my sphere of specialized knowledge, and I have to abide by the experiment in New Mexico and the findings there as to the actual phenomena that takes place in an atomic explosion, which is good enough for me.

The CHAIRMAN. Now, Major, I think that you did emphasize in your article, and I think it is fortunate that you did, that you were talking about present-type bombs and were not attempting to project into the future any improvements that might possibly be made, if you want to call them improvements, over the atomic bomb.

Major DE SEVERSKY. Of course, this thing is in the same stage that aviation was at Kitty Hawk.

The CHAIRMAN. Do you believe that?

Major DE SEVERSKY. Absolutely.

The CHAIRMAN. It is your belief that the bombs that we have now are to future bombs as the Kitty Hawk plane was to the 700-mile-an-hour plane that we have today?

Major DE SEVERSKY. Well, yes. I would like even to use the words of the group of scientists in Chicago who sort of challenged my statement. They said that Major de Seversky ought to remember that the Hiroshima and Nagasaki atomic bombs are firecrackers in comparison to the future bombs. That is exactly what I intended to show.

The CHAIRMAN. Any further questions?

Senator JOHNSON. I have some questions.

Major, first I want to say this: I am very much interested, and I think this committee will be, in a comparison between the Nagasaki bomb and the Hiroshima bomb. I think that is a very important point, especially in a study of the production of atomic energy.

Did I understand you to say that the Nagasaki bomb's effectiveness was only one-fourth that of the Hiroshima bomb?

Major DE SEVERSKY. Judging by the area of destruction.

Senator JOHNSON. And the Nagasaki bomb's effectiveness was retarded by the physical conditions, was it not—the mountains?

Major DE SEVERSKY. In two directions, yes. In another direction, south, it wasn't particularly impeded.

Senator JOHNSON. Do you think that the Nagasaki bomb was less effective than the Hiroshima bomb?

Major DE SEVERSKY. Judging by the area of destruction, my impression was yes.

Senator JOHNSON. I notice that writers have said that the Nagasaki bomb made the Hiroshima bomb obsolete.

Major DE SEVERSKY. Who said that?

Senator JOHNSON. Well, several writers. I have seen it published several times.

Major DE SEVERSKY. What does it mean?

Senator JOHNSON. Well, it means a great deal to this committee.

Major DE SEVERSKY. What does it mean, "made obsolete"?

Senator JOHNSON. Well, it seems that the Nagasaki bomb was so superior to the Hiroshima bomb that the Hiroshima bomb was already obsolete.

Major DE SEVERSKY. I think that these writers who wrote were interpreting the official information that was supplied to them without realizing what they were saying. I am sure what they were trying to say when they said "superior" is that the design and construction of the bomb itself and the method of explosion and detonation were improved, and therefore the bomb dropped in Nagasaki was a great deal superior to the one that was dropped at Hiroshima, and for these reasons it made the Hiroshima bomb obsolete.

Senator JOHNSON. I think that the opposite is true. I think they meant the effectiveness of the two bombs, and as I understand it, from what little information we have been able to get on the point from witnesses, the Nagasaki is much more difficult to detonate than the Hiroshima bomb. The Hiroshima bomb is much easier to handle than the Nagasaki bomb, but the Nagasaki bomb is so much more effective when it is detonated. That is a very important point to this committee. One reason I might give is that in the tests that are to

be made, the naval tests, the Nagasaki type of bomb is to be used, and then there is a very important point which I don't care to go into now in the production of the two bombs, an extremely important point, and, of course, if we were making atomic bombs, we would want the most effective bomb.

Major DE SEVERSKY. In that case I would recommend that you take the opinion of the scientists and engineers who make the bomb, because they certainly have a better knowledge of which bomb is better. The only thing I have stated about the difference between the two atomic bombs can be read in my statement. Mind you, I am not challenging any official statement: I am challenging the statements of unofficial sources spread around. That is what I am challenging.

Senator JOHNSON. I am not challenging you or anybody else. It was said that the Nagasaki bomb was many times—I read somewhere it was 100 times—more powerful than the Hiroshima. I read it in the paper.

Major DE SEVERSKY. When I got there and got the figures of the square mileage that was destroyed, I found that the actual area of destruction in Nagasaki was about one-fourth that of Hiroshima, and that approximately coincided with the figures supplied by the Air Forces. If the figures I used, on which I based my conclusions, are wrong, my conclusions are obviously wrong.

Senator JOHNSON. Well, from what you say and from what you saw of the effectiveness of the two bombs, comparing the effectiveness of the two bombs, if you were undertaking a naval experiment, which bomb would you use?

Major DE SEVERSKY. I would use the one that is considered to be the more efficient.

Senator JOHNSON. Well, judging the effectiveness only from what you saw there, which one would you use?

Major DE SEVERSKY. Well, if you are asking me the question, I would like to give you my opinion.

Senator JOHNSON. I would like to have your opinion on it because it is an important point.

Major DE SEVERSKY. In the first place my belief is that neither the Nagasaki nor the Hiroshima bombs will sink battleships if they explode in the same manner as they exploded when used at Hiroshima and Nagasaki. Under those conditions I do not think that very much damage will be done to a battleship.

Senator JOHNSON. From either one?

Major DE SEVERSKY. From either one. I mean, as far as material damage is concerned; as far as radioactivity is concerned, speculation on that point I leave to the experts.

No one can accuse me of particular fondness for battleships, but I still think that the battleship, under those circumstances, will survive the atomic bomb.

Of course, if the bomb scores a direct hit, it will probably destroy the battleship, but so will also one of the ordinary bombs of the proper size. It also will destroy a battleship if there is a direct hit. As you know, quite a few battleships were sunk in that manner during the last war.

The only thing, in my opinion, that would be of particular interest is the detonation of the bomb under water. That, of course, might

produce all sorts of effects which are open to speculation. But, as far as dropping the atomic bomb above the fleet—well, I want to repeat that the ordinary bomb, properly designed for that purpose, would produce more positive results, if it scored a direct hit, unless the radiation of the atom bomb will be much greater than it was in Nagasaki, or the gamma ray's effect, which has been referred to in the Hiroshima bombing, will destroy the crew.

As I say, a direct hit will destroy the battleship. Either one of them will.

Senator JOHNSON. In the photographic views of Nagasaki, certain buildings were left standing, tall buildings, which I understand were supposed to be of steel and concrete construction. But we are told that all of them, these buildings, would have to be torn down, that they were so badly damaged that they were not safe, while they looked to be all right from the photographs. We were told they would all have to be demolished, destroyed. Is that your conclusion?

Major DE SEVERSKY. I cannot say that I think so. Of course, some particular buildings may have been damaged, shaken up by the explosion much more than was visible. It is just like using a glass which is cracked: even if I do not see any chips in it, I would not take a drink from that glass, I would take a new glass just as a precaution.

Senator JOHNSON. I am not talking about what we may want to do, but what may have to be done with such buildings. If they were condemned, they wouldn't be condemned simply on a whim, such as if you were to take a highball out of another glass. They would be condemned because of actual damage.

Major DE SEVERSKY. Yes. I think the building has to be inspected and if there is sufficient damage, demolish it.

As I remember, some of those buildings could be rebuilt, and others would have to be taken down.

Senator JOHNSON. You think some of them, however, could remain standing safely?

Major DE SEVERSKY. I think so; particularly in Hiroshima.

Senator JOHNSON. Particular in Hiroshima.

Major DE SEVERSKY. I climbed on top of a great many of them, back and forth, investigating every floor. I wasn't worried that the buildings would fall, when I climbed them.

Senator JOHNSON. Of course, some of them could be standing for several years; although they might not be safe, they could be left standing.

What was the effect on the roofs of these buildings? We were told that there was a blast of wind of 700 miles created by the bomb.

The CHAIRMAN. 1,000 miles an hour.

Senator JOHNSON. Yes; 1,000 miles an hour. And we were told that that wind crushed the roofs of the buildings down into the building. Did you notice that?

Major DE SEVERSKY. I can show you pictures of dozens of buildings where the roofs were not pushed down.

Senator JOHNSON. Where the roofs were intact?

Major DE SEVERSKY. Yes, some of them. A wind of about 700 miles an hour, or 1,000 miles an hour, a wind like that would do terrific damage; therefore, if there were such wind, it must have been very spotty. I can show you in Hiroshima, for example, pic-

tures of towers, poles, such as lamp poles, and all sorts of fragile things, on the roofs of the buildings, that had not been blown away. Such things certainly would have been torn away if a 700-mile-an-hour wind was blowing.

I do not deny that investigations show that such a wind takes place in an atomic explosion; however, its effect on the target depends on the manner and the conditions under which the explosion takes place.

I don't believe it did take place. I brought with me Kodachrome colored pictures of the points I mentioned. I certainly would like to have an opportunity to show them to substantiate my statement.

In all fairness, instead of just saying, "This is my observation," I should be given a chance to prove it with photographs. I have been more or less interrogated here, and if that is the case, I would like to have the opportunity to show you what I mean with pictures instead of just from "observations." I am sure you gentlemen will certainly agree with my point of view. Common sense will indicate that I am not far off.

Senator JOHNSON. Well, Major, I certainly am not antagonistic to you. I am not trying to badger you or heckle you, or anything of the kind.

You were over there and you saw the effects of these bombs, and I think you are a very important witness and a witness in whom I have had a great deal of confidence throughout the years, and still have.

So, what you are saying and the testimony that you are giving, is taken very seriously by this member of the committee, at least.

Did you visit the New Mexico detonation?

Major DE SEVERSKY. No, I did not.

Senator JOHNSON. You have not seen that?

Major DE SEVERSKY. I only read about that and when I read about it, naturally, until I saw the results of the Hiroshima and Nagasaki bombings, I thought I had a pretty good idea of what took place. I think millions of Americans had the same idea as I did, that everything was completely wiped out, and the sand was fused and the area was covered with a glasslike crust.

I was very much surprised, therefore, when I came there, to find that there were quite a few trees standing, quite a few buildings standing. Some vegetation was still blooming and growing, though not much of it.

I can show you some pictures of it in color, so there will be no doubt about it.

Senator JOHNSON. Trees that were not destroyed and still alive?

Major DE SEVERSKY. All the leaves were gone from the trees but not from some of the low vines on the ground—I have a picture of such a vine, one with six branches, just about 100 feet from the center of the explosion, that looks very pretty.

Senator JOHNSON. Did I understand you to say, Major, a moment ago, that within a mile of the center of the explosion that flimsy Japanese houses were still standing?

Major DE SEVERSKY. Not within a mile.

Senator JOHNSON. Within what radius?

Major DE SEVERSKY. I mean the destruction was within a radius of 1 mile. Beyond that, I found Japanese buildings that stood up—in Nagasaki.

Senator JOHNSON. Still standing?

Major DE SEVERSKY. Yes.

Senator JOHNSON. One mile from the center?

Major DE SEVERSKY. Roughly about 1 mile. I have pictures of them which I would like to show you.

Senator JOHNSON. Was that true in both cases?

Major DE SEVERSKY. It was a 1-mile radius in Nagasaki. I think that is one thing that was different between the two; I think the radius in Hiroshima was a little bit greater than 1 mile, as I remember.

Senator JOHNSON. Did you talk to anyone that had that experience there and was blinded by the light of the bomb?

Major DE SEVERSKY. No, but I talked to some people who were not blinded—you mean blinded forever?

Senator JOHNSON. Just for the moment.

Major DE SEVERSKY. Yes. Well, this fellow [indicating photographer] blinds me all the time, but I am used to that.

However, seriously speaking, that is true. Yes, that was the thing that about everybody who saw the flash agreed on.

I talked to the people in the Press Building, just three or four blocks from the center of the explosion. When I came, there were quite a few people in it. I went there with one of our A-2 officers and some members of the United States Strategic Bombing Survey. I talked to the people in the building. Among them were about three or four Japanese who were in the building when the bomb exploded and they were able to describe to me more or less what happened.

They said that at first they saw a flash, then terrific explosion. All the windows were blown out. The fire started on the fourth floor, where they stored negatives, inflammable negatives. They did not discover the fire, of course, until quite a few minutes later. By that time all the surrounding wooden houses were already on fire.

They argued among themselves as to the cause of the fire. Some of them were sure that the negatives caught fire at the moment of the explosion; and others said, no, they caught fire from the adjacent trees or wooden houses. When the latter became inflamed, sparks started to fly into the building through the broken windows.

Senator MILLIKIN. I would like to ask a couple of questions, Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. Pursuing the line suggested by Senator Johnson, assume that there were two Hiroshimas, each exactly the same as the other. Suppose you dropped the normal Hiroshima bomb on one, and then you dropped the Nagasaki bomb on the other Hiroshima. Which would have done the most damage?

Major DE SEVERSKY. Well, I have no choice. The difference between them, as far as the damage was concerned, would be so little that I think either one of them would be equally good.

Senator MILLIKIN. You have no preference?

Major DE SEVERSKY. They were perfect jobs at that time.

Senator MILLIKIN. You have no knowledge of the respective potency of the two bombs?

Major DE SEVERSKY. No.

Senator MILLIKIN. On page 124 of the Reader's Digest to which I refer, it says:

The more painstakingly I analyze my observations, indeed, the more convinced I am that the same bombs dropped on New York or Chicago, Pittsburgh or Detroit—

you are referring there to the Nagasaki and Hiroshima bombs—

would have exacted no more toll in life than one of our big blockbusters, and the property damage might have been limited to broken window glass over a wide area. True, the atom bombs apparently were released too high for maximum effect. Exploded closer to the ground, the result of intense heat might have been impressive. But in that case the blast might have been localized, sharply reducing the area of destruction.

Do your observations which you have made to the effect that you were comparing an atomic bomb exploded in the air as against a blockbuster exploded on the ground, apply also to what I have read?

Major DE SEVERSKY. Yes.

Senator MILLIKIN. And on page 125, you say:

It seems to me completely misleading to say that the atomic bomb used on Japan was "20,000 times more powerful" than a TNT blockbuster. From the view of total energy generated, this may be correct. But we are not concerned with the energy released into space. What concerns us is the portion which achieves effective demolition. From that point of view, the 20,000 figure is reduced immediately to 200 for a target like Hiroshima. For a target like New York, the figure of 20,000 drops to one or less.

May I ask you again, did you have in mind when you wrote the things I have cited here, an atomic bomb exploded in the air, as against a blockbuster exploded on the ground?

Major DE SEVERSKY. The same.

Senator MILLIKIN. That runs all through your testimony?

Major DE SEVERSKY. That is right.

Senator MILLIKIN. And when you say that you reduce the effectiveness of the atom bomb dropped on a target like New York from a figure of 20,000 to 1 or less, that rests on the assumption that you have discussed; and it also rests on your judgment as distinguished from actual calculation?

Major DE SEVERSKY. That is right.

Senator MILLIKIN. Thank you.

Senator AUSTIN. I would like to ask a question.

The CHAIRMAN. Senator Austin.

Senator AUSTIN. Is it correct or not that the explosive effect of a detonation of TNT or of atomic energy includes the eccentricity of swirls or waves of energy going in incalculable directions so that you may have one spot in the area uninjured by the wave and right beside it a spot is destroyed by the wave? Is that characteristic of such an explosion?

Major DE SEVERSKY. As far as the atom bomb is concerned, I have observed the same thing.

Senator AUSTIN. Yes.

Major DE SEVERSKY. I have observed, for example, in Nagasaki, instances where, say, for a mile everything is destroyed; in another mile in the same direction there was no destruction. Then, all of a sudden, at the end of the 2 miles, we find some destruction again.

Also, in Hiroshima, I found isolated districts where there was destruction by blasts beyond the radius of the general destruction.

So, apparently, there is a phenomenon of rebound or a certain irregularity in the distribution of blast, the primary cause of which might be the terrain. It is for this particular type of phenomenon.

As I said, my observation was that it is true that there was no definite regularity in the propagation of the blast. I mean, that is the deduction that I made from my observations in those two cities.

Senator AUSTIN. Historically, we have many examples of that characteristic of explosives. I recall one of an explosion in a laboratory, where one side of the laboratory was completely blown out and yet people in the other side of the same room were wholly uninjured and unaffected by the explosive wave.

Major DE SEVERSKY. That is why, Senator, I am so reluctant to tell exactly what is going to happen when two bombs are exploded within, say, Wall Street in New York, on contact. It is very difficult to predict exactly what is going to take place.

It depends upon the conditions, the character of the target, and the interrelationship between the components of the targets or the places.

But, one thing I do know. It is not going to do what people believe through so many stories; that is, that for 2 miles in radius New York would be completely wiped out. That is what I tell people about those two bombs, so that they will really calm down a bit.

Senator AUSTIN. It comes down to the general principle, does it not, that where an explosion takes place in an area where there is destructible material, the extent of the explosion must be related to the power of the explosive; isn't that about it?

Major DE SEVERSKY. We have to have some basis to start with.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Yes, sir.

Senator MILLIKIN. I think everyone would agree that the area of demolition that was achieved in either Nagasaki or Hiroshima would not be duplicated in lower Manhattan with either one of the two bombs. But would that destruction, in terms of units of destruction, be the same?

Major DE SEVERSKY. No. Units of destruction are not necessarily in direct proportion to the energy released. In the latter area, the units will be smaller. It all depends on the yardstick used to measure the destruction.

Senator MILLIKIN. Units of energy will be calculated on the theoretical proportions, will they not?

Major DE SEVERSKY. They will be there, they cannot disappear.

Senator MILLIKIN. And the effect will be lessened in the case of either the blockbuster or the atomic bomb?

Major DE SEVERSKY. In other words, you have to consider the limiting factors which are inherent in the target itself. In the latter case, the target, with its tall steel and concrete buildings, will impede the propagation of the blast and even the propagation of the gamma rays; it will protect some of the people.

Senator MILLIKIN. But it is not a fair comparison to take an area of destruction and then erect a sort of strawman to make the argument on the theory that someone claims that there may be the same destruction in the lower part of Manhattan?

Major DE SEVERSKY. What is this?

Senator MILLIKIN. In Hiroshima you had a definite area of destruction, right?

Major DE SEVERSKY. That is right.

Senator MILLIKIN. No one would expect the same area of destruction in Manhattan, would they?

Major DE SEVERSKY. Oh, would they not? I can show you illustrations from all over the world, in Europe and American newspapers. To show you the pictures is not just the same as telling you; you'll see what I mean if you let me show you these pictures, because, you see, visual education and visual demonstration are more powerful than words.

When people see a red circle drawn around New York and the caption says that this is what will happen if an atom bomb is dropped, that everything within that red circle will be destroyed, such a picture will remain in their memories much longer than the oral descriptions of people who know.

One of the purposes of my article was to offset such incredible claims for the bomb. I think wild exaggeration is only going to hamper your work and becloud a clear understanding of what is taking place.

As I said, before I went to Hiroshima and Nagasaki myself, I was, like other people, oversold. I was lucky I didn't write anything about it.

But I remember telling a friend that if an atom bomb were dropped on the Navy, it would blow the Navy out of the water, it would evaporate the water around the fleet and leave ships suspended in space; then the battleship would plump back into the water and would be swallowed by the ocean.

That is what I was telling some of my friends that the Hiroshima bomb would do to the Navy—under the impact of hysterical propaganda.

So, you can readily understand my feelings when I come to Hiroshima and Nagasaki and I realized what a fool I would have been if I had made those statements public—in writing. I was mad.

Senator MILLIKIN. Would it not be equally misleading, Major, to depreciate the explosive effects, the destructive force of the atomic bomb if it landed in the same place as the blockbuster? Would not the enormous energies released produce somewhat the same amount of damage, even though the area might be less than at Hiroshima or Nagasaki?

Major DE SEVERSKY. No, I don't think this is a fair question, sir. There is nothing misleading in the things I have said. I do not say that the bomb is almost a human being and can think; I do not say that if it were dropped from this altitude there is going to be so much energy, and if it were dropped somewhere else the released energy would be different. It releases the same energy, naturally, no matter where it is dropped.

I still believe that I am nearer to the truth by saying that if the bomb were dropped over Chicago as it was over Nagasaki, the same bomb, at the same altitude, it will do no more damage than one blockbuster.

Those people who say that the entire city of Chicago would be blown up are way off the beam. From a tactical point of view, I think I am certainly much nearer to the truth. You see, I am speaking in terms of tactical considerations. I am talking as an airman.

If I have an air force and I have to do a job of destruction of Hiroshima, I could do the same job with 200 B-29's that the atomic bomb did from one B-29.

From a purely tactical point of view, therefore, that atom bomb was only 200 times more powerful, because, for all practical purposes, the city would have been wiped out in both cases.

To say that it was 20,000 times more powerful—because a lot of people felt that in order to destroy Hiroshima we had to exert 20,000 times more effort—just isn't so.

Measured in the tactical effort of the Air Force, we could do the same thing with 200 B-29's. We also must not forget another condition, a condition which I notice is overlooked when atomic discussion begins to apply atomic energy to the future war possibilities. It assumes that the enemy is going to take it sitting down.

People go on the assumption that we are going to be on the delivering end and that the enemy is going to be solely on the receiving end. Because we had control of the air over Japan, we were able to send one atomic bomb in one airplane. If we hadn't had control over Japan's air, we probably would have had to send 200 airplanes to be able to deliver 1 atomic bomb. In the future, of course, that ratio might be changed.

And again, I feel it my duty as a citizen who was there and who saw the results of atomic bombings to tell people exactly what it means in military effort. Because I am particularly interested in our national defense, I try to measure the military effort exerted under single atomic bomb conditions, with ordinary methods of bombing. But I would like to qualify that the loss of life would not have been as large, if ordinary incendiaries had been used.

Senator MILLIKIN. And as to these remarks that you just made, your comparison is again assuming the explosion of the atomic bomb in the air?

Major DE SEVERSKY. That is the premise of my article. I only discussed those bombs as they were dropped and how they were dropped.

The CHAIRMAN. Well, what do you think would happen to human beings in the area of the atomic bomb explosion, as compared to people in the area of one 10-ton blockbuster? The loss of life, of course, has been proven to be measurably greater.

Major DE SEVERSKY. Well, the gamma rays will be a factor in the latter case, but, as I said before, by the time I got there I couldn't collect any authoritative information on radioactivity.

The CHAIRMAN. But the people were dead, were they not; over 100,000 were killed at one stroke.

Major DE SEVERSKY. But there won't be so many killed in the future, because, you see, what will happen in the future is that people won't be taken by surprise. They will be prepared for the ordeal. Now, in the case of Hiroshima; the whole city collapsed instantaneously; there were no open streets left, since they were blocked by debris.

For example, if an incendiary bomb were to be dropped in this room, we still could run out through the doors. But there were no doors, no windows, in Hiroshima, everybody was pinned underneath the rubble. The wood was scattered and spread all over the streets. No one could go through them. Everybody lay exactly where they were.

So, regardless of the effectiveness of the gamma rays, there was a terrific loss of life.

The CHAIRMAN. All that would not have been done by one 10-ton blockbuster?

Major DE SEVERSKY. Of course not. I think it is clear in my article, there is no question about it.

The CHAIRMAN. General Groves has testified before this committee—

Senator JOHNSON. First, before you go on to that, Senator, may I read one paragraph of the major's statement; it is short, on that point?

The CHAIRMAN. Surely.

Senator JOHNSON. In describing what happened at Hiroshima, the major said:

It was like a great flyswatter 2 miles broad, slapped down on a city of flimsy, half-rotted wooden houses and rickety brick buildings. It flattened them out in one blow, burying perhaps 200,000 people in the debris. One must see it to believe the flimsiness of such Japanese structures. For the most part they are built of two-by-four boards, termite eaten and dry-rotted through generations. To make things worse, they are top-heavy with thick tile roofs. Often they tumble down without apparent reason.⁴

That figure of 200,000 people, that is the estimate of the number of people that were buried in the debris in Hiroshima?

Major DE SEVERSKY. Some probably escaped. I mean, they were knocked down but some were able to crawl out.

Senator JOHNSON. Further on, you say that 60,000 were burned to death.

Major DE SEVERSKY. That was information that was given me when I was over there.

Senator JOHNSON. Further on, you say:

Thousands of them must have been killed outright by falling walls and roofs; the rest were crippled and immobilized in a burning hell and some 60,000, it is estimated, were burned to death.⁵

The CHAIRMAN. Major, I just have one final question.

When we were talking to General Groves here about the possible future results of a bomb being dropped—let us leave New York and Chicago and come to Washington—the question was directed to General Groves:

General, relating the bomb to approximately the same size that was sent over Hiroshima, suppose one dropped upon Washington. Could you estimate the amount of damage and relate it to Washington?⁶

General Groves answered:

Related to Washington, if that bomb had been dropped, say, in the center of the Pentagon, there wouldn't be any Pentagon left.

Do you concur in that opinion?

Major DE SEVERSKY. I do.

The CHAIRMAN (continuing to read):

General GROVES. * * * If it were dropped in what would probably be the goal of any enemy dropping it in Washington, so that it hit on the Federal triangle

⁴ See Major de Seversky's Supplementary Report on Atomic Bombings of Hiroshima and Nagasaki, which follows his statement in this part of the hearings.

⁵ Ibid.

⁶ See pt. 1 of the hearings on atomic energy, p. 42.

and destroyed the offices of the Government, it would have destroyed an area maybe 2 miles in diameter so there wouldn't be much left there.

Of these big Federal buildings that are well built, many would have their walls standing. All of the limestone and marble on the facing would have been blown off. There is not much question of that, but the concrete and steel structure might still be standing.

All interior partitions would be gone; all the windows and window frames would be gone, and in general you would have a number of buildings standing just as you see them in the picture of Hiroshima, everything flat in between, and maybe 2 feet deep in rubble of all varieties with these walls standing there but absolutely unusable.

Do you concur in that statement?

Major DE SEVERSKY. Not in its entirety, sir. I think it is very pessimistic.

The CHAIRMAN. "The normal house"—this is still quoting General Groves—

that most Washingtonians live in would be completely destroyed in that area. It wouldn't be findable.

Major DE SEVERSKY. Yes; with regard to the wooden buildings, probably they would suffer the same fate that they did in Hiroshima.

The CHAIRMAN (continuing to read):

The area of real damage, where there wouldn't be much left, would have extended from the Capitol to the National Cathedral on Massachusetts and Wisconsin, or something of that general order.

It would have gone over across the river into the Pentagon area, and have blown out all the windows and window frames of the Pentagon, and probably blown out most of the interior partitions. It would not have destroyed the Pentagon, but it would probably have done a tremendous amount of damage.

You think that is too pessimistic a conclusion?

Major DE SEVERSKY. Naturally, the damage that would be done here would be much greater than in New York or Chicago, because in Washington you have big concrete buildings with little wooden houses alongside, and those wooden houses would catch fire. Perhaps the damage here would be much greater than in Chicago or New York.

The CHAIRMAN. Well, at least, as far as Washington is concerned, you do not say that one blockbuster would be as effective as one atomic bomb?

Major DE SEVERSKY. No; that is why my comparison was with Chicago and New York.

The CHAIRMAN. Well, we are kind of interested in Washington, too.

Major DE SEVERSKY. So am I. As I said in my article, it all depends on the character of the target itself. The target Washington is certainly more susceptible to destruction by atomic bombs than a target like New York or Chicago.

The CHAIRMAN. How many blockbusters do you think it would take, here in Washington, to do the same amount of damage as one atomic bomb?

Major DE SEVERSKY. Well, it is very difficult to say; but, with the terrifically excellent precision of our Air Force, I don't think it would take very many to destroy the same number of buildings.

The CHAIRMAN. What do you mean by "very many"?

Major DE SEVERSKY. Well, I imagine—I saw some destruction by our raids, particularly by the B-29's, where the B-29's dropped 1,000-pound or 2,000-pound bombs, 2,000 G. P. bombs in average—200 of

them probably would exceed the damage, the actual physical damage, in Washington, of one atomic bomb.

Senator HART. Major, I understand your objective in producing this article was to offset considerable overstatement, in your judgment, as to the power demonstrated by the two explosions over those two Japanese cities.

Now, in your comparison of one 10-ton blockbuster with one atomic bomb, were you really attempting to offset those overstatements by one of your own? Do you feel now that you were overstating, in that comparison?

Major DE SEVERSKY. No; I don't think so. I think, now, as I stated before—and as far as my own conscience is concerned it is clear—I think that if the same atomic bomb were dropped over the steel and concrete section of New York or Chicago, the same atomic bomb, at the same altitude as in Hiroshima, the demolition would not have been greater than the destruction created by one 10-ton blockbuster.

You may find me wrong; maybe I went too far—I don't know; but it is the result of my careful judgment, within certain limits of accuracy, of course based upon my visual appraisal of what had taken place in Japan.

But, I know one thing; it would not have destroyed Chicago completely, the same way it did Hiroshima and Nagasaki.

Senator HART. You do not dispute General Groves' statement to the effect that the interiors of the buildings which were left standing because of their strength would have been entirely ruined, and so on?

Major DE SEVERSKY. Some would, some would not.

Senator HART. And that was done over an area that could not be possibly done by one 10-ton blockbuster, could it?

Major DE SEVERSKY. No; of course not, because the blast of the atomic bomb is certainly more extensive than the blast of a blockbuster.

Senator HART. I rather fear, Major, that you were combating what you thought was one overstatement by one of your own.

Major DE SEVERSKY. If I only equalize it, I am very happy. I think overexaggeration is a great danger to our country.

As I say, it is dangerous. The other day, a very well-known commentator gets up and says, "It is all a lot of bunk to talk about reorganization of our military institutions; we must dispense completely with all our present forms of national defense; the atomic bomb has replaced them; we do not need an army or a navy or an air force."

Senator HART. Particularly the Navy?

Major DE SEVERSKY. Well, he said it was even foolish to think of the reorganization of these departments, the Army and the Navy and the Air Force; he said that you must abolish them, because the next war is going to be fought entirely by a push-button from a scientific laboratory.

I certainly feel that it is very dangerous to our national security, the propagation of such stories. Such thoughts, I think, are very dangerous.

Senator MILLIKIN. Mr. Chairman, may I ask a question?

The CHAIRMAN. Yes.

Senator MILLIKIN. In your comparison, Major, you were comparing the case of the explosion in the air of an atomic bomb as against a blockbuster exploding on the ground.

Assuming that an atomic bomb were exploded on the ground in lower Manhattan, how many blockbusters would you have to have to do the same effect? It would require probably more than one?

Major DE SEVERSKY. If the bomb hits on the ground, the atomic bomb, then the effect of the heat is going to be tremendous.

Senator MILLIKIN. Yes.

Major DE SEVERSKY. And, of course, the radiation will be much greater in the explosion of the atomic bomb. I have conceded from the beginning that the atomic bomb is certainly a great step forward in the science of demolition.

I feel that while atomic energy may not yet perform useful work such as running washing machines, flatirons, toasters, and jet airplanes, I still feel that we are dealing with a very efficient explosive which enhances the power of our military forces.

Senator MILLIKIN. How many blockbusters would you guess would be required to do the same effect as the atomic bomb in the instance I have given you?

Major DE SEVERSKY. Why do you want my guess? If you are so interested, we may furnish you later on with more substantial statements.

Senator MILLIKIN. Well, your guess, your judgment, was what you based these other figures on.

Major DE SEVERSKY. Well, frankly, all right, if you want my guess—it is going to stand as a guess.

Looking again at what happened at Hiroshima—and I still want to show these pictures so that you can see the same thing as I did—my guess is—

Senator MILLIKIN (interposing). I want to see them.

Major DE SEVERSKY (continuing). If it were dropped right on the ground, amongst very high, tall buildings, I imagine that it probably—I have figured out that inasmuch as one 10-ton blockbuster probably will destroy a block, each blockbuster one block apiece completely, and it will also damage the surrounding buildings to a certain extent, blow the windows out, and the partitions, and so on, the atomic bomb probably will destroy not only the block it hit but probably the next one in every direction. So, in reality, it will probably require 10 blockbusters to cause the same demolition that will be done by 1 atom bomb, if both of them scored direct hits.

Senator MILLIKIN. And at the same point.

Major DE SEVERSKY. And at the same point.

Senator MILLIKIN. Thank you, sir.

The CHAIRMAN. So that makes you 10 percent right, if you take the figure of one given in the Reader's Digest.

Major DE SEVERSKY. No. Again, you are measuring different things. You cannot measure yards with minutes. When it comes to the Reader's Digest, when it comes to the explosion of an atomic bomb exploded above the ground, I am going to stick to what I said, just the same.

That is my impression; I made the statement, and I do not intend to deviate.

The CHAIRMAN. Have you taken into account the damage that would result in the case of skyscrapers?

Major DE SEVERSKY. No fire damage resulted to the top, the roofs, of the Hiroshima skyscrapers.

The CHAIRMAN. So, you don't think there will be any fire damage in New York?

Major DE SEVERSKY. Of course, in the case of very small buildings—as in Hiroshima, some of them not more than 10 stories high—the decrease in distance from the bomb exploded high in the air would be about 100 feet, or roughly 5 percent; the heat effect is not much greater.

But, if you take on the Empire State Building, which is 1,200 feet high, then you have reduced that distance considerably. You cut it in half. In that case, I would not be surprised but that the top of the Empire State Building would sizzle a bit. Yet the Public Library might remain fairly cool, though practically all its windows would be blown out.

It all depends on the target. Scientific destruction isn't such a simple thing. That is why our Air Force has such an elaborate institution for operational research.

We had such operational research in the Eighth Air Force. Most of those people in it were scientists; they tried to estimate actually the amount of explosives required to destroy a given target. Imponderables came into the picture; they studied the problem thoroughly so that they could tell almost exactly what to use against a given target, and how much of it was required. It was a big job.

The CHAIRMAN. Major, I want to ask you a very simple question.

Major DE SEVERSKY. Yes.

The CHAIRMAN. Would this fire damage that you would anticipate from an atomic bomb exploded in New York be not greater than the one 10-ton bomb, the blockbuster?

Major DE SEVERSKY. If it drops 2,000, 3,000 feet up?

The CHAIRMAN. If it drops 3,000 feet up and the blockbuster drops on the ground, what would be the difference in the damage or the danger from fire by the explosion?

Major DE SEVERSKY. Judging from the appearance of the Hiroshima buildings, I do not think that widespread fire would be the case.

The CHAIRMAN. Thank you.

Major DE SEVERSKY. But, I do not know what might happen if it exploded 500 feet or 600 feet or 200 feet.

The CHAIRMAN. If it exploded at 500 feet, you might expect greater fires?

Major DE SEVERSKY. Naturally, because there is no question in my mind, judging by the experiments in New Mexico, that considerable heat was generated.

Therefore, it is quite obvious that the nearer to the buildings that the bomb will explode, the greater will be the effect of the heat generated by the explosion, which heat there is no question occurs.

The CHAIRMAN. Now, you gentlemen—

Major DE SEVERSKY. I would like to say something more.

The CHAIRMAN. Pardon me.

Major DE SEVERSKY. I would just like to make this concluding statement. As to the value of the atomic bomb. I am not depreciating the

value of the atomic bomb. As a matter of fact, I think it is a great thing, and I think it is a great thing that it was used.

I only want to make one thing clear. I worked since early days with our Air Force. I felt that there was a great apathy in recognizing the air power as a new, decisive military force. I think it is very gratifying to see that now, in the case of atomic energy, we are going in advance of the scientific phenomena. We are talking about and planning the regulations for the use of atomic energy, when nobody even knows how to harness and use it commercially. Scientists writing in the newspapers are from 10 to 50 years apart as to the actual time when such energy will be harnessed to do useful work.

But I still think it is wonderful that in this particular case we were on time, which means to be ahead of time. But I do feel that great harm was done to the atomic cause by overexaggeration of what actually took place in those two cities. I don't attribute that hysteria to any official information because there was no official information, so far as I saw, that would inspire such wild predictions.

The CHAIRMAN. I have read to you, Major, from General Groves' testimony before this committee. Of course, it is in great disagreement with what you say.

Major DE SEVERSKY. Well, it is not in disagreement with me alone. I might be wrong, but I vaguely remember that there was disagreement between General Groves and Dr. Bush. I think General Groves said that the bomb could destroy 40,000,000 men in an instant; and Dr. Bush said that it would be 30 years before we could approximate anything like that figure.

There is another source of confusion in the minds of the people, because the scientists themselves cannot agree on what the bomb itself can do and I think that they ought to get into line and give us one story, because I think it is very confusing, not only to me, who am not a specialist but have a smattering of knowledge, but even more so to the people, when one scientist tells us that we are going to use atomic energy for practical purposes in 5 years, and another in 50 years. There is something wrong in Denmark.

If one of my engineers told me that he had designed such and such an airplane but he was not sure whether it would work in 1 year or 2 years or 30 years, I would fire him.

There is too much basis for speculation. I think the atomic boys ought to line themselves up, so that people would have a true, uniform picture, so that they would know where they stand as far as the use of atomic energy is concerned.

In the particular case of its use over Japan, I thought it was a very well-chosen weapon, and I would like to read you the concluding statement which I made to the Secretary of War, which is going to be made public, on the use of the atomic bomb.

Psychological effect of the atomic bomb: Even before the atomic explosion, Japan, with its industries destroyed, and all the major cities but Kyoto reduced to ashes, was a thoroughly defeated and beaten nation. It was desperate to terminate hostilities—and it was searching for a face-saving device to protect the prestige of the Government in order to avoid internal collapse. The atomic bomb provided a perfect excuse for surrender. They could now pretend that they were not to blame for the defeat—an almost supernatural element had intervened to force their hand.

Emperor Hirohito placed the responsibility for defeat on the Japanese people themselves. He pointed out that the scientific backwardness of Japan made the struggle hopeless, and urged the Japanese people to endeavor to improve their scientific knowledge in the years of peace to come.

But it should also be remembered that the atom bomb provided a providential face-saver for our military leadership. Having failed to understand the strategic action of air power, or to visualize its decisive function, we were committed to colossal invasion plans. The so-called Olympic and Coronet invasion operations were ready, dates were set, immense resources deployed. Our leadership was deeply committed to invasion, because it had so often and so vigorously insisted that there could be no victory without coming to grips with the Japanese armies in the traditional fashion. No doubt many of them were heartsick about the necessity, but they felt that there were no alternatives. Although it was already evident to all airmen and many in the other services that in Japan we were winning a victory through air power, I am personally convinced that we would have gone through with the invasion and paid the tragic and unnecessary cost in life. The momentum of the old assumptions was too great to be arrested.

Came the atom bomb. Instantly it released everybody from all past commitments. The nightmare of an invasion about which there was so much doubt was canceled out. Now victory without the preliminary of invasion and mile-by-mile surface struggle—with seven million Japanese still under arms—became possible, without loss of prestige. It was a face-saving miracle which saved perhaps half a million American lives and several million Japanese lives. Though the Hiroshima and Nagasaki episodes added only less than 3 percent to the material devastation already visited on Japan, its psychological value was beyond calculation—for both the defeated and the victors.

Those who made the decision to use the atom bomb, therefore, should be highly commended, because never in the history of human conflict was there a better demonstration of applying the right force in the right place at the right time.

This is, I feel, exactly what happened at Hiroshima and Nagasaki. The atom bomb was used, the targets were chosen perfectly, because there we were able to exact the maximum effect, both material and psychological.

It is also important that in all our dealings with this explosive, as long as we have explosives, we ought to continue to treat it as one of our greatest military advancements. I personally feel that until atomic energy becomes a utility—in other words, something like electric power, for light and power—it primarily will constitute a weapon, or, rather, a major explosive weapon. I think we ought to continue to develop it in comparative secrecy, until such time as the world will decide to disarm.

I think, in this proposed commission, that the military should be represented, at least until such time as the energy of nuclear fission becomes a utility and releases power which can be harnessed to do useful work. So long as it is only an explosive, I think it is very important for us to treat it as a military subject.

The CHAIRMAN. Thank you very much, Major. Can you get your pictures out?

Major DE SEVERSKY. Right here?

The CHAIRMAN. Yes.

Senator JOHNSON. Major de Seversky, do you want to place in the record your full statement?

Major DE SEVERSKY. Yes, please.

Senator JOHNSON. Mr. Chairman, may we have Major de Seversky's full statement for the record?

The CHAIRMAN. Yes, I think it should be put in the record.

Major DE SEVERSKY. All right, fine. It is a part of my report to the Secretary of War, also.

(The prepared statement submitted by Major de Seversky is as follows:)

FEBRUARY 11, 1946.

The Honorable ROBERT P. PATTERSON,
Secretary of War, War Department, Washington, D. C.

DEAR MR. SECRETARY: As special consultant to the Secretary of War, and in line with your instructions, I left for the Pacific theaters of war on September 28, 1945, and returned to the United States on November 15, 1945. My mission was to observe and appraise the role of air power in the attainment of victory over Japan; to study the magnitude and character of aerial destruction; to study the air-power strategy, tactics, and equipment of the Japanese. I was interested, among other things, in appraising the nature and effects of aerial warfare in the Pacific in the light of my observations during a similar mission in the European and Mediterranean theaters of operation.

In pursuance of these purposes, I traveled extensively through the entire area, and especially the main Japanese home islands. I discussed all pertinent questions with key leaders in our own and allied commands; interrogated enemy military and civilian leaders; and talked to people in all walks of life in the defeated country. I made several flights in a B-29 and went through the B-29 tactical procedures in visual and instrument bombing. Opportunities were ample for observing our own as well as enemy equipment, air bases, installations, supply and logistic stations.

In Japan proper, I made observations in the leading cities, including Tokyo, Yokohama, Yokosuka, Fuchu, Karawa, Konosu, Kumagaya, Oshi, Fukaya, Sano, Ishibashim Nikko, Nagoya, Kyoto, Toyonaka, Kobe, Kure, Amura, Sasebo, as well as dozens of smaller towns and villages. I circled and observed scores of other cities from the plane. I made a particularly intensive study—from the air and on the ground—of Hiroshima and Nagasaki, the two cities on which atom bombs were dropped.

I visited Guam, Saipan, Tinian, and Iwo Jima, and in all these places conferred with commanding officers and toured our installations. I also stopped at Shanghai, Manila, and Corregidor, making flights of observation over Manila, Corregidor, Fort Drum, and Subic Bay. During a day's stop at Calcutta, I conferred with Rt. Hon. Richard G. Casey, at that time Governor General of the Bengal Province, and with Sir Alan Brooke, new Chief of Staff of the British Army. Also, I visited all U. S. Army Air Forces installations and Air Transport Command installations at Kurachi, Cairo, Tripoli, Casablanca, the Azores, and Stevensville.

Among the American commanders with whom I conferred in line with my mission were Gen. Douglas MacArthur, General of the Army; Gen. Walter Krueger, Maj. Gen. Ira P. Swift, and their respective staffs; Maj. Gen. F. C. Sibert in command at Kure; Maj. Gen. Harry Schmidt, USMC, at Sasebo; Maj. Gen. LeRoy P. Hunt, USMC, at Nagasaki; Gen. Barney Giles and his staff; Lt. Gen. Nathan B. Twining and his staff; and Lt. Gen. Albert C. Wedemeyer. I had occasion to talk to Mr. Franklin D'Olier, chairman of the United States Strategic Bomb Survey, and his assistant, Mr. Paul H. Nitze. They and their staff gave me the fullest cooperation. I spent considerable time with Maj. Gen. O. A. Anderson and his staff and with General Fellers, personal aide to General MacArthur.

Among the Japanese, I interviewed Emperor Hirohito and high-ranking members of his household; Rear Admiral Takata of the Imperial Japanese Navy; Lieutenant General Kawabe, commanding at Kokosoguan; Major General Miwa; Lt. Gen. Saburo Endo, who was in charge of aircraft and engine production for the entire Japanese Empire; Lieutenant General Samo, commandant of the Osaka Arsenal; and many others. I interrogated key leaders of industry, among them Mr. Matoro, former chairman of the board of the Mitsubishi enterprises. In addition, I talked to average Japanese of all classes. Especially in the atom-bombed cities, with a view to a more accurate understanding of what actually took place there, I questioned doctors, nurses, fire fighters, eyewitnesses.

On the basis of these varied observations and discussions, I am in a position to transmit to you my personal judgments on a variety of aspects of the war in the Pacific theaters.

* * * * *
11. *The two atom bombs.*—I come now to my observations on the atom bombing of Hiroshima and Nagasaki. Because of the importance of this subject, I have dealt with it more comprehensively in a supplementary report which I

am attaching to this report. Here I shall merely summarize my observations: After spending 2 days in each of the atom-bombed cities, examining the destruction areas and questioning all types of local observers, I gave an interview to American correspondents in Tokyo. My statements at that time were in such striking contrast to the misconceptions about the character and effects of the atom bombing that they evoked a storm of controversy. I am obliged, however, to report to you the facts as I saw them and the conclusions I drew from these facts.

I did not "underrate" the atom bomb, nor raise doubts about its significance for the future of warfare. My interview dealt solely with the actual bombs dropped on the two Japanese cities and the actual results obtained. The loss of life and property was as large and as tragic as reported. But the character of the destruction did not even resemble the popular notions generally held on the subject.

The common belief, based on erroneous lay reports and pseudoscientific assumptions, is that scores of thousands of people died "instantaneously" in a kind of vaporizing process; that solid matter evaporated instantly in unprecedented superheats; that in huge areas "bald spots" were created by total combustion of all organic and inorganic matter. All of these assumptions are wholly unfounded.

The destruction was entirely incendiary in character, and the deaths were due almost entirely to fire and to falling structures. The atom-bomb blast collapsed the flimsy, half-rotted and top-heavy wooden houses, causing thousands of fires which immediately combined into one huge bonfire. The victims were caught and pinned in the debris where most of them perished in the many hours that the conflagration raged.

Most important, concrete buildings, even in the very heart of the bomb explosions, remained erect, though most of them were gutted by the spreading fire. More than that, even flagpoles, siren devices, and other fragile objects on such buildings remained intact. There were no traces of unusual heat effects even on the tallest of the surviving buildings. Neither in Hiroshima nor in Nagasaki was there any such "bald spot" as we were led to expect by the New Mexico experiments. Everywhere, including the immediate area of explosion, there were charred and leafless trees, poles, half-burned and unburned chunks of wood—the typical debris of a fire. In short, there were no visible effects different in nature from those caused by ordinary incendiary bombing and the physical picture presented by the two cities was precisely the same as in Japanese cities destroyed by ordinary bombs.

Another item which needs noting is that the damage in Nagasaki was only about one-fourth as large as in Hiroshima, despite the fact that the bomb dropped on Nagasaki was said to have been more powerful. It suggests that the relation between mass and destructive results is not necessarily in direct proportion. Of course, it is quite possible that the heights at which the bombs were exploded had much to do with the extent of the damage and the absence of any of specific "atomic" effects.

As to the deaths from radioactivity—by the time I had arrived at Hiroshima and Nagasaki, I could not find any victims, nor could I get any first-hand information from doctors, nurses, or hospital attendants to whom I talked. Since the New Mexico experiment proved beyond any doubt the presence of radioactivity in atomic explosion, such cases should have taken place in the two Japanese cities unless the bomb exploded so high that its effect was greatly reduced.

I made the statement in Tokyo, and feel justified in repeating it here, that the same bombs dropped in exactly the same way on a steel-and-concrete city like New York or Chicago would have done no more damage than a 10-ton block-buster. Had Hiroshima and Nagasaki been modern concrete and steel cities, there would have been no wholesale collapse of houses, no bonfire and no such tremendous loss of life.

Another statement, which I do not hesitate to reiterate, is that two hundred Superforts loaded with incendiaries would have done as much damage to Hiroshima as the atom bomb, except that the loss of life would most likely have been smaller.

It seems to me of the greatest importance that these facts about the atom bombing be made known to the American people. Enlightened democratic public opinion has been the prime factor in guaranteeing our victory in this war. The maintenance of such an opinion requires that our people be taken fully into confidence on all the facts.

SUPPLEMENTARY REPORT ON ATOMIC BOMBINGS OF HIROSHIMA AND NAGASAKI

Because of the importance of the above subject, I felt warranted in submitting to you a more detailed and descriptive report in connection with the use of atomic bombs on Hiroshima and Nagasaki.

I made five separate observation flights over each city, and spent 2 days in each city examining the sites and the character of the damage. I observed the ruins and the rubble, visited structures which had survived the bombing, interrogated eyewitnesses, and took hundreds of pictures. This effort, moreover, was the climax of nearly 8 months of intensive study of destruction in all its aspects. I had become thoroughly familiar with every variety of damage—from high explosives, incendiaries, liquid fire, artillery shells, dynamite, and combinations of several of these.

Having completed my inspection of the atom-bombed cities, I therefore felt justified in giving my impressions to American correspondents in Tokyo, who transmitted them, on the whole accurately, to the American people. It was my considered opinion, I told them, that the effects of the atom bombs—not of future bombs but of the two specific specimens unloosed on Japan—had been wildly exaggerated and that the nature of the destruction had been fantastically distorted. The same bombs, I told them, if dropped in the same manner on a modern city like New York or Chicago, would have done no more damage than a 10-ton blockbuster; and the results obtained in Hiroshima and Nagasaki could have been accomplished by about 200 B-29's loaded with incendiaries, though the loss of life in that case would have been much smaller.

I did not "underrate" atom bombs or dispute their future potential. Certainly I did not dismiss lightly the hellish horror of the two stricken cities. I merely conveyed my professional findings on the physical results of the two bombs—and they happened to be in startling contrast to some of the hysterically imaginative versions spread through the world.

My statements at that time were in such striking contrast to the misconceptions about the character and effects of the atom bombing that they evoked a storm of controversy. The dissenting faction pounced upon my findings in outraged anger. I was attacked by all sorts of people. Scientists who had not been within 5,000 miles of Hiroshima issued round robins denouncing my views. These critics behaved, indeed, as if they had a vested interest in the fanciful misrepresentation of the facts. Almost for the first time in my career, I found myself in the position of a "conservative" under attack by "extremists."

The violence of the opposition, however, cannot alter the facts on view in the two Japanese cities. Many of these facts which the most honest and best-intentioned observers may be unable to interpret correctly unless they have the necessary training and experience. Because I believe that the truth is more useful than pseudoscientific fairy tales, I must repeat that the events of Hiroshima and Nagasaki have been seriously misreported and misunderstood, with the result that confusion prevails on a subject which calls for accuracy, clarity, and calm appraisal.

I was in England testing British jet planes when the atomic bombs were dropped. Naturally, I was as excited as everyone else by the new development and the horizons opened up by atomic power. My whole life had predisposed me to credit the miracles of science. From the teeming newspaper and radio accounts, I visualized the total devastation of Hiroshima and Nagasaki in one-millionth of a second. With my mind's eye I saw the instantaneous dissolution of the cities and their people, not a building left standing in the stricken areas, sand and earth fused to glass, steel evaporated, tens of thousands of human beings "pulverized" in the twinkling of an eye. Because they were so often and so unanimously repeated, I credited the reports of heat of incalculable intensity, instant extinction of life and destruction of matter. I agreed, as a matter of course, with those who said that if such a bomb were dropped over a battleship, the heat would melt the vessel or evaporate the surrounding ocean, or both, in a flash.

In short, I accepted the popular picture of a new kind of total destruction, different not only in extent but in quality from the destruction by explosives and fire I had seen elsewhere. One curious item did stir my doubts. It was a photograph of a devastated Hiroshima in which a concrete building stood upright in the midst of the bombed area. It set me wondering how that structure had evaded the phenomenal new force. All the same, if I had not journeyed to Japan and investigated for myself, I probably would still be laboring under the illusions so common on the subject.

After visiting the major war areas scattered through the Pacific, I arrived in Japan. I began the study to which you had assigned me, by making an aerial tour of the islands of Honshu and Kyushu, which compass the main portion of industrial Japan. Taking off from Tokyo, I flew over Yokohama, Yokuska, Nagoya, Osaka, Kobe, Akashi, and dozens of other cities and towns subjected to air attack. Some of the towns are so close together that they seem almost continuous industrial areas.

All these areas of annihilation presented approximately the same visual pattern. The smaller towns were completely burned out. Viewed from above, the consumed sections looked pinkish—an effect produced by the piles of ashes and rubble mixed with rusted metal. That color, in fact, is the prevailing one in devastated Japan seen from overhead. Similar pinkish carpets were spread out in the larger cities, but among them stood big and small modern buildings and factory structures, unscathed bridges and other objects. Many of the buildings, of course, were gutted by fire but this was not apparent from the air.

The center of Yokohama, for instance, seemed almost intact when viewed from the vantage point of an airplane. Osaka, the Chicago of Japan, was a vast expanse of pink crisscrossed with white lines, except in the more modern center of town, where the concrete buildings had survived the ordeal. The long industrial belt stretching from Osaka to Kobe had been laid waste by fire, but the factories and other concrete structures with few exceptions were still standing. On the whole, it was a picture quite different from what I had seen in German cities subjected to demolition bombardment; quite different, too, from the picture presented by the Osaka arsenal—the most devastated high-explosive target I have seen. The difference lay in the fact that Japanese destruction was overwhelmingly incendiary, with comparatively little structural damage to noninflammable targets.

Finally, we flew over Kure, where so many Japanese battleships litter the ocean floor—and then to Hiroshima.

I was keyed up for my first view of an atom-bombed city. I was prepared for radically different sights: the kind of sights suggested by the excited descriptions I had heard and read. But, to my surprise, Hiroshima looked exactly like all the other burned-out cities I had observed in the 8 hours of aerial cruising.

Within an area defined by a ring of black undestroyed houses, there was the familiar pink blot, about 2 miles in diameter. What is more, it was dotted with buildings still standing erect, with charred trees, poles and other things. Only 1 of the city's 20 bridges was down. The concrete heart of Hiroshima, its clusters of modern buildings in the downtown section, stood upright and seemingly undamaged—how strange, I thought, that in all the hundreds of Hiroshima pictures published after the bombing, I did not happen to see a single "shot" of this section.

I had viewed numerous targets destroyed by every conceivable method and had confidently expected to find something novel here. What I found was simply another and quite typical burned-out Japanese city. I know what the blast of a 5- or 6-ton bomb can do to nearby buildings. It was obvious to me at once from the appearance of Hiroshima's concrete buildings that the blast could not have been as powerful as we had been led to expect. It was extensive blast, as evident in the size of the area effected, rather than intensive. Closer inspection of the buildings later would show, of course, terrific damage by fire, just as in Tokyo or Osaka.

I had heard about buildings instantly consumed by unprecedented heat. Yet here under my eyes were buildings, structurally intact, and what is more, topped by undamaged flagpoles, lightning rods, painted railings, penthouses with wooden-framed doors, air-raid precaution sirens bright in their silver paint, and other fragile objects; clearly they had withstood the blast and somehow escaped the phenomenal heat. None of this jibed with my preconceptions based on the generally accepted reports.

We landed. For 2 days I examined Hiroshima. I drove to the T-bridge which was the aiming point for the atomic bomb. In its environs I looked for the "bald spot" where everything presumably had been vaporized and "boiled into dust" in the twinkling of an eye. It wasn't there or anywhere else in the city. I looked for other traces of phenomena that could reasonably be tagged as unusual, as "atomic" in character. I could not find them.

What I did see was in substance a replica of Yokohama or Osaka, or the Tokyo suburbs—the familiar residue of an area of wood and brick houses razed

by uncontrollable fire. Everywhere I saw the trunks of charred and leafless trees, burned and unburned chunks of wood, the rubbish heaps left by unchecked fire. Obviously it was a fire, here as in other Japanese cities, intense enough to bend and twist steel girders and to melt glass until it ran like lava.

I examined with particular attention the concrete buildings nearest to the center of explosion, some of them only a block from the heart of the atom blast. They showed no structural damage—only the typical effects of fire. Even cornices, canopies, and delicate exterior decorations were intact. Window glass was shattered, of course, but single-panel frames held firm; only window-frames of two or more panels were bent and buckled. The blast impact, therefore, could not have been very intensive. Nor was there any trace of heat beyond what was normally generated by inflamed Japanese cities without the benefit of atom bombs.

Then I questioned a great many people who were inside such buildings when the bomb exploded. Their descriptions matched the scores of accounts I had heard from people caught in concrete buildings in areas hit by blockbusters and incendiaries. They indicated no special effects that could be attributed to the new kind of explosive.

Hiroshima's 10-story press building is located about 3 blocks from the center of the explosion. It is badly gutted by fire but otherwise unhurt structurally. I was told that the people caught in the building did not suffer any unusual effects. They saw a flash. Fire broke out on the fourth floor, where inflammable negatives and films were stored, and thence spread to other floors. Some of the tenants asserted that the fire started simultaneously with the bomb flash; others insisted that it was set off by sparks from the nearby cinema theater, which had caved in and burst into flame.

The Hiroshima hospital, about a mile from the heart of the explosion, had most of its window panels blown out. Because there were no wooden structures in its immediate vicinity, however, it escaped fire. In general, the effects here were analogous to those produced by the blast of a distant TNT bomb.

The more I looked and questioned, the more convinced I was that the world had obtained a totally erroneous impression of what had taken place in Hiroshima. The total death and destruction were as large as reported. The horror was as profound as reported. But the character of the damage was in no sense unique; neither the blast nor the heat was as tremendous as generally assumed; and most important, there was clear proof that the same bomb applied in the same manner on a different type of target would have had totally different results.

From Hiroshima I flew to Nagasaki. I repeated the process of investigation and cross-examination. It added little to what I had learned in the other city. The pink blot was much smaller. It was also studded with concrete buildings, gutted by fire, but standing upright. Fewer of these buildings were in evidence, only because there were fewer modern structures in Nagasaki.

In contrast with Hiroshima, all of downtown Nagasaki, though chiefly wooden in construction, survived practically undamaged. Part of this unaffected section, it was explained, had apparently been shielded from the explosion and its consequences by the intervening hills. But another part, west of the river, lies down the river in a straight and quite unimpeded line from the explosion center. It is not protected by the hills. Yet it escaped serious damage, with only a few of its houses caved in. The Nagasaki blast had virtually dissipated itself by the time it reached this area. Few houses collapsed and none caught fire.

Some of the mistaken reports about Nagasaki derive from the fact that all destruction is credited to the atom bomb. It must be remembered, however, that the city had undergone an effective raid by General George Kenney's bombers on August 1, 6 days before the atom bomb was released. The famous Mitsubishi plant in the heart of Nagasaki had received its share of the 20 high-explosive bombs dropped in that raid, 8 of them scoring direct hits on machinery. That plant, which I inspected in detail, presented the typical appearance of an industrial objective which had suffered high-explosive attacks and fire.

On the basis of my observations, this is what I visualize as actually having happened in Hiroshima and in essence it holds good for Nagasaki as well.

If there had been any primary fire, that is to say fire kindled by the heat of the explosive itself, my personal observation could not justify such a conclusion. The bomb presumably exploded too far above ground for that. If the temperature within the exploding area is superhigh (and the effects in New Mexico tend to indicate that) then it must have been dissipated in space. The

presence of unscorched paint and fragile objects on the top of the concrete buildings would tend to encourage such an assumption. What struck Hiroshima was the extensive blast.

It was like a great fly swatter 2 miles broad, slapped down on a city of flimsy, half-rotted wooden houses and rickety brick buildings. It flattened them out in one blow, burying perhaps 200,000 people in the debris. One must see it to believe the flimsiness of such Japanese structures. For the most part they are built of 2-by-4 boards, termite-eaten and dry-rotted through generations. To make things worse, they are top-heavy with thick tile roofs. Often they tumble down without apparent reason.

The wooden slats of the collapsed houses were piled like so much kindling wood in a fireplace. Fires flared simultaneously in thousands of places, from short circuits, overturned stoves, kerosene lamps and broken gas mains. The whole area exploded into one fantastic bonfire, as normally happens after a major incendiary attack. The concrete buildings naturally were also enveloped in flames.

In normal incendiary fires, people have a chance of escape. Parts of the houses burn before other parts; the inmates run from room to room, then into the streets, to open places, to the rivers. In Hiroshima the majority had no such chance. They were hopelessly pinned and trapped in the burning debris. Thousands of them must have been killed outright by falling walls and roofs; the rest were crippled and immobilized in a burning hell and some 60,000, it is estimated, were burned to death.

Those who managed to extricate themselves rushed for the bridges and the rivers. There is reason to deduce that the one collapsed bridge broke under the weight of the frenzied mobs, although some maintain that it was brought down by the bomb blast. On the other bridges, the crush of hysterical humanity pushed out all the railings, catapulting thousands to death by drowning. The missing railings were not wrenched out by the bomb blast as nearly all reports have had it.

On a vast and horrifying scale it was fire, pure and simple, that took such a high toll of life and property in Hiroshima, and in Nagasaki as well. There was no evaporation of human beings or steel or wood, no melting and boiling of matter other than the usual kind in great conflagrations. All these claims are pure invention, the product of imaginations inflamed by atomic publicity.

The victims did not die instantaneously in a sort of atomic dissolution. They died slowly, horribly, in the long hours that the fire raged in the stricken cities. Quite possibly the blast was strong enough to cause internal injuries to many of those caught in the center of explosion, particularly lung injuries. But that, too, is an effect quite familiar among victims of ordinary high-explosive bombing.

As to death from gamma rays—by the time I had arrived at Hiroshima and Nagasaki, I could not find any victims, nor could I get any first-hand information from doctors, nurses or hospital attendants to whom I talked. Since the New Mexico experiment proved beyond any doubt the presence of radioactivity in atomic explosion, such cases should have taken place in the two Japanese cities unless, again, the bomb exploded so high that its effect was greatly reduced; nor could I find anyone who had personal knowledge of any lingering radioactivity phenomena.

Such are the facts as I found them—and they seem to me tragic enough without imaginative pseudoscientific trimmings. I might add that I am not alone in my impressions. Scientific observers on the spot to whom I talked in general shared my point of view. Nothing official came from the War Department to justify the wild exaggeration. The blasts were powerful enough to collapse miles of flimsy wood and brick houses, but too weak to damage the concrete buildings even at the focal centers of the explosions. It is simply untrue that 60,000 people in Hiroshima and 40,000 in Nagasaki were snuffed out in one-millionth of a second. It simply is not true that matter was vaporized in the intense heat—if steel had evaporated, certainly wood would have done the same, and undamaged wood abounds everywhere in the rubble. In neither of the bombed cities was there a bald spot—a spot denuded of all inflammables such as was created in the New Mexico experiment—and both atom-bombed areas have plenty of tree trunks, walls with growing vines, half-burned wood, to disprove the claims of superheat.

I come now to those of my statements at the Tokyo conference which have drawn the most passionate retorts: (1) That the Hiroshima and Nagasaki bombs, if dropped on a large American city, would have done little if any more damage than a 10-ton blockbuster; and (2) that 200 B-29's loaded with incendiaries

would have visited the same amount of damage on Hiroshima—or on Nagasaki—as the atom bombs.

In connection with the first statement, the essential fact is that all but one of the concrete buildings in the center of Hiroshima, where the bomb exploded, show neither signs of structural damage nor traces of intense heat from above. It is an inescapable deduction, therefore, that if all of Hiroshima had been a city of steel and concrete like the average American or European city, the results would have been comparatively light. In that event, only the buildings directly hit—only those at the actual point of contact—would have suffered seriously. There would have been no collapsed houses, no instantaneous bonfire, no such colossal loss of life.

The more painstakingly I analyze my observations, indeed, the more convinced I am that the same bombs dropped on New York or Chicago, Pittsburgh or Detroit, would have exacted no more toll in life than one of our big blockbusters, and the property damage might only have been confined to shattered window glass over a wide area. True, the atom bombs apparently were released too high for maximum effects. Exploded closer to the ground, the results of intense heat might have been evident and impressive. But in that case the blast might have been localized, sharply reducing the area of destruction.

The same logic, incidentally, applies to a bomb of the Hiroshima or Nagasaki type dropped over a battleship. Unless a direct hit (or perhaps a near miss) were scored, the battleship would have sailed serenely on its course, I believe; and the crew, if it did not remain on the open deck, would have survived as well. A direct hit is another matter; but we know that when an 11-ton bomb hits a battleship it rolls over and sinks in 22 seconds, as the mighty *Tirpitz* did when struck by a British bomb.

I must add, of course, that whether or not battleships can be wiped out by atomic bombs has not the slightest strategic importance. The battleship is obsolete not because it can be "atomized" but because it has lost its military functions.

On my second statement, three scientists at the University of Chicago were among those who took me severely to task. They pointed out, according to a radio broadcast, "that if 200 Superforts with ordinary bombs could wipe out Hiroshima as a single atomic bomb did, the same number of planes could wipe out 200 cities with atomic bombs."

These experts meant well. Their elementary arithmetic was faultless. They merely forgot to mention one detail—that the 200 cities should be as flimsy and dry-rotted as Hiroshima. The crux of the matter is the target. Potential destruction on one type of objective does not necessarily apply to another type. On a steel-and-concrete city high explosives would have to be added to do the job. One atomic bomb hurled at Hiroshima was equal to 200 Superforts; but in New York or Chicago a different kind of atomic bomb exploding in different fashion, would be needed before it could equal one Superfort loaded with high explosives.

In the frantic journalism immediately after the Japanese were atom-bombed, a newspaper published a picture of Manhattan Island with an area roughly 2 miles in diameter in the heart of the city blacked out. This was intended to dramatize what the bomb dropped on Hiroshima would have done if dropped on New York. Such a falsification of the facts is obviously too gigantic to have been intentional. It merely attests the hysterical credulity with which absurd claims and senseless deductions are being swallowed.

It seems to me completely misleading to say that the atomic bomb used on Japan was "20,000 times more powerful" than a TNT blockbuster. From the view of total energy generated, this may be correct. But we are not concerned with the energy released into space. What concerns us is the portion which achieves effective demolition. From that point of view, the 20,000 figure is reduced immediately to 200—and that only for a target susceptible to the kind of results obtained in Hiroshima. For a target like New York, the figure of 20,000 drops to one or less.

In any case, the comparison of the atom bomb with TNT is not helpful, since the two are not commensurable at this stage of development. It is like comparing a pneumatic drill and a flaming torch—everything depends on whether you're trying to burn a wooden fence or demolish a concrete wall. All we can say with certainty is that the atomic bomb proved supremely effective in destroying a highly flimsy and inflammable city. It is one of those cases when the right force was used against the right target at the right time to produce the maximum effect. Those who made the tactical decision to use it in these cases should be highly complimented.

The United States Strategic Bomb Survey, which did such a splendid job in assessing the bomb damage in Europe, and which is now studying the ruins of Japan, unquestionably will furnish us with an equally authoritative report in the latter case. It will leave little doubt as to the true causes and effects of the atomic-bomb demolition.

The bomb dropped on Nagasaki was said to be a great many times more powerful than the one dropped on Hiroshima. Yet the damage in Nagasaki was much smaller. Hiroshima is twice as big as Nagasaki and 60 percent of it was destroyed, whereas only 30 percent of Nagasaki was wiped out by a much bigger and better bomb. In Hiroshima, 4.7 square miles were razed; in Nagasaki, only 1.45 square miles. The improved atom bomb, in other words, was only about one-fourth as effective!

Why? There are various theories, but no one known for certain. It underlines the fact that something besides additional mass will be needed to produce greater results on the target. The fact that a bomb contains 100 or 1,000 times as much uranium or plutonium is no guarantee that it will be more destructive in direct proportion to the mass. Eventually, of course, the science of demolition will solve the problem of obtaining maximum results from atom missiles. Methods will surely be found for dissipating less of the released energy in space and directing more of it to destruction. The aforementioned Chicago scientists reminded me in their statement that "the bombs dropped on Japan were the first atomic bombs ever made. They are firecrackers compared to what will be developed in 10 or 20 years."

That is exactly the point I am trying to make: That we are as yet in the primitive stage of the atomic weapon—a stage equivalent, in some respects, to that of aviation when the Wright brothers made their first successful flight at Kitty Hawk. Imaginative scientists and journalists at that time could have stirred up a panicky excitement by behaving as if superplanes were already a reality and all other forms of transportation had to be scrapped at once.

Something of this sort of behavior has served to stampede humankind into a state of near hysteria by the first exhibit of atomic destruction. Fantasy is running wild. There are those who think we ought, willy-nilly, to dispense with all other forms of national defense. They talk of a dozen professional suicides who will take compact atomic bombs in suitcases, put on false whiskers, deploy themselves through an enemy country—or in our own country—and blow it to bits in a few seconds. Such hyperbole makes exciting Sunday-feature stories, but it is a dangerous basis for national thinking.

On the size of the bombs, incidentally, there had been much uninformed speculation. How do so many experts know that the atomic bomb weighed only "a few ounces" or "a few pounds"? After all, our biggest bomber, not a pursuit plane, was chosen to carry it. How do they know that there were no operational difficulties and other complications which affect the effectiveness of the new explosive?

Some of the confusion that exists in relation to the actual results of the atomic explosion over Hiroshima and Nagasaki could be explained by the fact that a great many people automatically transplanted the results obtained in New Mexico to those towns. They took for granted that the phenomenon of New Mexico repeated itself in Japan in all details. Most of them apparently did not realize the paramount effect of the altitude at which atomic explosion takes place. As a matter of fact, unless one has a broad knowledge of demolition in all its various forms, the first-hand observation obtained in New Mexico might prove a handicap to those who later on visited Hiroshima and Nagasaki. Impressed by the original explosion, they took for granted that the entire destruction was caused by the direct and primary action of the bomb.

To the eye accustomed to the bomb damage, Hiroshima does not represent any more remarkable a sight than hundreds of other bombed cities anywhere on the face of the earth. The only remarkable thing about it is that one single bomb did it, but I must repeat that the credit for the result must be equally divided between the unusual efficiency of the bomb and the unusual firmness of the town. The enormous loss of life should also be credited to the element of surprise. The population was not prepared for the ordeal and no precautions of safety were taken. If a city of this size had been unexpectedly attacked by poison gas, the loss of life might have been even greater, yet the use of a simple gas mask might preclude any loss of life. Even thus,

death from radioactivity in the future may be prevented by appropriate defensive measures.

There seems to be almost a conspiracy of circumstances to whip up atomic hysteria. Emperor Hirohito, his court, their press and their radio, had every reason to propagate extreme versions. It gave them the perfect face-saving excuse for surrender. They could not pretend that they were not to blame for the defeat—an almost supernatural element had intervened to force their hand.

But it should be acknowledged that the atomic bomb provided a providential face-saver for our military leadership as well. Having failed to understand the strategic action of air power, or to visualize its decisive function, we were committed to colossal invasion plans. The so-called Olympic and Coronet invasion operations were ready, dates were set, immense resources deployed. Our leadership was deeply committed to invasion, because it had so often and so vigorously insisted that there could be no victory without coming to grips with the Japanese armies in the traditional fashion. No doubt many of them were heartsick about the necessity, but they felt that there were no alternatives. Although it was already evident to all airmen and many in the other services that in Japan we were winning a victory through air power, I am personally convinced that we would have gone through with the invasion and paid the tragic and unnecessary cost in life. The momentum of the old assumptions was too great to be arrested.

Came the atom bomb. Instantly it released everybody from all past commitments. The nightmare of an invasion about which there was so much doubt was canceled out. Now victory without the preliminary of invasion and mile-by-mile surface struggle—with 7,000,000 Japanese still under arms—became possible without loss of prestige. It was a face-saving miracle which saved perhaps half a million American lives and several million Japanese lives. Though the Hiroshima and Nagasaki episodes added only less than 3 percent to the material devastation already visited on Japan, its psychological value was beyond calculation—for both the defeated and the victors.

Other circumstances conspired to skyrocket the dramatization of the atom bomb. Somehow it fitted into nearly everybody's propaganda purposes. To isolationists it seemed final proof that we could let the rest of the world stew in its own juices—with our head-start in atomic energy and our superior know-how, we were safe against the rest of the world. The internationalists, on the other hand, tried to intimidate us by reminding us that we had no monopoly on science. Everyone could manufacture the atomic bomb, they said, and if we didn't play ball we would be destroyed.

And thus the exaggerations and frantic forecasts flourished in our land. Thus public opinion was fed on fantasy to the pitch of fever. The process is still under way. Even an attempt to report sanely what actually did occur in the atom-bombed Japanese cities is resisted as a species of treason.

I am one of those who fought against inertia and apathy in the domain of air power. Consequently I am gratified that in relation to the emergence of atomic energy the public is alert, that we are planning well ahead. But there is no call for the kind of frenzy that paralyzes understanding. Our only safety is in a calm confrontation of the truth.

I earnestly urge a cooling-off period on atomic speculation. In my study of the war—and especially of the reasons for our victory—I have been convinced that our chief advantage lay in the fact that, as a democracy, our people had access to the truth. This made it possible for an enlightened public opinion to act as a decisive corrective on the blunders and prejudices of military leadership. Where the strategic ideas of a dictated Germany were frozen, ours were kept under constant public scrutiny and pressure. It was that which kept our leaders on their toes, made them responsible to the people and gave our war effort a flexibility that guaranteed success.

It is in the interest of that crucial enlightened public opinion that I have considered it necessary to cut through fantasy about the bombing of Hiroshima and Nagasaki in an effort to get closer to the truth. I am the last one to deny that atomic energy injects a vital and perhaps revolutionary new factor into military science and world relations. But I do not believe that the revolution has already taken place and that we should surrender all our normal faculties to a kind of atomic frenzy. Whatever we decide to do, let us do it calmly, logically and above all without doing violence to ascertainable facts.

ALEXANDER P. DE SEVERSKY.

FEBRUARY 11, 1946.

The CHAIRMAN. Major, I understand that your demonstration might take as much as an hour. Is that correct?

Major DE SEVERSKY. Well, I can limit it to half an hour.

The CHAIRMAN. General Farrell is anxious to get away, and I suggest that we could do these pictures after lunch and also hear the other gentlemen. I suggest that we project the pictures after lunch. General Farrell is anxious to get away, and I understand that you are not ready anyway; you have no extension cord.

We will proceed with General Farrell.

STATEMENT OF GEN. THOMAS F. FARRELL

The CHAIRMAN. General Farrell, I believe you were General Groves' deputy in charge of the exploding of the two bombs.

General FARRELL. I was in charge of the operations in the Marianas; yes sir.

The CHAIRMAN. You have read Major de Seversky's article and you have heard his testimony today?

General FARRELL. Yes, sir.

The CHAIRMAN. Would you please go ahead, General, and comment on it?

General FARRELL. Well, I will have to disagree definitely with some of the conclusions, most of which have been discussed by the committee. The principal conclusion in there is that one 10-ton blockbuster exploded in New York or Chicago would do as much damage as an atomic bomb which was exploded as high in the air as the one which was exploded over Nagasaki and Hiroshima.

Secondly, there was the conclusion that B-29's loaded with incendiaries would have done the same or as much damage in Hiroshima as was done by the atomic bomb. There were some minor statements about how there was no damage to lighting poles, flagpoles, and no structural damage to the concrete buildings. Then, the statements that the people in the hospital, the Red Cross hospital in Hiroshima, were not seriously affected.

Let me see, there are one or two more: That in New York, property damage through an atomic bomb would be limited to broken window glass scattered over a wide area; that the damage in Nagasaki was confined to one square mile; that in Hiroshima it was 4.1 square miles. Those are the principal points that I disagree with.

Now, taking them in order: The atomic bomb does release the energy equivalent of 20,000 tons of TNT. That has been measured and computed by distinguished scientists. The 10-ton bomb has the TNT equivalency of about 5 tons.

On its very face, the energy of one is not equivalent to the energy of the other, under any circumstances. The energy released from a 10-ton blockbuster, if you dropped it at an intersection of downtown New York, speaking very liberally it might be conceived to destroy four blocks, and I doubt if that would be total destruction. That would be an area of 16 acres, or one-fortieth of a square mile.

In Hiroshima the absolute total destruction, the total area of absolute damage ran up to 4 square miles; and the area of substantial damage, serious damage, was a couple of more square miles, totaling something like 7.

At Nagasaki the total damage to the buildings was about 2.4 in the built-up area. The 2.4 was the area of very serious damage. The secondary, but still serious, damage was 1.2 more, or 3.6 in total.

In New York, we have only a small percentage of heavy structures, certainly not exceeding 10 percent. The greater part of New York is brick and stone buildings and an even greater area of wooden buildings.

The damage to New York there would be somewhat lower than at Hiroshima or Nagasaki. As compared to the 6 or 4 square miles, there, to be conservative, the damage in New York would be 3 to 3½ square miles. That would still be 120 or 140 times the damage created from the explosion of a blockbuster.

The damages resulting from this atomic bomb are, speaking generally, three—flame, blast, and radiation. In addition, there is another one, I think that we must add, which is the psychological damage, fear. This weapon is a saturation weapon, in that the damage is instantaneous and total and complete and there is no defense. People lose what courage and ability they may have had to defend themselves and cope with the situation. Therefore, that is a most potent factor.

To substantiate that: From eyewitnesses we hear stories of great streams of people leaving Hiroshima and Nagasaki immediately after the bombing; and that is one of the most potent effects from the use of this bomb, this psychological impact.

I do not know that we could create the same damage with 200 planes.

Major de Seversky compared the 1 plane with the 200 planes. We were attached to the Three Hundred and Thirteenth Wing at Tinian. We saw the reports of the B-29 raids with incendiary planes. Since then, we have gotten the factual information from the Twentieth Air Force. The figures are as follows:

The total number of incendiary-carrying airplanes was 15,964. The total number actually dropping incendiaries was 14,462. The total square miles destroyed was 172. It took 84 B-29's to destroy 1 square mile by incendiary raid.

Applying that factor to the Hiroshima situation, you would come out with 378 planes for the very heavily damaged section. Taking into consideration the secondary area of serious damage, it would be 352 more, or a total of about 730 B-29's to do the same total damage and the same secondary damage as that of one atomic bomb. It would take 730 B-29's to do what one atomic bomb did to Hiroshima.

Nagasaki was a bad target, from the point of view of the bomb. It was surrounded and shielded by hills, the width of the area was only about a mile and a half, and more than half of the total effect of the bomb was wasted against the hillsides.

Taking only the built-up area, the total destruction in Nagasaki was 2.4 square miles, which gives us, from the same figuring, 202 airplanes; if we take the secondary damage, we would have to add to that 101 airplanes, or a total of 303.

So, combining those figures, we would have used 730 planes at Hiroshima and 303 for the damage at Nagasaki. So, I would have to say that 200, as stated by Major de Seversky, was a very low average. A more comparable figure might be 500 B-29's.

Also, as we measure the actual damage against the potential damage, we must keep in mind the fact that at Nagasaki a great portion of the

effective power of that bomb was wasted, because Nagasaki was not a suitable target.

The CHAIRMAN. General Farrell, 11 men were carrying the atomic bomb. How many men would there be in 500 Super-Fortresses carrying incendiaries?

General FARRELL. Some 5,000, sir. There are 10 or 11 in a crew; 5,000 is the answer.

The CHAIRMAN. Thank you.

General FARRELL. So, on those two points, I would have to disagree with the conclusions of Major de Seversky.

Now, then, comparing the destruction as between Hiroshima and Nagasaki, there is a distinction, because there was a considerable difference in the character of the two cities.

Hiroshima was a weak Japanese city; it was built, the houses, mostly of bamboo and tile and small 2-by-4 framing.

I must say that situation was thoroughly well known to the War Department and to the scientists working on the problem. We had a distinguished target committee sitting for weeks deciding upon the selection of targets. All that data were before them, they knew what was to be expected. The target was selected so as to utilize to the maximum the power of that bomb. And, gentlemen, the results came out exactly as predicted and as expected in Hiroshima.

In estimating the damage over a place like upper New York, it would be, somewhat, a problem differing only in degree. The damage would be somewhat less. I would cut the area of primary damage from 6 miles. In my judgment it would be 4 square miles, although that may be conservative. It would still be 150 or 160 times the power of the one 10-ton blockbuster.

In places where there were high skyscrapers, they would cut that down lower, to maybe 2 square miles. That would still be 80 times the blockbuster.

I do not want to exaggerate, but I want to get across the fact that the public is coming to think that this bomb hasn't the power it actually has. It does have that power.

On the other hand, I do protest against exaggerations, particularly the lurid exaggerations, the statements that the atomic bomb is like a volcano or an earthquake.

The atomic bomb is probably the greatest man-made demonstration of power, but it does not compare with nature. I think it is awful enough and potent enough as it stands, without exaggeration and certainly without belittlement.

The atomic bomb certainly can be made bigger. Certainly, you can make more. Certainly you could deliver more. I do not think you would drop one bomb over New York.

I don't want to say what eight bombs might do to New York, properly placed, or what three bombs could do to Washington, or six in Chicago. Those cities would not be functioning, if proper locations for bombs were selected, with proper fuzing, taking into consideration the character of the buildings below them.

In the atomic bomb we have a terribly powerful force and it must be regulated.

There was a statement that the ground was not seared. Of course it wasn't seared. Our intention was not to get total destruction but

to get the maximum area of destruction. As I say, the predictions were exactly as indicated.

The bomb, exploded high in the air, does release a tremendous percentage of its energy into the open. It is only the part of the energy which strikes the ground that does the damage. But you could not do anything else unless there were some way of getting it into the ground rapidly before it exploded.

But there is no question about its might. If two bombs will do to cities what was done to Hiroshima and Nagasaki, put two cities out of commission and stop a war, I think it is a fairly effective weapon.

Those are my views with respect to the conclusions in the article. We have very detailed statistical reports and photographs of the thirty-odd reinforced concrete buildings in Hiroshima. Seven of them did suffer serious structural damage.

At Nagasaki there was much more damage to reinforced concrete structures. The buildings directly in the area were either totally destroyed or destroyed except for a few walls.

There was a school building where one whole side was crushed in. There was a church with 12- and 18-inch brick walls blown completely to pieces. So it does, even at a great height, have a tremendous effect on masonry work.

And remember, all you have to do to increase that destructiveness is to bring it down a little bit. We should not belittle it, and we must keep the public aware of the fact that this thing has tremendous power.

If two atomic bombs can do that, 200 could do more, and 2,000 could do more. I am sure you gentlemen are aware of the seriousness of this, and I think it is terribly important to keep the public aware of the seriousness.

Senator JOHNSON. What about the naval experiment that is under way?

General FARRELL. I think that has rather a great deal of value for the Navy, Senator, because they will learn many things about the designing of ships, about tactics and organization.

I think also it will have a tremendous effect upon the American public and the world, to teach them again that this bomb is something of tremendous power. For that reason alone, even if the Navy learned nothing, I think the experiment will be worth the effort and cost put into it.

Senator JOHNSON. Do you concur in the judgment, the selection of the Nagasaki bomb rather than the Hiroshima bomb for the naval experiment?

General FARRELL. Yes, sir. That bomb is more efficiently designed, and it is considerably improved.

Senator JOHNSON. What about the effectiveness, more than the design?

General FARRELL. I think our statistics show that the effectiveness is greater or certainly equal to the other.

I think the impression that the Nagasaki bomb is capable of doing less damage was brought about by the fact that more than half of the area in Nagasaki where this bomb was exploded was surrounded and shielded by wooded hillsides, where the bomb simply blasted the hillsides. The unit destruction was certainly equal to the other.

I may say, however, that the Hiroshima bomb caused greater fire damage, the fires were more widespread, because it landed over an area largely built up of ramshackle structures; whereas at Nagasaki there were more steel buildings and masonry, and the fire was not so damaging. The blast effect was greater than in a similar region in Hiroshima. The fire damage was greater at Hiroshima also because there were secondary fires caused from overturned stoves and short circuits, which set fire to great areas.

Senator MILLIKIN. Is it possible to compare the effects of an atomic bomb exploded in the air with the effects of a blockbuster exploded on the ground?

General FARRELL. They certainly are not the same. However, I will be fair about it. Those are the proper places to set those two off for their respective jobs.

Senator MILLIKIN. For their particular purposes?

General FARRELL. The blockbuster bombs should be exploded on the ground, and the atomic bombs in the air.

Of course, you could detonate the atomic bomb in the ground or at the ground. While it would be a guess, I think it would certainly totally destroy at least 1 square mile, which again is more than 40 times the power of the blockbuster.

The area, compared to a 10-ton blockbuster, would be not less than 1 square mile which would be totally destroyed by the atomic bomb.

Senator MILLIKIN. Thank you.

The CHAIRMAN. Major de Seversky wants permission to ask the General a couple of questions, if that is agreeable to the committee.

Major DE SEVERSKY. In the first place, I want the general to feel that I do not criticize the fact that the bomb was exploded 2,000 feet in the air. On the contrary, I will repeat what I said, that I thought it was the right force to use, that it was used in the right place at the right target.

In other words, I know it was calculated to be exploded at that altitude in order to produce the maximum blast effect.

But, at the same time, the General—when making comparisons, he said that in New York it would destroy—what was it?

General FARRELL. About four city blocks.

Major DE SEVERSKY. And he said in Hiroshima it destroyed 4 square miles.

Mr. MORRISON. A 10-ton blockbuster would destroy four city blocks.

Major DE SEVERSKY. These I consider not comparable. You cannot compare one blockbuster destroying four blocks in New York and an atomic bomb destroying 4 square miles in Hiroshima, because the targets themselves are so utterly different. There is no use in comparing two different forces, used on entirely different targets.

Then, a further thing. There is the question of preparedness. The Japanese certainly were not prepared for the atom bomb, but it does not mean that the world is going to be unprepared in the future. The important fact is that the Japanese were not prepared. Any weapon used with the element of surprise can produce abnormally high results, no matter what it is, even a penknife.

For example, if we take Hiroshima and drop on Hiroshima, without any suspicion on their part, poison gas, we would probably kill everybody in Hiroshima. However, if they were prepared, if they expected

it, by using a rather simple measure such as a gas mask, they may reduce this loss to only a few people.

Therefore, the fact that a terrific result was gained through surprise is not so remarkable. I think it would be much more remarkable if the people were prepared and, in spite of it, terrific damage were inflicted. Then I think you would have something to brag about.

But the Japanese were caught by surprise. It was in our favor; it was our advantage. Let us not consider surprise an inherent part of the weapon. In the future, the world will find means of defense. Of necessity, there will be provided some sort of shield against radioactivity. There will be bomb shelters for people, lined with the proper insulation.

So, while it is true that the terrific loss of life and damage was due to the element of surprise, I want to point out that the element of surprise is not going to be with you forever.

Now, the General said something which in a way substantiates my statement. He said if we had to bomb a concrete city, he would use the bomb differently and a different fuze. That is exactly what I said in my article. In order to produce maximum damage in New York, "a different kind of atomic bomb exploding in a different fashion would be needed." In other words, if it exploded away up in the sky, it would not be the most efficient way of using the bomb against a city like Chicago or New York. Also, you would have to have quite a few more atomic bombs to destroy them than you did in Hiroshima and Nagasaki.

As to the number of airplanes used to produce the same damage, I disagree with General Farrell. I am willing to stand on my experience.

I think his number of 700 is exaggeration. I have studied bombing a great deal. I have studied not only the actual destruction on the ground but I have also led bombing forces in attack in World War I. I am convinced that I could have knocked out these two cities so that they would have been absolutely no good for any useful purpose, with all their industries blown out, with the number of planes I have stated.

The CHAIRMAN. Do you wish to make any comment, General?

General FARRELL. The only thing I will say is that the figures I gave are based on the actual records of all the incendiary bombs dropped by the B-29's in the Pacific area. The data are from the official records of the Twentieth Air Force, and it comes out to 84 aircraft actually over the target; you must use 84 per square mile.

Mr. NITZE. May I comment?

The CHAIRMAN. Certainly.

Mr. NITZE. I think part of the difference in the computations comes from the fact that a good part of the B-29 raids against cities were conducted against areas partially burned out, so that actually it decreased the effectiveness.

These cities where the atomic bombs were dropped were undamaged, virgin targets. Our calculations, I think, would come closer to 300 planes.

The same results could be accomplished with fire bombs, but the point is that you still have to consider the matter of blast; you would

not get the same blast effect or anywhere near the same casualty effect, nor anywhere near the same psychological effect.

So, there was only a partial effect which could have been achieved with something in the order of 300 B-29's, dropping incendiaries.

General FARRELL. I would like to give you a few factual data as to the physical damage.

At Nagasaki, the window damage was complete, at 12,000 feet, or 2½ miles. The plaster damage was very heavy up to 9,000 feet. The roof damage was heavy up to 2 miles; light up to 3 miles. Window frames and doors, heavy up to 8,000; light up to 12,000. Nine-inch brick walls, heavy up to 5,000 feet; some damage at 6,000. That is, these brick walls were cracked.

Heavy reinforced concrete buildings, 10-inch walls or 6-inch walls, were destroyed up to 2,000 feet. Churches built of brick, 18-inch brick, completely destroyed at 3,500 feet.

That gives a damage radii of total and secondary damage of different types of structures—those were all from blast.

Major DE SEVERSKY. If the general states that the concrete buildings were destroyed up to 10,000 feet, I can also state that concrete buildings were not destroyed as close as 200 feet.

General FARRELL. There were exceptions; yes, sir. There was destruction up to 2,000 feet, however.

Major DE SEVERSKY. Did you say that at Nagasaki the total destruction was 12,000 feet?

General FARRELL. For glass.

Major DE SEVERSKY. Oh, windows.

The CHAIRMAN. Thank you very much.

Senator JOHNSON. Does the general have something else to put in the record?

General FARRELL. No, sir.

The CHAIRMAN. Now, we can go ahead for a short period of time.

If there is no objection from any member of the committee, we will go ahead with the next witness.

Who would like to be next?

Off the record.

(Discussion off the record.)

STATEMENT OF COL. STAFFORD WARREN

Colonel WARREN. I feel that Major de Seversky probably had a little difficulty in getting oriented when he first went around in those two cities. I say that because that was my first impression when I first went in to those two cities. It was very difficult to analyze what had actually happened.

Of course, our parties had landed at Yokohama, and had gone around in Yokohama and Tokyo for several days. A comparison was rather difficult. In the first place, there were no standing brick walls or ordinary chimneys in the two atomic-bombed cities. So you have, essentially, a wide area which is completely flat and covered by rubble. Your impression is that maybe nothing much happened but fire, and it is true that the majority of the wooden buildings did burn.

But the burning was under somewhat different circumstances than has been indicated. As a result of the atomic bomb explosion, the majority of these buildings within half a mile were probably reduced

to splinters, because we were able to find, in the large open spaces of the stadium tract which was near to zero, pieces of four by fours, six by sixes, and eight by eights, which were from a foot to 2 feet long. Those pieces apparently had been carried by the winds into that area where they could not be burned. Elsewhere, throughout the flattened area were large timbers, partly from the roofs of houses which had been splintered. So, when the fires did start, they consumed essentially what was kindling, and the fires consumed that at a very high rate.

We took a great deal of care to look for the demolition bombing which had occurred in Nagasaki. We were only able to find three direct hits on the Mitsubishi plant and in the midget-submarine area in the southern parts of the bay area. Out of 12 bomb hits and craters that we were able to locate and recognize, there were also three which made direct hits on the medical school. These were 500-pound demolition bombs, and they had caused extensive local destruction. However, the loss of life and the volume of buildings and equipment demolished were quite small, although these bombs, particularly the three which had struck the medical school, had caused a great impression on the Japanese.

Each of two bombs that hit the medical school happened to land inside of a surgery. Major Youngs and I had quite an argument for a few days as to whether these were ether explosions or explosions of some anesthetic, because the extent of the damage to the building was out of proportion, at least in my mind; it was too minor in extent, when surrounded by the rest of the destruction which was present. They totally demolished the insides, for about 20 feet on a side, and they bared the reinforcing of the concrete. If the city had not been touched by anything else but these, they would have been considered serious.

In the medical school, the remembered loss of life from these two direct hits was very small, probably four or five people only. Of course, these were small bombs, not 10-tonners, and I appreciate that fact. But, when you looked outside of the school building, or looked inside elsewhere, the amount of over-all damage produced was ridiculously small in comparison to the rest.

One very great source of confusion was the fact that the Japanese themselves had no information, no precise data. They did not know what the population of either city was beforehand. They had very little way of telling how many people had survived or had returned to the city.

I am embarrassed by the fact that even though I led a medical party which was supposed to get figures on the mortality, and so on, that we could not come back with any definitive figures that I would be able to say were more than a guess.

The only actual fact that we could get at the end of the second month of study, at the beginning of October, was that at Nagasaki they had recorded the burning and cremation of 40,000 bodies. It is my belief that there must have been 20,000 or 30,000 more in the ruins, buried or consumed by the fire.

The data in Hiroshima was likewise inadequate and I see no way of putting a precise figure on the mortality or how a precise figure can ever be put on the total casualties.

A good deal has been said about the radiation effect. We spent a great deal of time trying to evaluate the number of people who were killed by the gamma radiation or other radiation at the time of the explosion or subsequently.

Our best guess is that if there had been no gamma radiation, the total casualties would have been 5 to 7 percent less. In other words, the gamma radiation and allied radiation effects did not add a great deal to what would have happened if the same amount of energy had been released by TNT.

A great many people were injured by fire; that is, by flames from the burning buildings, in exactly the same way that they were injured in the fire bombings. This is a burn in the ordinary sense.

When we left Nagasaki, the cases in the hospitals averaged 20 cases of fire burns to one of gamma-ray injury. There will continue to be fire-burn cases in these hospitals probably for months yet, but I believe most of the gamma-ray effects, or most of the cases affected by gamma rays are no longer much in evidence, although the symptoms of such injury can still be detected by careful investigation in some ambulatory cases.

The mortality from the gamma-radiation injury had ceased pretty well before the eighth week after the explosion, but the deaths from fire burns, those slowly healing subacute and chronic cases were still very numerous.

There was no crater. The amount of radioactive material found was of great scientific interest, but of no biological significance; that is, it was never there in amounts dangerous to any living thing.

As General Farrell has said, the ball of fire did not come to the ground and we have good evidence of that in the wooden structures, the poles, particularly. The fires which did occur were, in the main, of secondary origin. There are Japanese reports of fields of wheat that were ripe catching fire about a half a mile to three-fourths of a mile away on the hillside. There were certain individuals with black clothing who had the clothing catch on fire. Clothing with black stripes and other dark figures on the cloth was scorched and the pattern was often seen from a superficial burn on the skin from the infrared radiation. This healed promptly.

This effect was also well illustrated on the telephone poles, which were scorched on the side toward the demolition and on other objects which were combustible or whose texture and appearance could be changed by an increase of temperature.

We have a great deal of evidence to indicate that the concrete buildings were gutted by the blast waves and the burning of the contents of the buildings was caused, in a great number of cases, by short circuits and fires of other secondary origin.

However, in each case, the personnel in those buildings was subject to injury and death by the secondary missiles, the main one of which was the steel window framing, which was torn out of its socket by the blast force; these window frames were thrown into the room, through the room, knocking down the personnel and not infrequently knocking down also the partitions and going on into the halls or even through both hall walls.

The impression is gained that a great many of the concrete or heavily built buildings were not damaged. You gained that impres-

sion if you looked at them from the street. Our party had two engineers, whose duty it was to specifically inspect buildings and determine what were construction failures that caused death. As a result, we have a good deal of rather precise information in pictures to indicate that relatively few of these buildings escaped major damage of some sort from the blast.

The medical school buildings in Nagasaki were built to withstand earthquakes and were exceedingly heavy. The window frames in the majority of the buildings were steel frames which were poured with the building. In most cases, these frames were ripped out. The wooden false ceiling, the wainscoting, the laboratory equipment—everything in these rooms—the books in the library, and so on, looked as if an earthquake or a hurricane of extremely high velocity had disrupted the contents.

Not infrequently, bodies were still present two months after the explosion, underneath such debris. They were killed by the fall of the false ceilings. These false ceilings were heavy and when they fell on the individuals in the room they added to the mortality, in addition to that caused by the window frames.

It took us a long time to get any information from the Japanese, and almost day to day the data which they gave to us changed. As I remember, in these two cities—I am speaking particularly of Nagasaki where I remained the longer—the stories of the Japanese changed. They frequently told us what they thought we wanted to hear and we had great trouble in getting the true facts.

A great many of them cannot remember where they were. We got a great deal of information from the three doctors in the medical school who survived and who were able to help us in our survey of cases. Five doctors survived altogether, but the other two were unable to participate; they were badly injured. The rest of the staff of 50 died; 200 of the medical students survived, but they were not of much use to us, because a great many of them were still weak and unable to carry out any duties. The rest of the 600 either died or could not be accounted for. The number of nurses and patients who died is unknown.

At the Red Cross Hospital in Hiroshima, the chief of staff was very badly injured; he had fractures of his clavicle and scapule, and a great many cuts from glass. He was not sure of what happened to the rest of his staff, but he told us that a great part of his staff had not survived, and probably 15 or 20 of the nurses were dead. He could not say how many patients were dead. In fact, he had no very clear memory of that day.

We tried to get information from the Japanese survivors as to where they were at the time, so that we could set down precise figures as to the survival rates and mortalities and injuries, and so on. It was almost impossible to get this information with any accuracy. We not infrequently found that the Japanese could not tell us where they were at the time within 1,000 meters. It took often an hour of careful questioning of a patient, even an intelligent one, like a doctor or a nurse, to find out precisely what happened on that day.

The three doctors in the Nagasaki medical school remembered nothing for 2 or 3 hours afterward and the two who could not help us because they were badly injured remembered nothing until the next day.

Our conclusion was that we could trust very little of the factual information that came to us through interpreters, from these Japanese, these patients.

When you realize that all the records and all the facilities and all the organizations of both towns were wiped out, literally, in one instant, you can see that a survey party trying to get information about individuals has very little hope or chance of success.

I could go on at great length, but I think I have said enough for your purpose.

The CHAIRMAN. Thank you.

Major DE SEVERSKY. I would like to say that in general I agree with the observations of the colonel here, I agree that there was a very terrific fire; the rest remains for the experts to find out about.

We must realize that buildings in Hiroshima and Nagasaki were in the midst of a fire of terrifically high degree of temperature. Within the concrete, metal structures were expanding, breaking concrete walls and ceilings. There was a great deal of that sort of damage. I could not easily determine whether the damage was due to the original blast or to the heat and expansion of the internal structures. Generally, both looked alike.

Now, those chimneys—I am going to show you the pictures I have. Among these pictures that I will show you, there are pictures of chimneys still standing. I hope you don't mind that.

Colonel WARREN. Not a bit.

Major DE SEVERSKY. Your statement about the wood puzzles me. I conceive that the wood might have been thrown or moved around by the wind, but what puzzles me are the trees. There were tree trunks in abundance at zero point. While I admit an atomic bomb can do a lot, I do not think that an atomic bomb can move and transplant trees.

So far as the chaotic condition of the interior of the buildings is concerned, it must be realized that during the fire there was a great panic among the Japanese. The Japs were upsetting things; there was some looting going on, because there were no troops present.

In this connection, I remember an incident. When I went through the Vulkanrod laboratory in Germany, I thought the place was struck by a hurricane, but it wasn't a hurricane. It was struck by our GI's who went through and made sure the place wasn't going to be usable.

So, while I agreed with Colonel Warren about the interior destruction—well, so many things had taken place there that I imagine it is very difficult, with any degree of accuracy, to discern the cause of damages and really know exactly what happened in each particular case.

Colonel WARREN. May I reply?

The CHAIRMAN. Yes.

Colonel WARREN. The only chimneys, though; that were actually standing were reinforced concrete chimneys which were built to withstand earthquakes; and almost all of those had the reinforcing rods snapped on the side toward the blast or where the blast had exercised compression on the downward side. That would mean that the chimneys would have to come down in the majority of cases.

I think it was quite easy, in some places where there was no fire, to show that the damage to the concrete building was due to the blast forces alone.

Insofar as the trees are concerned, they also are streamlined, and the infrared radiation which they received was not sufficient to kill them.

Also, there was not enough heat on the ground or radiation heat on the ground to kill the seeds so that the plants sprung up right away.

In fact, the Japanese planted beans and corn, and, at our urging, they raised vegetables such as sweetpotatoes, and so on, because we thought that there was no danger from doing so and we wanted them to feel—and we wanted our troops to feel—that the area was safe. We had measured it and it was safe.

Another thing around the area below zero, for a distance of 300 or 400 yards, the forces were almost straight down, so that the telephone poles and trees were relatively untouched. They were not moved from their position at all. Branches were stripped off, but not much more damage than that.

On the other hand, when you go out a quarter of a mile or more, the trees and poles were pushed down—the majority, not all—so that their base was toward the center of the blast. That was one way by which it was easy to define where zero was.

However, as you pointed out before and as has been brought out, each explosion has a lot of vagaries in it. I think it was a common experience in London and elsewhere, where there were people killed in one room and none in the next room in the same building. So, we can explain a lot of things from that. I feel that we shouldn't haggle too much over what escaped or what was damaged.

The facts are that a tremendous amount of destruction occurred in these cities; it did the job it was intended to do. The forces involved are tremendous, they are greater than anything we have had to deal with before. I would hate to see any kind of a weapon like this used.

I have been involved in the New Mexico test and investigation of these two cities. I view the future use of them with a dim light. I would fervently hope that they are never used again as a bomb or as a weapon in the future. It is not a plaything, by any stretch of the imagination, and it does a tremendous amount of damage.

I think that the radiation has been exaggerated, because the small added percentage of the people killed from that, in addition to the expected effects of TNT bomb equivalent, was small. Also, the protection which would have to be built against the blast would probably be adequate to protect against the radiation.

That is all, thank you.

Senator JOHNSON. Colonel Warren, did I understand you to say that in Nagasaki the city had been previously bombed by conventional bombs of 500-pound size?

Colonel WARREN. Yes, Senator. A raid was made, so we were told, on the 1st of August, and a string of about 10 bombs was dropped on the east side. As a result, three of them made direct hits on the medical school, and something like 15 or 16 dropped on the south side of the harbors—they were aimed at the midget-submarine plant and the lower part of the Mitsubishi steel plant.

Senator JOHNSON. Were the hits in the medical school accidental?

Colonel WARREN. I think that both were accidental, except that they tried to get the midget-submarine plant at the south end of the harbor and they ran over too far to the north under the cloudy

conditions which prevailed. Or a man may have dropped his bombs to get rid of his load on the way home. I do not know the details. There were craters, though.

Senator MILLIKIN. That is, there were three hits that you found?

Colonel WARREN. There were three in the Mitsubishi steel plant and submarine area which actually struck buildings or the foreground of buildings. The rest of them hit the bank, they went into part of the bay and missed the buildings otherwise.

The CHAIRMAN. Are there any further questions?

(No response.)

Thank you very much, Colonel.

We will convene again at 2 o'clock to finish this line of testimony and also to hear a very important witness who will talk to us on the definition of basic scientific information.

The hearing will recess until 2 o'clock.

(Whereupon, at 1 p. m., a recess was taken until 2 p. m. of the same day.)

AFTERNOON SESSION

The CHAIRMAN. Mr. Nitze, you are vice chairman of the United States Strategic Bombing Survey made at Nagasaki and Hiroshima?

Mr. NITZE. That is correct, sir.

The CHAIRMAN. Have you some comments to make upon the testimony of this morning?

Mr. NITZE. Yes, we would like to make a few comments on that.

STATEMENT OF PAUL H. NITZE, VICE CHAIRMAN, UNITED STATES STRATEGIC BOMBING SURVEY, ACCOMPANIED BY PROF. H. L. BOWMAN, DIRECTOR, PHYSICAL DAMAGE DIVISION, USSBS, AND PROFESSOR OF CIVIL ENGINEERING, DREXEL INSTITUTE OF TECHNOLOGY, PHILADELPHIA, PA.; AND DR. LUTHER L. TERRY, MEDICAL DIVISION, UNITED STATES STRATEGIC BOMBING SURVEY (U. S. PUBLIC HEALTH SERVICE)

Mr. NITZE. I think first I would like to describe the United States Strategic Bombing Survey. It was set up in the fall of 1944 at the request of President Roosevelt to make an impartial survey of the effects of the strategic air attack on Germany. The Army supplied us with a large number of trained personnel, but the main direction of the survey was civilian in order to assure impartiality.

We made an investigation in Germany not only of the physical effects of the various weapons that were used, but also industry by industry to see how the damage to a given factory related to the overall production of the industry and to Germany's war potential. We made a survey city by city to see what the effect of urban area attack was, investigated what happened to the morale of Germany, what happened from the medical standpoint, and also what happened from the over-all economic and military point of view. We tried to cover the subject matter from the broadest possible point of view.

The CHAIRMAN. What is your background? Will you state it briefly for the record?

Mr. NITZE. Prior to joining the survey I was in the Foreign Economic Administration handling the procurement of strategic mate-

rials from abroad and the preclusive buying operations against the Axis, an economic background. Prior to the war I was a vice president of Dillon, Read & Co.

The group included specialists in all different fields. The groups, at maximum strength, was as large as 1,400 in Europe.

After completing the European survey, we were requested to make a similar survey in Japan, not only of the physical damage, but also the entire relationship between the physical damage and these other effects, the economic, military, and political effects.

Obviously the atomic bomb was a new element in Japan which warranted a great deal of attention, so we sent into Hiroshima and Nagasaki quite large groups. I think we had 114 people in each place for periods of up to 2 months; not all of them that long, but very extended periods of time, and those included structural engineers, ordnance people, medical people, experts in the electrical field, the railroad experts, and so on.

As Major de Seversky said, the problem of really defining what the effects were is a job which cannot be done hastily. Our first impressions were sometimes totally different from our final impressions. It is only after you have made a detailed examination structure by structure and have correlated all the data that you can come up with sufficiently basic and accurate conclusions to evaluate and compare atomic weapons with other weapons.

I think we might go to some of the major points which have been raised, taking first the question as to the blast effect which was caused by the atomic bomb in relation to the blast effect which might have been caused by a 10-ton blockbuster. We have computed the distances from ground zero point at which structures of all various types were destroyed. I think Professor Bowman could give some summary as to the range at which blast effects occurred.

Professor BOWMAN. The figures for Hiroshima are as follows:

We found that one-story brick buildings were destroyed pretty generally up to about 7,700 feet.

Senator TYDINGS. A mile and a half?

Professor BOWMAN. That is right. Brick multistory buildings were destroyed rather generally up to about 5,700 feet. Up to about 2,000 feet, reinforced concrete buildings would have about one-third of the area rendered useless.

Senator MILLIKIN. Up to about how many feet?

Professor BOWMAN. 2,000 feet.

Senator TYDINGS. Is this Nagasaki or Hiroshima?

Professor BOWMAN. Hiroshima.

Senator TYDINGS. That is the first bomb?

Professor BOWMAN. That is the first bomb. I don't have in exactly that same form the figures for Nagasaki, but as an example of reinforced concrete construction at Nagasaki, there were 21 reinforced concrete buildings located between 1,000 and 2,000 feet from ground zero. Of that 21, 4 were destroyed; 10 had what we have designated as "structural damage," which means that some of the main members would have to be rebuilt; and the remaining 7, which accounts for all 21, suffered what we called superficial damage—that is, they had walls knocked out or minor damage of considerable extent, and by minor damage I mean more than windows broken and partitions knocked out.

Senator MILLIKIN. Can you distinguish for us the destruction or injury caused by blast and by fire?

Professor BOWMAN. The damage that I have given here is all blast damage.

Senator JOHNSON. Was there very much apparent difference in the types of buildings of those that were completely destroyed and those partially destroyed and those that were superficially destroyed?

Professor BOWMAN. There are two factors that enter in. One, of course, is distance. The other is that in dealing with reinforced concrete buildings, as an example, there is a wide difference in construction. Because of the Japanese laws regarding earthquake construction, and also because of laws which required a much heavier roof than we use in many cases, some of those buildings were even stronger than ours would have been. On the contrary, some of them were of poor construction; the design may have been made all right, but the workmanship was poor. The concrete was poor in some of them, so that some of the differences that you get, the spread in distances, would be accounted for by the difference in construction of the various buildings.

Senator TYDINGS. Do you have a ready reference for quick comparison as to the damage and the extent of the damage from point zero of the biggest blockbuster beside the atomic bomb?

Professor BOWMAN. I don't have those figures, sir; I would have to guess.

Senator TYDINGS. Could you get it?

Professor BOWMAN. There would be a big difference, but I would have to guess.

Senator TYDINGS. Give me a guess now, and then correct it in the record permanently after you have time to verify your guess. How many times greater is the damage of the atomic bomb used over Hiroshima as compared with the damage that would have been done in the same spot by the biggest blockbuster?

Professor BOWMAN. You are talking about Hiroshima?

Senator TYDINGS. Yes—5, 10, 15, 25—how many times greater?

Professor BOWMAN. I would say the number is certainly not less than 100, and probably 200 would be a better guess.

Senator TYDINGS. So your answer is somewhere between 100 and 200 times as much damage was done by one atomic bomb as would have been done by the greatest blockbuster that was used in World War II. Is that right?

Professor BOWMAN. I think that is correct.

(Professor Bowman subsequently submitted the following, which was made part of the record:)

WAR DEPARTMENT,
UNITED STATES STRATEGIC BOMBING SURVEY,
PHYSICAL DAMAGE DIVISION,
Gravelly Point, Va., February 27, 1946.

HON. BRIEN McMAHON,
Chairman, Special Committee on Atomic Energy,
Senate Office Building, Washington 25, D. C.

DEAR SENATOR McMAHON: Inclosed are the statements on the relation between a 10-ton "blockbuster" and the atomic bomb which Senator Tydings requested me to submit for record when I appeared before your committee on February 15.

Sincerely yours,

H. L. BOWMAN,
Director, Physical Damage Division.

In appearing before the Senate's Special Committee on Atomic Energy on February 15, 1945, I was asked by Senator Tydings to guess the number of 10-ton "blockbusters" which would cause destruction equal to that of one atomic bomb of the type used in Japan, and to later correct the guess for the record.

My guess was that the number would be not less than 100 and might be as high as 200, assuming that each type detonated at the optimum altitude. On further thought I see no reason for changing these figures.

Theoretical considerations suggest that a 10-ton bomb (i. e., one containing a charge of perhaps 8 tons of TNT) would demolish multistory brick buildings with load-bearing walls located at distances of 400 feet from the point of detonation, would do serious structural damage (i. e., damage demolishing, or at least requiring the replacement of, main supporting members) to multistory buildings with frames of structural steel or reinforced concrete located at distances of 150 feet. Corresponding distances for the atomic bomb are 5,000 feet and 2,000 feet. Therefore, the relative areas of destruction are—

$$\text{Multistory brick} \cdot \left(\frac{5000}{400}\right)^2 = 156$$

$$\text{Multistory steel or concrete} \cdot \left(\frac{2000}{150}\right)^2 = 178$$

It is seen that these figures lie in the range 100-200 mentioned above.

These theoretical figures for the atomic bomb may be compared with figures obtained by actual survey at Hiroshima (corresponding distances at Nagasaki would be at least 15 percent greater). To multistory reinforced-concrete buildings at a distance of 2,000 feet from air zero (i. e., the point in the air at which the bomb detonated) the atomic bomb caused structural damage which rendered about one-third of the floor space of the buildings unusable. Also, multistory brick buildings were destroyed at distances (average) of 5,750 feet from AZ; single-story brick, at distances of 7,700 feet.

H. L. BOWMAN,
*Director, Physical Damage Division,
United States Strategic Bombing Survey.*

Mr. NITZE. On that point, wouldn't it be also fair to say that, irrespective of the target used, that ratio would not change greatly? In other words, both weapons used against flimsy construction or both weapons used against heavy construction, the ratio would still be relatively constant.

Senator TYDINGS. I will ask my question in another form. Does your proportion hold true as to lives as well as to buildings? Is it more or less in the case of lives in that area?

Professor BOWMAN. I don't think there would be any wide difference.

Senator TYDINGS. In other words, the life casualty would run along with the building casualties?

Professor BOWMAN. I think that is right.

Senator TYDINGS. Would you give me your best considered thought on that when you have a little time to reflect on it, and state what figure you actually think on sober second thought would be the one you suggest?

Professor BOWMAN. Yes.

Mr. NITZE. I think, Senator, that Dr. Terry could testify as to the relationship between casualties caused by incendiary bombs in other Japanese cities and the casualties in Hiroshima equated as to areas of equal physical destruction.

Dr. TERRY. Could you testify on that?

Senator TYDINGS. Let me ask you whether it is your intention later to give us similar figures on Nagasaki?

Professor BOWMAN. These figures apply generally.

Senator TYDINGS. Of course, there was more area destroyed at Hiroshima than at Nagasaki.

Dr. TERRY. In attempting to compare, of course, there are many variables, but we tried to make the equation as simple as we could.

Insofar as human lives were concerned, the number of deaths and injuries produced by an atomic bomb and produced by incendiary bombing in Japan, the simplest manner in which we could make an equation where there would be only one variable was to compare the number of deaths, rather the percentage of deaths produced in Hiroshima and Nagasaki to the percentage of deaths produced in other cities where a comparable percentage of the cities' area was destroyed by incendiary bombing. In other words, one would have to suppose—in applying that, for instance, to Tokyo, a much larger city—that a sufficient number of atomic bombs would be dropped to produce the same percentage of damage to the built-up area as was achieved in Hiroshima and Nagasaki.

On that basis, and comparing mortality and morbidity figures we found that the figure for injuries would be 15.2 times as great by atomic bombing as by incendiary bombing.

Senator TYDINGS. What do you mean? One incendiary bomb?

Dr. TERRY. I said incendiary bombing.

Mr. NITZE. To produce comparable physical damage.

Senator TYDINGS. Would it take 15 times the number?

Dr. TERRY. No, this represents the number of injuries produced by the atomic bomb in comparison to incendiary bombing. If one produced the same amount of damage in two comparable cities, in one by incendiary bombing, in the other by atomic bombing, there would be 15 times as many people injured in the second as in the first. There would be 18 times as many people killed. The exact figures are 15.2 and 18.6.

Senator TYDINGS. You mean the atomic bomb would injure 15 times as many?

Mr. NITZE. If one destroyed three square miles of Tokyo by incendiary bombs, and if one also destroyed three square miles by atomic bombing, the casualties in the first instance would be one-fifteenth of the casualties in the second instance.

Senator TYDINGS. So that if a city were 3 miles square, for example, and was completely devastated by either method, the amount of casualties as a result of atomic bombing would be 15 times as great as by incendiary bombing?

Mr. NITZE. Right, on the basis of Japanese experience.

Senator TYDINGS. Now I understand you.

Major DE SEVERSKY. May I ask a question?

The CHAIRMAN. Yes, go ahead.

Major DE SEVERSKY. Your comparison is one Japanese city as against the other Japanese city, one Japanese city attacked by atomic bombs against another Japanese city attacked by incendiaries. Are you convinced that the same ratio will apply exactly to a steel and concrete city where there are no wooden structures?

Dr. TERRY. I was not talking about concrete cities. I was talking about comparative mortality and morbidity figures for Japanese cities. For incendiary bombing, five of the largest cities in Japan were taken; for the atomic bombing, the two cities were taken.

Senator TYDINGS. Could you right there give us the number of planes and the number of incendiary bombs that would be used in the comparable area for your statistics for incendiary bombing as

against the one plane and the one bomb used in an atomic bombing, and the length of time?

Dr. TERRY. I don't know.

Senator TYDINGS. Would it be possible for you to construct a reasonably accurate table in answer to that question?

Dr. TERRY. Oh, yes; I think so.

Senator TYDINGS. Will you do it and put it in the record?

Dr. TERRY. Certainly.

Senator TYDINGS. I would like to know the number of planes and the amount of time.

Dr. TERRY. What do you mean by time, sir?

Senator TYDINGS. Well, whether you could take 100 planes in 2 days, or 50 planes in 4 days, or whatever it would take.

Dr. TERRY. If you will pardon my interruption, I don't believe the time element would be of any importance, because actually we will presume that one plane could fly there as quickly and drop its bombs as quickly as a thousand planes.

Senator TYDINGS. If 100 planes came over, they would be a better target than if one plane came over. One plane would be the worst target of all.

You can shoot into a flock of ducks and hope to kill one without aiming very well; but you cannot shoot one duck without having a pretty good aim. That has been my experience with duck shooting, anyway.

Major de SEVERSKY. May I inject something here?

I feel that it is quite to the contrary. Of course, if you are attacking a defenseless city, that is one question; but, if one plane approaches a city that has adequate air defenses, it probably will never get there. In that case, you would probably have to send quite a number of planes to guarantee that one of them would actually deliver the atomic bomb to the right place.

Senator TYDINGS. But with 200 planes you lose the element of surprise. With one plane, you keep the element of surprise.

Major de SEVERSKY. Only for the first time or two times.

Senator TYDINGS. All you want is one time with an atomic bomb.

Senator JOHNSON. One hunter and 200 ducks, or 200 hunters and one duck—that is your comparison. If you have one duck among 200 hunters, as in the case of one plane, he doesn't have much chance of getting away.

Senator TYDINGS. I would like to know how many planes it would take to effect the same amount of devastation with incendiary bombs as it would take with one atomic bomb, and we can figure out the time element almost automatically.

Mr. NITZE. There was some testimony this morning with respect to the number of planes which would have been necessary to produce comparable damage at Hiroshima. I think General Farrell testified that it would be somewhere in the order of 400 to 750 planes, and our testimony was that taking into account the fact that in other cities there was some repeat raiding where you went over some already-burned-out area, while these were virgin cities from the standpoint of fire, about 300 planes would be the equivalent figure.

We also made the point, however, that that would only be fire damage which would result therefrom, that there would be no blast damage and far fewer casualties.

Senator TYDINGS. You can flee from a fire, to some extent, but you cannot flee from an atomic bomb very well.

Mr. NITZE. That is correct, and the casualties would presumably be one-fifteenth what they were from this particular bomb.

The second point we wanted to make was that as you increase the strength of your structures, the relationship does not necessarily go down; the stronger weapon is relatively just as effective against strong structures as it is against weak structures.

Senator TYDINGS. That is sensible.

Mr. NITZE. Granted that there are protective measures which you could take to reduce the loss of life, and Major de Seversky's point was very well taken this morning that this was a surprise attack, that people did not find themselves in shelters. They were all out in the open, and if there had been warning the casualties would have been measurably less.

Senator TYDINGS. You would, however, say that Major de Seversky's point was not well taken when he maintained that one atomic bomb is only 10 times as great as one blockbuster?

Mr. NITZE. That we think is completely out of the realm of any reasonable relationship.

Senator TYDINGS. Your opinion is based on actual examination of the facts, isn't it?

Mr. NITZE. Yes; but one does have to make some hypothetical calculations in order to translate it.

Senator TYDINGS. Not completely hypothetical?

Mr. NITZE. Not completely hypothetical.

The CHAIRMAN. Senator Tydings, Major de Seversky's statement in the Reader's Digest was that one atomic bomb delivered as it was over Nagasaki would do no more damage than one blockbuster dropped in the traditional blockbuster-dropping style over lower New York, not 10.

Senator TYDINGS. I don't think Major de Seversky would maintain that position now, would you, Major?

Major DE SEVERSKY. I still consider that the atomic bomb exploded over concrete and steel cities in the same manner as it exploded in Hiroshima would cause damage to the structure which would be on the order of the damage caused by one 10-ton blockbuster.

Senator TYDINGS. What is that again?

Major DE SEVERSKY. I said it would be approximately the same as the result of a direct hit by one 10-ton blockbuster, but I do not say they will be equal if both of them score direct hits. That is another story. We went through that this morning and it is all in the record, sir.

Senator TYDINGS. Well, I don't want to take issue with you, because I am here to listen and not to argue; but I would say that some 25 men who have preceded you on the stand, who have worked on the atomic bomb and experimented with it and have viewed the damage, all take issue with you, and none of them support you.

Major DE SEVERSKY. I still have to maintain my own opinion based on my observations, and if I find I am mistaken I will have enough moral courage to admit I was wrong.

Senator TYDINGS. All I was trying to do was to see if you could agree that the atomic bomb, as testified here, was 100 or 200 times

greater in its material destructiveness than is the blockbuster. You don't agree to that? You think they are equal?

Major DE SEVERSKY. It depends on the target. I went through that this morning.

Senator TYDINGS. I hope if I am in New York and they have a selection of weapons the next time they are going to bomb that city in the next war, the fellow who selects them will take a blockbuster instead of an atomic bomb, and I am sure you will agree with me.

Major DE SEVERSKY. It all depends on the means of defense you are going to work out.

Mr. NITZE. Perhaps the reason there is disagreement is that you might not get what is called structural damage, as defined by the weapons-analysis experts, which means main structural members have given way, to the heavy steel structures of New York from a bomb exploding at the height that the atom bomb was actually exploded at Nagasaki, but you would certainly get an enormous amount of the type of damage which is important to the citizens of the United States, which is to have the walls blown in, to have people killed in large numbers, to have the buildings made completely useless as any place where you can live or do any business.

Senator TYDINGS. I would like also to have put in the record, if it hasn't been put in, by whoever can put it in, that we have the scope of the 10-ton blockbuster put in the record at about this point so that we may have the actual limitations.

Mr. NITZE. As it happens, I don't believe there is a 10-ton blockbuster. None was ever built.

Senator TYDINGS. Well, whatever one there was, the largest. I would like to get that in so we not only would have what we know about the atomic bomb, but what we actually know about the 5- or 6- or 7-ton blockbuster.

Mr. NITZE. We might go through some of these paragraphs, paragraph by paragraph.

Major de Seversky says that the appearance of Nagasaki and Hiroshima was comparable to the appearance of any other city that was burned, which is quite right, because the result of the secondary conflagration is the thing which you first see when you go there, the remains of a big fire. But as one looks more deeply into the thing, the effects are different.

I don't believe an incendiary raid would produce evidences of flash effect such as one finds in Hiroshima and Nagasaki. I have here a piece of tile from the tile roofs that Major de Seversky refers to, which shows the bubbling effect one gets on the tile roofs.

Major DE SEVERSKY. Why is it caused by flash and not by fire? It is heat, isn't it? But why flash and not fire?

Mr. NITZE. I believe experience shows that that type of effect would not result from a secondary fire, that that could only be produced by the radiation and flash effect of an atomic bomb.

Professor BOWMAN. That only occurred near zero point. It didn't occur throughout the area where the buildings were burned.

Major DE SEVERSKY. I am going to show you a picture at zero point where the paint is beautiful, nothing was scorched. Unless the explosion hits like lightning bolts and sizzles this spot and that spot and not the entire area, I am completely flabbergasted.

Professor BOWMAN. There were acres of this bubbled roof tile.

Mr. NITZE. Out to considerable distances it was bubbled.

Professor BOWMAN. 600 to 1,000 feet from zero this effect took place.

Major DE SEVERSKY. How would you explain to me that on the top of those buildings, practically at zero point, the paint on the railings and wooden doors survived?

Colonel WARREN. There are a lot of things we cannot explain, but you can see plenty of evidence on telephone poles where this infrared radiation, without any flame at all, affected the side of the pole toward zero and not the side in the shadow, and that is exactly the same thing.

Major DE SEVERSKY. There is nothing to prove to me that this is necessarily a flash burn.

Senator TYDINGS. This goes horizontally through the air, as I understand it, and hits whatever it comes in contact with.

Colonel WARREN. It is like light, subject to screening which produces shadows.

Mr. NITZE. I think with respect to this point we can supply photographs of the gas tank which was some four or five thousand feet from zero point in Hiroshima where the paint is clearly glazed wherever it was exposed, and where you can see the shadows of an intervening building which was blown down by the subsequent blast as clearly as though it were brilliant sunlight. Even out at that distance there was that type of effect.

Major DE SEVERSKY. I can remember, for example, burns on a white concrete bridge at one place where one of the men I talked to told me people were knocked down and were lying on the bridge for some time during the raging fires. The whole bridge was smoked up, but when the bodies were removed they left a white imprint on the bridge.

Professor BOWMAN. But there are places where the railing of a bridge cast its shadow and the rail was still standing, so that wasn't lying on the bridge during the fire.

Major DE SEVERSKY. Behind the pole there were white spots.

Colonel WARREN. Not very far out.

Mr. NITZE. With respect, for instance, to such things as telegraph poles still standing, and with respect to chimneys still standing, those are certainly structures where the pressure equalizes very rapidly. The pressure hits on one side, and almost instantly the pressure is equal on the other side, so it is to be expected that that type of thing would survive and did survive even though some of the chimneys, as Colonel Warren stated, were structurally injured at the base. I think on analysis that is not a difficult phenomenon to explain.

If one wants to give protection to people close in to an atomic explosion, it can be done with adequate shelters; but you cannot have openings because the blast would blow in, and flying debris was one of the largest causes of casualty in Hiroshima and Nagasaki. If you don't have openings, then you don't have an equalization of pressure and the shelters would have to be strongly constructed.

One of the reasons why structural damage was probably not greater than it was from blast was due to this equalization of pressure as the windows blew in and the blast equalized. But if you try to protect the people inside, then you have to have a structure which will maintain itself even though the pressure does not equalize.

Major DE SEVERSKY. What do you think would be the effect if they used the kind of shelter that we saw at Essen and IG Farben in Germany?

Mr. NITZE. I think it was our opinion that shelters of that type would stand against a bomb exploded at this altitude, and that the people therein would have survived. In other words, it is possible to build shelters which would protect people from this explosion at this altitude. I think Major de Seversky's point is well taken that if you lower the altitude you shrink the area exposed to the effect of the bomb, even though you increase its effective power within the smaller area.

General Farrell's point that it probably is impossible to construct any structure which would give total defense against a direct hit is also well taken. All that can be done is to reduce the area of vulnerability by improved types of structures.

There are a number of minor factual errors in the article, in addition to these mentioned. It does seem, moreover, as though Major de Seversky had been trying to make a point and had not presented factual data impartially from the scientific point of view or from the impartial standpoint which he recommends at the end of his article. It seems the phraseology in the article is misleading where it is not wrong and is not necessarily a fair phraseology.

Senator TYDINGS. Of course, you are talking all the time about the old atomic bomb.

Mr. NITZE. Yes, our investigation of course was limited to the bombs that were dropped at Hiroshima and Nagasaki.

Senator TYDINGS. To the first two. Unfortunately, much of the testimony before this committee has been in secret with FBI men standing at the door, so we are in no position to talk about the future atomic bomb. It is only fair to say that these conclusions are based on the first two that were used.

Mr. NITZE. I think we might make a few comments with respect to the relative effectiveness of the bomb dropped over Hiroshima and the one dropped over Nagasaki. It is quite true that the area which was destroyed at Nagasaki was less than the area at Hiroshima, but that is solely due to the nature of the target. The intervening hills did protect a portion of the downtown area of Nagasaki, but not all of it by any means. I think we have got some photographs here which will show the degree to which that downtown area was injured.

I think Dr. Bowman's figures conclusively demonstrate that the radius from zero point, at which structures of comparable types were damaged, was appreciably greater at Nagasaki than at Hiroshima. That is correct; is it not?

Professor BOWMAN. That is correct.

Senator JOHNSON. The Nagasaki bomb, then, was the more potent of the two?

Mr. NITZE. Yes, measured from ground effects irrespective of the scientific computations as to the energy released.

Senator JOHNSON. Is that true in all departments—the blast, the radioactivity, the heat, and all?

Mr. NITZE. I think in all effects.

Professor BOWMAN. We have no figures on radioactivity.

Senator TYDINGS. Could I ask you whether the maximum point of blast effect was measured at Nagasaki, and if so what was it?

Mr. NITZE. The distance from ground zero?

Senator TYDINGS. You gave some figures starting with 7,000, 6,500, and 2,000 feet, and so on. Have you any comparable figures where the hills did not intervene showing the scope of the Nagasaki bomb?

Mr. NITZE. Yes, I think Dr. Bowman has those figures here.

Professor BOWMAN. I don't have exactly comparable figures.

Senator TYDINGS. Give us an approximation.

Professor BOWMAN. The relative effectiveness of the two bombs?

Senator TYDINGS. Well, as I recall you stated, I think, 7,800 feet.

Professor BOWMAN. I would say that the given effects at Hiroshima were repeated probably 25 percent further away at Nagasaki.

Senator TYDINGS. So that it would be a fair average conclusion to take the limitations you have mentioned on the effect of the bomb at Hiroshima and add 25 percent to each category in estimating the increased scope, and so forth, of the Nagasaki bomb?

Mr. NITZE. Yes.

Major DE SEVERSKY. Senator, I don't think it is exactly fair to use it as an inescapable conclusion, because while intervening hills limited the spread of the blast in one direction, they also might have assisted the propagation of the blast in another direction, forming a sort of channel, like the phenomenon that takes place in a wind tunnel or a gun barrel. In Nagasaki, I can show you a great many wooden buildings still standing up at a distance nearer to the zero point than in Hiroshima, and you can measure it yourself on the map.

Dr. MORRISON. But shielded by hills?

Major DE SEVERSKY. Not at all; I can show it to you.

Senator TYDINGS. I am in no position to argue the merits of this, but with a limited knowledge of it I don't think it got much force from from the echo of the hills.

Major DE SEVERSKY. This section here [indicating photograph], I have pictures of it; it all consists of ordinary Japanese wooden buildings. That distance from here to zero is shorter than the distance in Hiroshima in a similar case, yet here it isn't protected by the hills. There are no obstructions in this direction, and that is a fact.

Senator TYDINGS. What have you gentlemen to say to that observation?

Professor BOWMAN. There are freak effects in all bombings, but I am comparing comparable concrete buildings, and I would like to revise the 25-percent figure I gave a minute ago and make it 15 percent. I have looked at some figures, and I think that the results in the two cities were of such magnitude that you can say that equal damage occurred 15 percent farther out in Nagasaki than in Hiroshima.

Dr. MORRISON. If I may, I would like to add one more statement on the USSBS people's statement.

We made measurements simultaneously with the blast which were not measurements of damage, but simply measurements of the excess pressure, which I think would quite well agree with the damage estimates that these gentlemen have made. These are instrumental measurements, not measurements of the damage on the ground, but certain instrumental effects we observed which confirmed our belief that

the Nagasaki bomb was a more powerful weapon, and which agree in magnitude with the damage estimates.

The CHAIRMAN. All right, Dr. Nitze. I don't want to hurry you, but I do wish to get through with this.

Mr. NITZE. I think we have touched on the major points. I think the most important point is that on heavier structures, if we were using the bomb against a city which was built not as the Japanese cities were built but with much heavier structures, you would still have approximately the same relationship between the effectiveness of a blockbuster and an atom bomb as one does have against the flimsy structures.

I think that is the major point of this argument.

Major DE SEVERSKY. If it exploded in the same manner?

Mr. NITZE. That is right.

Major DE SEVERSKY. We have no disagreement.

Mr. NITZE. I might discuss your computation here. You said:

It seems to me completely misleading to say that the atomic bomb used on Japan was "20,000 times more powerful" than a TNT blockbuster.

In the first place, there is an error in the mathematics there, because in the first paragraph you have talked about a 10-ton blockbuster, and such a bomb would contain 5 to 7 tons of TNT, and as I remember it the statement was made that the force released by the Nagasaki bomb was 20,000 tons of TNT, so the figure would go right down to 3,000 to 4,000 and not 20,000 such blockbusters.

To continue to quote from your article:

From the view of total energy generated, this may be correct. But we are not concerned with the energy released into space. What concerns us is the portion which achieves effective demolition. From that point of view, the 20,000 figure is reduced immediately to 200 for a target like Hiroshima.

We feel that that figure is wrong; that it would be in the order of 100 to 200 ten-ton blockbusters, which brings us up to a 1,000 or 2,000 tons of bombs and 500 to 1,000 tons of TNT in any case.

Major DE SEVERSKY. I have an explanation to make there. In that particular case, I considered the ratio between the two tactical efforts to destroy the target. In other words, I feel that 200 planes loaded with ordinary bombs could do the same destruction to Hiroshima that one plane could do dropping one atom bomb.

Mr. NITZE. But if we are talking about that, a plane carries up to 5 to 10 tons of bombs; it doesn't carry just 1 ton of bombs.

Senator TYDINGS. Are we talking about 200 planes—carrying what?

Major DE SEVERSKY. A full load, roughly 10 tons.

Mr. NITZE. Then, it is 2,000 planes.

Major DE SEVERSKY. No, 200 planes.

Mr. NITZE. Two hundred planes you are figuring for incendiaries, which we think ought to be 300 planes.

Senator TYDINGS. Read that paragraph to me, again, will you, please?

Mr. NITZE (reading):

It seems to me completely misleading to say that the atom bomb used on Japan was "20,000 times more powerful" than a TNT blockbuster. From the view of total energy generated, this may be correct, but we are not concerned with the energy released into space. What concerns us is the portion which achieves effective demolition. From that point of view, the 20,000 figure is reduced immediately to 200 for a target like Hiroshima.

Senator TYDINGS. That should have been 2,000, then, according to the calculations you just made here.

Mr. NITZE. That is correct.

Senator TYDINGS. So it is 1,000 percent out of line?

Mr. NITZE. That is correct. [Continuing to read:]

For a target like New York, the figure of 20,000 drops to one or less.

We don't think it drops at all.

Senator TYDINGS. All right.

Major DE SEVERSKY. I still want to defend the figure of 200 for the simple reason that what I was trying to point out to the people was that the Hiroshima bomb was not 20,000 times more powerful than a TNT blockbuster. I was also answering the Chicago scientists, who accused me of wrong arithmetic. I was proving to them that I was right when I figured that Hiroshima might have been put out of commission or destroyed by 200 Superfortresses. They said that if one Superfortress destroyed one city, 200 Superfortresses ought to be able to destroy 200 cities. I said to them they forgot one little detail, that all such cities ought to be of the same flimsy nature of Hiroshima.

Senator TYDINGS. What would happen if 100 Superfortresses carried 100 atomic bombs over Hiroshima?

Major DE SEVERSKY. I think that would be a waste of material. My answer was directed particularly to this group of scientists in Chicago. I thought that they should have qualified that all the 200 cities should be of the same nature as Hiroshima; in that case, they would be right. If the 200 cities were like Chicago and New York, it will be an entirely different matter. Two hundred bombs of the type that were dropped on Hiroshima will not destroy 200 Chicagos, and I stand by that statement.

Senator TYDINGS. I think I see what you mean, but the article conveys another impression. That is my point. I see what you are saying now, but I think your article conveys another impression; and in any case, it is 1,000 percent in error even on your own explanation.

Major DE SEVERSKY. Are you talking about destruction, yes? I am talking about the number of planes. That paragraph is tied up with the previous paragraph. You cannot read the two paragraphs separately. You have to read both of them, and the entire content of the article; and I have no question that anybody who reads it will understand what I mean.

Senator MILLIKIN. Mr. Chairman, could I ask a question of any of the witnesses here, whether it would be feasible or practicable to conduct a model test, a heavy structure model test, and extrapolate the results?

Mr. NITZE. I think Dr. Morrison could testify best on that.

Dr. MORRISON. I think we had very good tests at Nagasaki and Hiroshima which were very expensive, and I think the British people and our own people have analyzed the results.

As to the conditions of the first atomic tests, we made very careful tests of measuring impulses and all the effects of damage as a result of distance.

Now, experience with explosions has given us a way to correct these figures as to damage to all sorts of structures. European and otherwise, and I think it is on this experience that the USSB surveys have worked. I don't think we need any more information on that, and it would be

expensive. I think we can predict within a factor of two or thereabouts just what would happen to any particular building.

The CHAIRMAN. Taking it into New York, now, with his example of one blockbuster doing as much damage as one atomic bomb, what comments have you got to make on that?

Dr. MORRISON. That it is not true, because it does not agree with the facts. It is a technical question.

The CHAIRMAN. What is true?

Dr. MORRISON. I don't know. I think the USSBS people might be better to estimate than I. It is evident that the damage is not proportionate to the energy released, and that is perfectly clear. The damage is done more or less in proportion to the area of damage which goes up not directly with the distance away for a given effect but the square of that distance. If you double the distance of effects, you multiply by four times the amount of damage, other things being equal.

Major DE SEVERSKY. How about interfering structures between?

Dr. MORRISON. If you double the radius—

Major DE SEVERSKY. You cannot talk about radius without first giving the nature of the target.

Dr. MORRISON. I say if the radius were double. Now, to double the radius requires much more than a two-fold increase in energy, very much more—I would say in the order of 8 to 10 times more; allowing for intervening structures, I would say 10. Without that, I would say something like 8, and that is why we made a bomb of this size, a 20,000-ton equivalent, as the President has said.

One could make bigger bombs to do more damage, but it soon doesn't pay because you have to increase the energy so much.

Senator MILLIKIN. You say from the experience and knowledge we already have you can make a fair approximation of what will happen if an atomic bomb of the kind that we have now, or of any other kind, might be dropped in lower Manhattan?

Dr. MORRISON. Yes, sir.

Senator MILLIKIN. Are you ready to speculate on how many blockbusters it would take to produce the same effect at the same place?

Dr. MORRISON. Well, I don't like to make an off-hand statement. Major de Seversky has had a long time to talk to the committee. He has printed articles, and I have to try to answer in an off-hand sentence, so I hope you will understand that what I am saying is not very sound, and I will give a large region for error. I will be conservative and say at least 100, perhaps 300 or a thousand, depending on the nature of the targets. I cannot imagine any target in which the bomb used in the appropriate way against the blockbuster used in the appropriate way for it would not do something like 100 times as much damage.

Senator TYDINGS. Considering the opposition of a great deal of the country to certain parts of New York City, I think the committee might take under advisement an actual demonstration.

Major DE SEVERSKY. Senator, I think it is very difficult to prove these contentions, because I do not think the New Yorkers are likely to be bombed within the next year. But we are going to have some tests in the near future, and I would like to ask Dr. Morrison what he thinks the atom bomb is going to do to the Navy, and then probably within 6 months or so we will be able to find out which assumption is closer

to the facts, because then we will be able to see the results with our own eyes.

Would you tell me roughly your idea as to what you think is going to happen to the ships?

Dr. MORRISON. I do not want to talk about the Navy, but since you direct me to do it, and if the committee is perfectly willing, I am willing to talk about it, but I shouldn't. I do not know the precise ships or their placements, and, therefore, what I have to say is rather speculative.

I would tend to agree with the statement you made earlier that the air shot will not damage more than a handful, if that many, ships. That is all I can say.

If you want to drop the bomb within a couple of ship-lengths of any ship to make a pretty broadside target, either 500, 800, or 1,000 feet, you would smash any capital ship, in my opinion. But I think the test as actually done with a high-level air shot will not damage but the closest ships. The next will be slightly damaged, and the ships any distance away will not be damaged at all.

Major DE SEVERSKY. The only difference between you and me is this: I feel that if the air shot is going to be dropped like at Hiroshima, the battleship is not going to be damaged very badly.

Dr. MORRISON. I would advise you not to stand on the deck of that battleship.

Major DE SEVERSKY. I don't think I would like to, either, but I think I wouldn't mind—except for the radioactivity, after what I saw in Hiroshima—I wouldn't mind being below the deck.

Senator TYDINGS. You may be my proxy, Major.

The CHAIRMAN. Are there any other comments, Mr. Nitze?

Mr. NITZE. I would like to make one more comment.

I think the measurement of the physical destruction is not the appropriate measure of the true effectiveness of the bomb, for the impact this bomb had on Japan, or any other country presumably, is far greater than that. For instance, one can take this general hospital in Hiroshima which the major referred to and said that no one was seriously damaged in the building and the building was not structurally injured. It is true that no structural member was damaged in that building, but it is also true that as a useful instrument as a hospital it was completely useless to the Japanese for 3 weeks or longer thereafter.

Major DE SEVERSKY. And I added that the damage was exactly the same as the damage that would be done by a blast of TNT bomb. In other words, glass was blown out, the plaster fell down. It probably knocked a lot of patients down too.

Mr. NITZE. 90 percent of the people in it were injured.

Major DE SEVERSKY. Not by direct action of the atomic bomb, but by falling plaster, which would happen with a TNT bomb.

Dr. MORRISON. How far away would a TNT bomb have to be to do the same damage to the hospital?

Major DE SEVERSKY. I would say about two or three hundred feet.

Dr. MORRISON. This was exactly 1 mile away.

Major DE SEVERSKY. About 10 times.

Colonel WARREN. And it tore up X-ray equipment bolted to the floor, moved partitions and dental chairs that are very heavy.

Major DE SEVERSKY. But the building itself was structurally intact.

Dr. TERRY. It injured 90 percent of the people in it, the patients and personnel, and the hospital was not able to continue as a hospital.

Major DE SEVERSKY. That is what I say in this article. The loss of life was tremendous from the atomic bomb—far more than from any other source.

Dr. TERRY. You said the people inside were not seriously affected, which is not true when 90 percent of the people were injured and when the personnel was not adequate to carry on the hospital functions. It is not exactly a complete misstatement, but it is said in such a way that no one could interpret it correctly.

Senator TYDINGS. What would be the cost to repair that building, as compared with its original cost?

Dr. MORRISON. I think one of the people from the USSBS might be able to help. Anybody who has built buildings has some notion. I have not built buildings and do not know what would be the cost of rebuilding the Red Cross Hospital in Hiroshima from the condition in which it was left after the bomb as compared with the cost to build the complete building. My impression is that most of the value of that building was destroyed by the bomb because such a terrible job was done to the internal building.

Major DE SEVERSKY. I don't think the hospital was destroyed to that extent. I think it was primarily superficial damage—windows and plaster. I went through it very thoroughly, and, as a matter of fact, my statement is based on the report of doctors and nurses who had been working there. I simply repeated what three doctors told me and what six nurses told me. Naturally people were injured by falling plaster like in an ordinary TNT explosion but there were not any 1,000-mile hurricanes blowing through there. There were some people injured by glass. In England, during the bombing, the major injuries were sustained from flying glass. Those are not supernatural phenomena.

Dr. TERRY. From a practical standpoint, it doesn't make any difference how a man is killed, whether by hitting him over the head or by flying glass—he still is dead, and that is the important thing I think one has to consider in talking about injury produced regardless of how it was produced. The one outstanding feature, I think, about the atomic bomb from all other types of bombs is the abnormally large number of human casualties that were produced. They were produced in all manners, but that is relatively unimportant. The fact is they were produced.

Major DE SEVERSKY. Due to the element of surprise. I could guarantee to produce more injuries in the same city by using poison gas if no one knew I was going to use it. It is a question, in that case, of attacking an unprepared and defenseless city where there was no adequate air-raid precaution measures. They were not prepared for the ordeal, and you cannot credit the bomb with the unusual loss of life on that basis. Through the whole history of military science, when you have an element of surprise you cannot properly judge the true value of your weapon, because, under those circumstances, its efficacy is enormously enhanced. We cannot take for granted that similar losses will occur in the future, because in Hiroshima and Nagasaki the element of surprise was the major contributing factor.

The CHAIRMAN. Any other observations?

Mr. NITZE. I think there are a great many detailed observations we could make. There is one further point I would like to refer to, and that is that Major de Seversky this morning referred to the fact that Japan was already defeated by air power, and that the major influence of the atomic bomb was that it made an invasion unnecessary.

On that point I think we would more than agree with the major. It is our opinion that Japan probably would have surrendered prior to November 1 in any case; the atomic bomb merely accelerated the date at which Japan surrendered.

We have got some photographs in case anybody would like to look at them, but I do not think they are necessary.

The CHAIRMAN. Dr. MORRISON, have you any salient points you wish to make?

Dr. MORRISON. Perhaps I would like to make a couple of remarks.

STATEMENT OF DR. PHILIP MORRISON

Dr. MORRISON. As I see it, Mr. Nitze has expressed the real point in issue here, which is whether the atomic bomb will do a great and overwhelming amount of damage to American or European industrial cities since it has only been observed to do damage over rather lightly constructed cities, like the cities of Japan.

The nature of Major de Seversky's comment is that it will only do damage comparable to that of a very large TNT bomb carriable by one plane. Against this one has to look into the technical features of the situation, which I do not believe Mr. de Seversky has had an opportunity to do; at least he doesn't seem to have had access to the published figures and all the standard general information on damage, some of which is very relevant.

It is true that we do not have any experience with the atomic bomb over a city of western construction. We have, however, some experience with large explosions in these cities. I think the most famous explosion was that in the harbor in the city of Halifax caused by the detonation of picric acid, which is similar to TNT, corresponding to 4,000 tons. That was out in the harbor some distance from the shore. It was outside the city of Halifax, and although I have only been in Halifax once, I would say that if you should pick out a city at random in the United States you would find a city similar to Halifax. It is not like lower Manhattan, but there is not much in the United States that is like lower Manhattan. This city was damaged pretty badly by this accidental explosion equivalent to 4,000 tons of TNT. I think the number of casualties is not well known, but it was estimated to be about 30,000. This is the best sort of experience we have in this direction.

In one German city there was a 5,000-ton explosion of ammonium nitrate, and there again the casualties—this was rather remote, out from the center of the city in a chemical plant—were only a few thousand. I think you have to think of these things to see that a 20,000-ton explosion, that of the atomic bomb, will do much the same sort of damage.

The scale factors in going from a 10-ton to a 20,000-ton bomb are known. It is not correct to say that there is 2,000 times as much dam-

age. There is 2,000 times as much energy, but not 2,000 times as much area of damage.

However, one can look at some of the scale factors, and I think you will see the sort of thing we have in mind. For example, the standard British figures learned by experiment and also by actual observation in damaged regions show that for a 2-ton blockbuster. Let me give you a few figures. We have not, of course, exposed people to this, but from actual measurements made in the same way with the same instruments on 2-ton bombs and on the atomic bomb, and from actual observations of what 2-ton bombs do in European cities, we have some standards to go on. It is a question of measuring, not a question of opinion, as far as I can see. It is a technique one has studied and knows something about.

One distance, for example, is the distance at which lung damage from blast becomes important. This is surprisingly close to a bomb. That is, people are rather resistant to blast, so if a man is not hit by debris or pushed against a wall, or burned, but simply hit by a blast wave, it must be close to him. The figure given is something like 50 feet from a 2-ton blockbuster, and the man has a fair chance of surviving against this damage, against lung damage. That figure would go up to something like 1,200 feet for the atomic bomb.

In the same way, a 9-inch wall, which is a good example of grade B damage, would be expected to be pushed over most of the time at 200 feet from a 2-ton blockbuster, and I would say that the equivalent scale factor from our experience with this bomb would be about 4,000 feet.

Pressures due to a tornado produce only partial structural damage—a tornado would not have fazed the medical school or the Red Cross Hospital at Nagasaki. It would have done about the same thing the bomb did, smashed the insides. But the aerial photos would still look pretty good. That is what we call roof and ceiling damage—skylights, casements, interior partitions, and so forth.

The tornado scale of damage was produced 450 feet away from a 2-ton blockbuster, and about seven or eight thousand feet away from an atomic bomb, I would say.

Now, if you get 650 feet away from a 2-ton bomb, you have the effect of a wind gale as of a severe storm which will knock over billboards, light roofs, and probably knock over many Japanese houses, but not very serious. That same effect would be produced at about 14,000 feet as against 650 feet. All one has to do is to look at these scale factors, and it becomes hard to see how you can conclude that against any kind of a target, the two will not have qualitatively a different kind of damage—100 times as much—maybe 300, I wouldn't argue about that, and I think that is all that any responsible person has ever claimed.

It is perfectly true that the total area of damage in lower Manhattan would be much less than the total area of damage at Hiroshima; no one can doubt that. I think the total casualty damage would be comparable, because the thing that protects Manhattan is that it is strong and densely populated. It was made to have a lot of people in it. I think in the same way, roughly, you would do about the same dollar damage in lower Manhattan as you do in

Hiroshima. The building costs more to build and is stronger when you get it done.

I don't think the military effect would be much less than the military effect of a bomb dropped at the right time of day over Hiroshima. If you dropped one at random on Manhattan, not Wall Street, you would produce an effect of much the same qualitative and quantitative damage as at Hiroshima. There would not be so much burning, but the buildings would still be broken down. There would be extensive class B damage, buildings made unusable, capable of repair but not totally destroyed, extending over several miles. You will have casualties running from 30,000 to 100,000.

If the hit were lucky, in the middle of the day while people were on the streets, it might be 200,000.

I cannot see how a conceivably lucky hit with a 10-ton blockbuster could do anything like this. The whole point of what people have been saying about the atomic bomb is not that somehow it magically kills people. It does not vaporize them. It does not make them into glass. It doesn't do any of these things. No one who was responsible said that. But it does produce extensive damage, damage which cannot be produced by less than 100 superbombers of a sort we don't have many of now. One has to remember also that to talk about raids of a hundred or a few hundred bombers measured against one atomic bomb does not give you the right factor. What one must think of in determining what this will do in the future conduct of war and solving the problems you have before you is not the question of what happens when one atomic bomb comes, but what happens when a thousand come, because we are told, and I can assert that it is true, that we can manufacture atomic bombs without appreciably increasing our plants. I think that to correspond with this sort of bomb production, Mr. de Seversky's figure as to the necessary airplanes—which I think he would find great difficulty getting off the ground—would be 200,000 bombers, with 2,000,000 trained crew and another 10,000,000 ground crew. I don't think you can load these people and send them off in a day or 2 days.

Senator TYDINGS. I followed all these figures you have made about the 2-ton blockbuster at 50 feet and a 2-ton blockbuster on a 9-inch wall, and so on, and I see that through all these figures the factor runs about 15 percent, or rather 15 times, and that applies even to area. Would that be a correct summation of your testimony?

Dr. MORRISON. I think that the scale figure I used for distance was about 20, to be very conservative.

Senator TYDINGS. In some cases they are 20, as I followed the figure, and in others they go down to 12, so I arbitrarily figured it at 15. Probably it is closer to 17 or 18.

Dr. MORRISON. It depends on the kind of damage you are talking about.

Senator TYDINGS. But the general examples you gave have a ratio of 20 to 1?

Dr. MORRISON. Yes, sir; that is quite right for distance—not for area, sir. You see, if I did damage over a distance of five blocks, I would damage then a square 10 blocks on an edge, which would be 100 blocks.

Senator TYDINGS. I multiplied that and took diameters instead of radius.

Dr. MORRISON. But I think you have to multiply again by the same figure to get the right ratio for area, because the diameter is in two directions.

Senator TYDINGS. That is the way I took it.

Dr. MORRISON. Well, I think we have some disagreement then in our figures.

Senator TYDINGS. Let me understand. You said, for example, that a person from a blast 50 feet away might live, and it would have to be 1,200 feet away with an atomic bomb. Therefore the figure of radius there is 24 times.

Dr. MORRISON. Yes.

Senator TYDINGS. Now we take that radius and make a diameter out of it, and make a circle or an area out of it from zero point. That is what I did in each one of these equations, so it runs out around 20 percent—that is, 20 times.

Dr. MORRISON. I think in order to get the area you have to square the ratio. Suppose we consider the case of lung damage. Let me take 1,000 feet as against 50 feet for round numbers.

Senator TYDINGS. Let's take the area of a 1,200-foot radius and a 50-foot, and multiply them both and compare them—and that is what I did.

Dr. MORRISON. That is what you did?

Senator TYDINGS. Yes.

Dr. MORRISON. Maybe we should do it together.

Senator TYDINGS. You would square the diameter and multiply by 0.7854, wouldn't you, to get the area of a circle?

Dr. MORRISON. Did you square 1,000? Let me put it a little more simply. Instead of a circle, use a square.

Senator TYDINGS. You are right; I see your point. I did everything except square it, and you have squared me.

Senator JOHNSON. Dr. Morrison, is it an exaggeration to say that one atomic bomb equals 20,000 tons of TNT?

Dr. MORRISON. No, sir; that is a correct statement.

Senator JOHNSON. That is a correct statement?

Dr. MORRISON. That is a correct statement. It is not a correct statement to say that it does the damage which 20,000 individual 1-ton bombs would do. That is no longer a correct statement.

Senator JOHNSON. What is the basis of comparison, then?

Dr. MORRISON. The basis of comparison is on energy released, and what we are saying is that the atomic bomb does the same damage that would occur if you had an arsenal containing 20,000 tons of TNT all in one piece, and simultaneously blew it up. Then you would have very comparable damage.

There are some additional factors, but for the purposes of argument they are not important; so I would say it is a sound statement to say it is like an explosion of 20,000 tons of TNT. It does not do as much military or tactical damage, as Mr. de Seversky has pointed out, as 20,000 individual planes each dropping 1 ton.

I might perhaps give a rough explanation of why this is. The point is that you blow up the center of this region very thoroughly. You blow it up into tiny, little pieces; whereas if you have 1-ton bombs, you blow up many more regions into medium-sized pieces. As far as the military effect goes, it doesn't matter if a man is blown into a thousand or five thousand pieces, or into two, as Colonel War-

ren reminds me. It is more efficient to kill a man by blowing him into two pieces than to waste your energy in tearing his building or him up into shreds. The building is useless and the man is dead.

All you have done is spread energy violently in this area. As you go farther out, the energy goes down. It is not true that 20,000 tons of TNT does 20,000 times the area damage as one blockbuster of one ton achieves, but it does do several hundred times as much area damage, and that is the point we are trying to make.

Senator JOHNSON. Thank you.

The CHAIRMAN. Is there anything further that any of you gentlemen wish to add?

Senator MILLIKIN. I would like to put a clincher on the thing I have already put to the witness.

If you made the New York Stock Exchange the zero point, could you by your calculations and by your existing knowledge of this energy figure out how many atomic bombs of given power would have to be put down there on zero to accomplish a desirable area of destruction?

Dr. MORRISON. Well, I think that if one had photos of the area, some information from the structural people about the strength of the buildings, one could plot out roughly the A and B damage circles around this zero point for one bomb, and one could decide where to drop the next nearest bomb to get the desired damage.

Senator MILLIKIN. You might miss it, but it wouldn't be grotesquely wrong?

Dr. MORRISON. That is right, sir. It doesn't mean that everybody within the damage circle would be dead, 100 percent damage. There would be some cases of people who would walk out, some cases of bannisters not knocked down, and so on, because of the very complex geometry of a city wherein nobody can go and look at the ruins and say, "There was a telephone pole just up here that shaded that particular piece of railing."

That is a thing you cannot find out afterward, but the military can predict results with good accuracy. This was done for the Eighth Air Force and the Twentieth, as well, during the war, with considerable success, and it was done, I may say, for the Hiroshima and Nagasaki areas. We have tried to make an estimate of what the military effect would be, and we found it to be about right.

We did underestimate—and this was an error—the terrible effect on casualties, and the great morale and psychological effect that came from the saturation nature of the bomb. Mr. Penney, of the British Mission, pointed out in advance that we were tending to underestimate the saturation. He correctly said, 3 days after the test shot in New Mexico, that one of these bombs would destroy the military value of a city of 300,000 population. The city of Hiroshima is 308,000.

Senator MILLIKIN. I think I can put my question in an entirely different form. Are you able to estimate with reasonable accuracy the masking effect of heavy structures, assuming you know all about those structures and their relation one to another?

Dr. MORRISON. That is a little hard to do. I think with fair accuracy one could do that, but that is a rather serious problem.

Senator MILLIKIN. That is why I asked awhile ago if there was a practical way to do it in model form.

Dr. MORRISON. I am afraid it is hard to do it. This is a question I cannot give an answer to offhand, but I don't think the masking effect would seriously affect the military nature of the problem. The buildings would have to go somewhere. They fall in the streets; people are killed by the blast leaking through the alleyways and so on. You might not correctly estimate the air cover, but you would not, I think, incorrectly estimate the effect of damage.

Now, it is certainly possible to build buildings that will withstand anything but a very close hit from an atomic bomb. It is easier to build buildings that will withstand anything but a direct hit from a 10-ton bomb, but I don't think any sizable fraction of our population live in such structures.

I think the structures, as Colonel Warren pointed out, that the Japanese had in Nagasaki, and some of the structures in Hiroshima were stronger than any comparable buildings we have in this country. I don't think you can find anything equal, except in Los Angeles and Berkeley, Calif., where special earthquake building has been done. This was not uniformly true, but there were some buildings of that kind.

If you take a train coming through New York or Chicago, as I have done, you look over the rooftops of the city from the elevated structure, you don't see many buildings that would last within a few thousand feet of an atomic bomb.

The CHAIRMAN. Thank you very much, Doctor.

Dr. Ridenour, you are here specifically to talk about basic scientific information and technical know-how and what you conceive to be the necessary secrecy restrictions, I believe.

Dr. RIDENOUR. Yes, sir.

The CHAIRMAN. Will you proceed, Doctor?

STATEMENT OF DR. LOUIS N. RIDENOUR, REPRESENTING THE FEDERATION OF AMERICAN SCIENTISTS

Dr. RIDENOUR. My name is Louis N. Ridenour. I am on leave from the physics department of the University of Pennsylvania, and now at the Radiation Laboratory, Massachusetts Institute of Technology. Although I was a prewar nuclear physicist, since the beginning of 1941 I have been concerned with the design of military and naval radar equipment, and with the steps necessary to insure that effective use is made of this equipment in actual warfare.

The hearings so far held by this committee are impressive in their completeness and impartiality. I wish to discuss one tremendously important aspect of atomic legislation: its provisions for maintaining secrecy with regard to the fundamental scientific content of what has been called the secret of the atomic bomb.

This question has been touched on in testimony before this committee. There is universal agreement that it is wise and useful to permit and even encourage full and free publication of all the results and findings of basic scientific work, provided only that this is not done on a unilateral basis—provided, in effect, that other nations will trade their scientific results for ours. However, some of the individuals who have appeared before you—for example, General Groves—have either implied or stated explicitly that it would not be wise

for us to maintain such a policy of free publication of basic scientific work if other nations refuse to do likewise. I feel that this is entirely wrong. I shall try to show you that the interests of our nation will be better served by complete freedom of publication of the results of scientific work than by attempting to restrict the circulation of such information to a certain group in this country, in order to prevent its leakage to foreign nations who might be our enemies in a future war. In my opinion, this is true even if no other nation in the world has a policy of free publication of scientific results. It is true whether we think that we have entered on an era of international peace, or believe reluctantly that we must prepare ourselves for inevitable war.

It is easy to make an idealistic argument for freedom of scientific publication: to say that the publication of results is the lifeblood of science, to assert that only by demonstrating our international good faith by a policy of free publication can we hope to set the stage for international trust and understanding. I shall not make such arguments, because I do not believe that they cover the present case. Our nation is clearly committed to an atomic armament race at least as an interim national policy; the fact that we are still manufacturing and storing up atomic bombs admits of no other interpretation. There are evidences that other great nations are ready to enter into this race with us. Under these conditions, we must make plans in the light of the possible failure of the measures now being taken for securing international agreement on inspection and control of atomic energy. I shall therefore confine my remarks to the desirability of freedom of scientific publication in an era of international suspicion, during an armaments race, and even in the midst of a war.

C. F. Kettering has said: "When you lock the laboratory door, you lock out more than you lock in." In the radar field, we started with the same atmosphere of secrecy, the same precautions about compartmentation of information and clearance of individuals, which characterized the atomic bomb project right to the end, and still characterize it today. However, we did away with most secrecy before the end of the war. At the end of the war, the Army was publishing a magazine on radar with a circulation of over 12,000. It had become by that time apparent that secrecy cost us in efficiency far more than it gained us by keeping the enemy in ignorance. We found it a lot harder to inform the enemy than readers of spy stories may think. In the spring and summer of 1943, Allied aircraft were finding and killing German submarines at a rate not far from one a day, by the use of a new type of radar. There was literally no more important problem to the German high command than to find out the nature of the device our aircraft were using. Exactly the same radar was then in use by Allied bombers attacking Germany; and the inevitable losses of such aircraft scattered this radar—about which the German Navy was so eager to learn—all over Germany and the occupied countries. Despite all this, 6 months elapsed between the loss of the first complete equipment to the Germans and their realization that this was the radar their submarines had to combat.

The use of the word "secret" for the results of scientific investigation or the findings of engineering is genuinely misleading. Let me illus-

trate what I mean. If I say, "I am thinking of a number, but I shall keep it a secret," I have used the word "secret" in its usual sense. Apart from the possibility of my telling you the number, you have no way of knowing it or of finding out what it is. On the other hand, if I say, "I know the critical mass of U-235 necessary to make a bomb, and I intend to keep it secret," I am using the word "secret" in an entirely different sense. I am saying to you, not that you cannot find out what I know, but that you must find it out for yourself, without my help. This may cause you to become annoyed with me, but it cannot keep you in ignorance.

In order to be sure that I am keeping such knowledge from you, I must also keep it from some of my own people. Since it is never known, in science, which man will have a new idea, or what each man must know in order to have the ideas and do the work of which he is capable, I am hobbling my own work by my misguided belief in the usefulness of scientific "secrecy." Arbitrary exclusion of a certain number of my own scientists from full knowledge of my progress removes entirely the usefulness of these men.

This is really the crux of the argument. If we can hide nothing permanently by scientific secrecy, then it is clearly undesirable, for it slows our own progress. Scientific history is full of coincidences—of cases in which two or more men, in different parts of the world, have reached the same result and independently of one another's work and at the same time. Dr. A. H. Compton, an outstanding figure in the work on the atomic bomb, was awarded the 1927 Nobel prize in physics for his discovery of what is now called the Compton effect—the inelastic scattering of light quanta by free electrons. In Holland, this is called the Debye effect, because Compton's explanation of his experiments was given independently by Debye at the very same time.

The Russian physicist, Gamow, and Gurney and Condon—the same Dr. Condon who is scientific adviser to this committee—gave independently and at the same time an explanation of the phenomenon of alpha-particle disintegration of the radioactive elements. The very phenomenon of nuclear fission itself, the basis for the atomic bomb, was only foreshadowed by the work of Hahn and Strassmann in Germany. The hypothesis of a violent splitting of the uranium nucleus was independently proposed and verified by Frisch in Copenhagen and by Joliot in Paris. The suggestion that plutonium would be a suitable explosive for an atomic bomb was made in this country by Prof. L. A. Turner. The Smyth report points out that the same idea occurred independently to the British physicist Cockcroft, and Turner has told me that Von Halban, working in France, had the same idea at the same time.

Two promising new devices for the acceleration of electrons and atomic nuclei to high energies were invented last fall by two young American scientists. One, called the synchrotron, was invented by McMillan, at Berkeley; another, the microtron, by Schwinger, at Harvard. In the summer, 1945, issue of the *Journal of Physics of the U. S. S. R.*, a Russian physicist named Veksler published a paper describing these two devices. Though the scientific shades had been down between Russia and the United States during the war, after 5 years we find Russians and Americans doing the same things, in the same way, at the same time. The synchrotron involves a magnet,

whose design is straightforward but complicated. McMillan is presently building a synchrotron, on funds supplied by the Manhattan district. When a physicist at MIT, who is also planning the construction of a machine of this type asked McMillan for his magnet design, he was told that the Army would not permit the release of information on the magnet. Who are we attempting to handicap by such restrictions? Surely not the Russians; they not only invented the synchrotron, they did it earlier than we did.

In my own wartime field of radar there were many examples of the same kind. Radar itself was independently invented by the Germans, the French, the British, the Japanese, and ourselves. Each of these nations kept it secret from all of the others, not knowing to what little point this was done. Microwave radar, which has played such a great role in the Allied victory, was made possible by a single invention, the cavity magnetron. This is a transmitting tube which give previously unimaginable amounts of power on wavelengths far shorter than those available to radio engineers before the war. It was invented by the British. When the British sent a scientific mission over to this country in the late summer of 1940, one of the most impressive of the secrets they had to show us was the cavity magnetron. When the radiation laboratory was first set up, an attempt was actually made to keep knowledge of the magnetron localized in one group of the laboratory, not even letting the men who were working on a modulator to energize this tube know of the tube's design. Yet, all this time there was in the Russian literature a paper which exactly described the cavity magnetron, and gave the results of experiments with it.

In the light of all this evidence, and more of the same kind which I could quote for hours, you must forgive scientists for being impatient with talk of "the secret of the atomic bomb." The Army's policy respecting the release even of the most peripheral information obtained by the Manhattan project has been much too restrictive. Today, for example, more than 8 months after the explosion over Hiroshima, the entire nonsecret literature covering the immense amount of medical work on the effects of radiation and of radioactive poisons on living tissue is to be found in section 8.70 of the Smyth report. Quoted in its entirety, it is: "Extensive and valuable results were obtained." Even in an armaments race such as that we are in today, even in the war to which such an armaments race is likely to lead us, how do we benefit by withholding the results of such investigations in medical fields?

Some of my friends who have had no contact with the bomb project have been interested in speculating on the problems which surround the atomic bomb. Only a law providing for thought control on the Japanese pattern would make it an illegal breach of security to tell you the results of this speculation. It may be interesting for you to compare some of the results of this speculation with the things you have been told as "secrets" in executive sessions of your committee. Such results can be equally well deduced by the physicists of any second-rate world power on the basis of the completely available published information on nuclear physics. If you feel it is proper, I shall be glad to tell you of some of these speculations.

I cannot presume to advise this committee of the detailed way in which a bill for atomic energy control should provide for peacetime secrecy restrictions on the publication of scientific work. It is my opinion that all of the bills so far presented go much too far in the direction of imposing such restriction. There would be little purpose served by full publication of instructions for the manufacture of an atomic bomb, and I believe that it is wise to restrict the publication of information concerning finished military devices.

On the other hand, there is no benefit to us, and there can be very serious harm, in restricting the performance of experiments or the publication of results in any field of basic science, nuclear physics included. The definition of "basic scientific information" in S. 1717 in my opinion is not valid. It is important to publish not only the end results of scientific work, but a detailed description of how they were obtained. It is only this practice which distinguishes modern science from medieval alchemy.

We can make an analogy with the way other weapons are handled. The design of guns is kept confidential; yet the metallurgy of steel is dealt with in the usual way. Military aircraft are designed in secret; yet the aerodynamic principles on which they are based, and even techniques such as flush riveting, are freely published and available to all. It is thus that scientific and engineering progress is made.

Advocates of secrecy in science feel that it will advance our national security and strengthen our national defense, else they would not advocate it. All of the evidence available to me shows that scientific discovery and engineering development cannot flourish fully except under conditions which allow all competent men to be fully informed, and thus able to contribute to progress. We shall weaken, not strengthen, our national defense by any restrictive measures on performance or on publication in scientific fields.

That concludes my prepared statement.

The CHAIRMAN. Any questions?

Senator HART. Doctor, may I ask one question, in your own field of radar? It is true, is it not, that we were way ahead of our enemies in this last war in our adaptation of microwaves?

Dr. RIDENOUR. Yes, sir, that is true; and my belief, based on 5 years of observation, is that our leadership in this field was entirely due to the fact that the barriers of secrecy were broken down entirely between our Army and our Navy and among all three armed services of the British and between the British and ourselves, so that there was an enormous team of perhaps 10,000 scientists and engineers working together with full knowledge of the progress of the whole group. They advanced the art so fast that our enemies, who were still interested in engineering secrecy in this field, could never keep up.

Senator HART. Yes, but carrying your argument to its logical conclusion and making the assumption that your enemies could have obtained the information at the same time we did would have meant that we would not have weapons superior to them.

Dr. RIDENOUR. Well, sir, I question that, if I may, because we must distinguish between knowledge and performance. That is to say, it is not enough to be informed of the results of a scientific experiment or of the design of a particular device. It is still necessary to make

use of this information in the performance of another experiment, or in the manufacture and employment of the device. It is my contention that one must not make a small advance in a certain field and say "Now, I must keep this secret so no one catches up with me." He, must say, "I must tell this to everyone, to the competent scientists and engineers, and I will keep ahead of everyone."

Senator AUSTIN. I have a question that is probably curiosity and not founded on any real premise, and that is whether you think it is scientifically possible for the phenomenon of absorption of a neutron by a uranium nucleus relating this division into parts with release of energy—whether it is scientifically possible for that phenomenon to occur without the use of the devices or similar ones that you have referred to?

Dr. RIDENOUR: I am sorry, sir; I do not understand what devices you mean.

Senator AUSTIN. Literally, it gets down to the question of whether it is possible for an accident to occur which results in fission releasing great energy.

Dr. RIDENOUR. Oh, almost certainly such accidents are occurring all the while in nature.

Senator AUSTIN. That is just my question.

Now, will you explain that?

Dr. RIDENOUR. Yes, sir. As you know, cosmic radiation bombards the earth all the while and at sea level here the radiation consists of various types of energetic particles, and in particular contains some neutrons. These neutrons, striking uranium atoms up at Great Bear Lake or in the stone of this building, or anywhere in the world, will, on occasion, produce nuclear fission.

Now, this does not happen at a very great rate, else in the lifetime of the earth all of the uranium would have been used up by such a process; but it certainly is occurring all the while.

Senator JOHNSON. Is that the discovery that the Russians announced that was announced in the press as having come from Russia a few months ago, the discovery that you are mentioning now?

Dr. RIDENOUR. I don't think so, sir. This is not really a discovery at all. If one finds there are neutrons in cosmic radiation and uranium in the earth, this is a foregone conclusion.

Senator JOHNSON. The announcement of their discovery, so-called, seems to be similar to your theory.

Dr. RIDENOUR. I have seen only newspaper accounts of this announcement, and I infer from those accounts that what was discovered by the Russians was so-called spontaneous fission of the uranium nucleus. Just as a nucleus will sometimes shoot out an alpha particle, so also the fission into more or less equal halves with the release of energy may happen spontaneously. This is a rather infrequent event.

Senator TYDINGS. As I recall the newspaper accounts of that, it was the Russians who had discovered the process by which spontaneous nuclear fission took place.

Dr. RIDENOUR. Yes, sir; that would make sense.

Senator TYDINGS. That would make sense?

Dr. RIDENOUR. Yes; it would in the sense that the nuclear fission in which the atomic bomb people were interested was encouraged to happen.

Senator TYDINGS. If they had discovered that, I would assume that would be quite a worth-while discovery.

Dr. RIDENOUR. Well, I am not competent to say. I think it tells you some useful things.

The CHAIRMAN. Doctor, the term "basic scientific information" has been defined in S. 1717 as including, in addition to theoretical knowledge of nuclear and other physics, chemistry, biology, and therapy, all results capable of accomplishment as distinguished from the processes or techniques of accomplishing them.

Now, I take it you quarrel with that definition.

Dr. RIDENOUR. Yes, sir; I feel it is too restrictive.

The CHAIRMAN. Why?

Dr. RIDENOUR. Because it is not sufficient to say merely "I have done an experiment, believe me, and I find that the likelihood that a uranium nucleus will undergo fission if I bombard it with neutrons of a certain energy is thus and so."

It is not enough to give this result without saying how you attained it, because the main purpose of scientific publication in our modern age, let us say since Galileo, has been to make it clear to others how they can repeat and check the experiment that another man has done, and that is what I meant to imply when I said that our science differed only from medieval alchemy in that way. You know, the alchemist had recipes for turning silver into gold and lead into gold, and so on, and these recipes were secret. They didn't tell them to anyone.

The CHAIRMAN. Now, translating that into the Smyth report, you would say that the Smyth report deals exclusively in basic scientific information, would you?

Dr. RIDENOUR. Well, sir, there is a good deal of engineering information in it, and there is a good deal of basic scientific information which is left out. For example, it has almost no numerical results on the various nuclear processes, and the likelihood of their occurrence under various circumstances, and so on. It has almost no results of experiments, let alone the means of accomplishing the experiment.

The CHAIRMAN. Don't you feel that if the way these things were accomplished were to be made known and published in the world, it might bring very much closer the achievement of the same result, namely, the Nagasaki bomb in other countries?

Dr. RIDENOUR. I have heard varying estimates on that from people who were actually in the project. I think you should get a comment from someone who was in the project.

The CHAIRMAN. I am talking from your own knowledge and your own conscience. If we publish not only the results, but how they were achieved, to the world, then it certainly would bring that much closer the accomplishment of the perfected bomb in other countries, would it not?

Dr. RIDENOUR. I don't feel that it would make a very substantial difference, and the reason I don't is the one that I gave a little earlier, namely, that we must not only know things, we must also do things.

Some friends of mine who have worked in the atomic bomb project have said that the real time-consuming part of the work was the construction of the plants, and the lack of availability of scientific information scarcely held up the progress of the work at all. The scientific work was done concomitantly with the construction.

Therefore, if I were a scientist of Shangri-La, and the Sultan of the place asked me to make him an atomic bomb, I would call in today not only the scientists but also the contractors, and I would say to the contractors, "Now, I know roughly what I want." I would have the contractors start to build the sort of establishment that I gathered, from my general knowledge that everyone has of the project, would be necessary, and I would put my scientists to work filling in the gaps in what I need to know in order to make these plants run. I think the whole thing would fit together pretty well, and it would make very little difference whether this nation were publishing scientific papers on the subject of nuclear fission or not.

Senator TYDINGS. I understand your viewpoint on secrecy from this end down, but at what point do you think secrecy could be justified and under what circumstances, if at all?

Dr. RIDENOUR. Well, sir, I feel that it is justified with respect to the detailed design of military weapons. I do not want to have anybody, including me, told how we make an atomic bomb and how you make it go off. This is a very difficult thing to do, we are assured by all the published literature; and I am ready to believe it. I don't think that is any of the scientist's business, and I don't think it advances science any to publish it.

However, the design of McMillan's synchrotron magnet has nothing to do with it.

Senator TYDINGS. Let me see if I can generalize, which isn't fair, so as to get your viewpoint without consuming a lot of time. You would make available all the information that might be termed "scientific progress," but you would not make available that information whenever it took the characteristic of a weapon, or something closely related to a weapon—that is, the technique of the application of the discovery to the weapon itself?

Dr. RIDENOUR. Yes, that is right.

Senator TYDINGS. Is that a rough line of demarcation?

Dr. RIDENOUR. It is, and the reason I advocate this—I hope you will all understand—is not that I think it is a good idea from any idealistic or high-minded point of view, but that it gets you farther ahead. We see this in radar. There is one field of radar in which the assertion I made to you, sir, is not true. The compartmentalization was not entirely broken down. I refer to the identification equipment which was carried by Allied aircraft and ships in order to give a specific signal on Allied radar when a friendly vessel or aircraft was involved. This was kept much more secret than anything else in the whole field of radar, and operationally it was the biggest flop in the whole field of radar. After D-day in Normandy, IFF equipment was never used, and it was never used because it didn't work properly under conditions of high traffic density. It didn't work properly under conditions of high traffic density because it wasn't designed right, and it wasn't designed right, I think, because not enough work had gone into its design and not enough work could go into it so long as the secrecy requirements were maintained the way the people thought they should be.

Senator TYDINGS. You are not advocating the disclosure of anything in the nature of a weapon or what might be called indispensable to the weapon. You are talking about scientific discoveries removed from what might be called the weapons of war.

Dr. RIDENOUR. Yes, sir. I am parenthetically in this IFF discussion recommending that you make your compartments of secret knowledge rather big and roomy, even within the Army or Navy, or you will get into trouble; but that is another matter.

The CHAIRMAN. Going back to the atomic bomb again, if I understand your principle correctly, applied to the atomic bomb, you would open up entirely the processes by which fissionable material is made?

Dr. RIDENOUR. Yes, I would.

The CHAIRMAN. But you would stop at the point where the fissionable material was compressed into the bomb or bomb process?

Dr. RIDENOUR. Yes, sir.

The CHAIRMAN. Now, does that mean that you would open the doors of Oak Ridge and invite scientists from all over the world to come in there and see how we turn out that fissionable material?

Dr. RIDENOUR. I think it does, Senator. I am not supposed to know what is at Oak Ridge.

The CHAIRMAN. Well, having in mind that it has been testified here that when you have fissionable material you are 75 percent on the way toward making a bomb—and take my word for it that fissionable material is processed and produced at Oak Ridge; just assume that—do I understand your point to be that you would invite everybody in to look at that that had any curiosity on the subject?

Dr. RIDENOUR. I would see no harm in it, Senator, because, while you may be 75 percent on the way toward making a bomb when you have fissionable material, I don't think you are very far down the road toward having fissionable material after having the 25-cent conducted tour of Oak Ridge.

The CHAIRMAN. I agree with you on that.

Senator TYDINGS. I have been misled a little right here in your answer to Senator McMahon. I understood that you wanted a wide measure of exchange of information between people working on the same project without compartmentalization.

Dr. RIDENOUR. That is if there are any secrecy requirements maintained on the project by the other principle we were discussing, Senator.

Senator TYDINGS. But when you have permitted that freedom of exchange between people who are interested in the common venture, why should you take somebody from a foreign country and show them the application of those principles by actual mechanisms?

Dr. RIDENOUR. Well, sir, there are a couple of reasons for that.

Senator TYDINGS. Doesn't that violate pretty much your general line of demarcation which you cut out here a short while ago?

Dr. RIDENOUR. I don't feel it does, and I would like to enlarge a little on it, if I may.

Senator TYDINGS. Perhaps I misunderstood you.

Dr. RIDENOUR. Let me state again that I feel there should be full and free publication, and I really mean publication in the regular scientific journals.

Senator TYDINGS. Assume we agree with you on that.

Dr. RIDENOUR. I mean publication of things which do not directly have to do with the manufacture of military weapons, just as the metallurgy of steel is well known, and all that; but exactly how a particular gun is made is quite often kept dark. This being so, I think it is wise to do it even unilaterally. Supposing no other nation in the world

did it. We should go ahead and do it and let these fellows subscribe to the Physical Review, and everything like that.

Senator TYDINGS. I am not talking about publications now. Let's assume that we all agreed with you, just for the sake of assumption. What I am talking about is why, after we have told them how to do it, should we take someone in who is a foreigner, for example, through our plants and let him see how we apply the principles? What would be the advantage to us in that procedure, or to science?

Dr. RIDENOUR. Well, it would be a nuisance to us, of course; we would have to spend a lot of time doing this.

Senator TYDINGS. First of all, they would all come or would want to come, wouldn't they?

Dr. RIDENOUR. Quite a lot of them, probably.

Senator TYDINGS. Would you be in favor of letting them come if they didn't let you come?

Dr. RIDENOUR. Yes, sir; I would. The most direct and immediate way by which you would benefit is that a number of these people would never go home. You saw that happen before the war.

Senator TYDINGS. I don't know whether that would be an advantage or not.

Dr. RIDENOUR. It certainly was on the atomic bomb, as I am sure you will agree.

Senator TYDINGS. Anyhow, what I am getting at is this: I can see, thinking it through or reaching a conclusion, a great deal of logic in the exchange of scientific information and all of that. But I don't see the logic of taking a man into what might be called a plant devoted exclusively to national defense and showing him everything about it.

Dr. RIDENOUR. Well, sir, I hope that it won't be devoted exclusively to national defense. Fissionable material has to do with a great many other things.

Senator TYDINGS. But at the time it does. I am dealing with it as of this year, and my question is directed as to now, for example. Would you advocate taking foreign scientists through Oak Ridge now?

Dr. RIDENOUR. I certainly think it would do no harm.

Senator TYDINGS. Well, they would learn a lot that they could go back and save a lot of time on, wouldn't they?

Dr. RIDENOUR. I don't think they would save much time.

Senator TYDINGS. What would be the advantage of their coming, then? Certainly, if they are not going to profit by anything they would see, there would be no advantage in showing them through and no reason for following the logic you have expounded here.

Dr. RIDENOUR. There is the sort of peripheral advantage that on the one hand you encourage that they do this in your favor, and if this is done all over the world it is a good thing. In the second place, you make it perfectly clear that this is one oasis in a suspicious world where there is really freedom of science, and if you think it wouldn't fill full of scientists from all over the world—

Senator TYDINGS. Let us assume we agree with you, and we open the doors of Oak Ridge. Would you throw open the doors in plants of the other parts of the country that are engaged in other phases of the atomic bomb situation?

Dr. RIDENOUR. Well, as I understand the layout at Hanford, I would see no harm in selling tickets for that.

Senator TYDINGS. Where would you say, "Now, we have been very glad to have you over here, but this is the one place we cannot take you into"? Where would that be?

Dr. RIDENOUR. As I understand the arrangement, that would certainly be at Los Alamos, despite the fact that there is a very great deal of work which has gone on there in the past and is still going on which is pure science and has nothing to do with the weapon, for nevertheless there are departments there charged with the design and manufacture of bombs.

Senator TYDINGS. In other words, you would show them all phases of making the weapon and the parts of the weapon, but you would not show them the assembly of the weapon?

Dr. RIDENOUR. Yes, sir.

Senator TYDINGS. So if they knew all the parts that went into it, they could assemble it pretty fast, couldn't they?

Dr. RIDENOUR. That has been asserted. I don't particularly believe it. I think there is a difference between knowing how to do a thing and getting it done, and, as I have said before, my friends have told me that getting it done accounted for most of the time in our work on the project.

Senator TYDINGS. Of course I am not a scientist, and my observation may seem out of place; but I would like, as far as we can, to remove all barriers on the exchange of scientific information. As a layman in the scientific field, I don't believe I could go as far as your testimony here indicates without feeling that I had done my country a disservice, possibly, and I would rather err on the side of not hazarding that chance than to be too generous and find that I would be sorry for it afterward. That is a decision we have to make.

Dr. RIDENOUR. That is correct, sir, and I have been very anxious to come here simply because my observations of the war have made me believe that the country is better served by the rapid progress which can be maintained with full exchange of information.

Senator TYDINGS. Isn't there some intermediate point where the irritable phases of this could be relaxed or eliminated without going the whole way? It is a good bit like prohibition, you know. We either go all wet or all dry. Isn't there some temperance in it where you scientists could be reasonably satisfied and we wouldn't help our possible enemies of the future, and if so, what do you believe, notwithstanding your testimony, we might do even now without going the whole distance that you have indicated you thought we should go?

Dr. RIDENOUR. There are various degrees of publication in this field, as you indicate. One thing which could certainly be done tomorrow with no harm to anyone is to publish all of the medical information from the project. I cannot see how anyone could possibly feel the national defense was concerned in that in any way.

Senator TYDINGS. Would this be a feasible approach: that your body, which is organized into a scientific organization in this country, would have a committee, so to speak, on grievances, and that when you felt that the restrictions were unnecessary you could present those, say, to the Atomic Commission and have a hearing either in secret or in the open, and out of common exchange of ideas reach some more moderate point rather than be dependent on the Army and Navy men completely? Would that do it?

Dr. RIDENOUR. Well, sir, that would certainly be a very great help in the presence of restrictions which I hope it is possible to avoid.

Senator TYDINGS. In that way you would see their point of view, or hear their point of view, and they would hear your point of view, and perhaps through some committee of that sort you might get some more elasticity which would achieve more of what you want to accomplish.

Dr. RIDENOUR. I have read the testimony before this committee rather completely, and the estimates of the length of time it takes for another country to get to the stage at which we are now vary; but they are all in a rather modest range, 5 to 10 years, let us say. Now, the effect on this period of completely full publication of the kind that I have been recommending has been testified to be between 6 months and 2 years.

I think that this is such a small fraction of an already short period—

Senator TYDINGS. Let me put it to you this way, sort of anticipating you, but I want to get it in this form if without the exchange of any scientific information other countries working on the atomic bomb could not master it, let us say, within a period of 5 years, and if by the fullest exchange of scientific information and the tour through Oak Ridge and Hanford, and so forth, they could master it in 2 years, would you still be in favor of exchanging the information?

Dr. RIDENOUR. Yes, sir. I would feel that our national defense is better served for two reasons: In the first place, we have not conducted our negotiations which are intended to reach an international agreement in an atmosphere of at least, implied hostility; in the second place, our own progress shall have been so thoroughly expedited by doing this that our position relative to this other nation will be more favorable than a policy of secrecy would have brought it to be.

Senator TYDINGS. All I would like to say, in a humorous way and not to take issue with you, is that if you ever run for a public office never tell your opponents all the support you have got if you want to keep it.

Senator JOHNSON. Going back to your own field in radar, I am quite puzzled by some of your statements here, beginning in the bottom of page 2 [referring to Dr. Ridenour's prepared statement]. You stated:

In the radar field, we started with the same atmosphere of secrecy, the same precautions about compartmentation of information and clearance of individuals, which characterized the atomic bomb project right to the end, and still characterize it today.

Then you go on down a sentence or two, and say:

It had become by that time apparent that secrecy cost us in efficiency far more than it gained us by keeping the enemy in ignorance.

And then this sentence—I don't know whether it is facetious or what your meaning is:

We found it a lot harder to inform the enemy than readers of the spy stories may think.

Was there to be an advantage in telling the Germans about radar?

Dr. RIDENOUR. No, sir; that is a wry joke and not a very good one, I am afraid.

Senator JOHNSON. I am glad it is a joke, because I call to mind the proximity fuze, for instance, somewhat related to radar. If the Germans had discovered the proximity fuze and had applied the knowl-

edge of radar in that direction, it would have cost many, many American lives.

Dr. RIDENOUR. Yes, sir; and the astonishing thing to me and the thing I mean by this sentence, about how hard it is to inform the enemy is that we shot off so many hundreds of thousands of shells with proximity fuzes in them without the enemy apparently catching on. It is really very surprising how difficult it is to give secret information away. You can go to all sorts of lengths, such as scattering all these radar sets all over Germany, without doing it.

Senator HART. My prediction, Doctor, is that before you are as old as most of us here are you will have changed your views in that respect, and you will have many disagreeable surprises as to how easily others do learn our secrets.

Dr. RIDENOUR. That may be so, and I suspect it is particularly so in the operational field where the secrets are easy to understand, compact and easily carried around, and easily given away.

Technical secrets are rather another matter. In radar, for example, our people learned about enemy radar mostly by capturing it. I know this because I was privy all the information that we were getting, and this is how we got it. It was necessary to go run a raid against Bruneval in order to find out about the Germans' work on radar, and so on.

Our establishment up at MIT was spraying 10-centimeter and 3-centimeter radio wave lengths in all directions from the fall of 1940 on. It would have been necessary to do no more than live across the Charles River in an apartment house with a very simple kind of crystal receiver and wave meter to gain some very valuable information about wave lengths, of forthcoming radar to be used by our services, plus repetition rates, and a lot of other things people think they would like to know.

Senator HART. But not, Doctor, to learn how to make the proximity fuze Senator Johnson just spoke of?

Dr. RIDENOUR. Sir, I don't believe you learn this by reading a paper. I really don't. It took the people who made the tubes, which is the heart of the fuze, quite a long time to learn to make them despite the fact that they knew exactly what they were trying to do and worked very hard at it.

There is a big difference between knowledge and accomplishment.

Senator HART. Doctor, you state in your statement as a fact one thing that I don't know that any of the members of this committee know. You have asserted as a fact that we are still manufacturing and storing up atomic bombs. You must be very closely informed, Doctor, if you can state that as a fact.

Dr. RIDENOUR. No, sir; I may be mistaken about that. I drew it from General Groves' testimony before this committee and his estimate of the amount of money necessary to carry on the establishment, and so on. I might be quite wrong in that and if so, I shall be glad to withdraw it. I should withdraw the statement as a fact, that is quite true.

Senator HART. I don't call upon you to withdraw it. I thought you knew something that I don't know.

Dr. RIDENOUR. No; I do not. I was overguessing from my reading of the testimony here.

Senator TYDINGS. Don't you think the grievance committee might accomplish a great deal of liberty for you, so to speak, that would be wholesome? That is, the Army perhaps would be in a position to hear you if you had some organization where you could get at least a large part of what you want where they feel it wouldn't impair the safety of the country.

Dr. RIDENOUR. I do, indeed. I think it would be a very good idea if there must be restrictive legislation.

Senator TYDINGS. Assuming there must be some, even any amount of it, you certainly ought to have a place where you can be heard, in the secret or in the open, and can give them your reasons why and can tell them what you think is so, and out of that may come some progress.

Dr. RIDENOUR. That may be true. I myself would take care to work in a field where there are no restrictions, as many scientists would.

Senator TYDINGS. Even if you are right, a great majority of the American people, whether right or wrong, and certainly an overwhelming majority of Congress would be reluctant to throw the doors of Oak Ridge and places like that wide open.

Dr. RIDENOUR. I realize that entirely. I think this is a crusade.

Senator TYDINGS. But what we would do is be willing to put you in touch with the people who had charge of Oak Ridge, and if you could show them where the interest of the Nation would be served by throwing them open, we would want you to have that opportunity which you don't have now.

You would probably get the old buck passing all the way up, but what you want is a committee you can deal with directly, and they can take your request under advisement and give you a yes or no answer about. That would seem to me to be one way you would at least accomplish some of the things you have in mind, and which would be feasible of accomplishment in the Congress.

Dr. RIDENOUR. Well, that must always be borne in mind, I am sure.

Senator TYDINGS. We haven't got over 531 nuclear physicists in Congress, and it is a little hard for them to understand.

Senator MILLIKIN. I think the distinctive feature of your testimony is that you would share to some degree know-how even in time of war.

Dr. RIDENOUR. Yes, sir.

Senator MILLIKIN. That is a distinct novelty from the type of testimony we have been having, and I think you properly styled it as a crusade.

Let me ask you, if we had this bomb plant on December 7, 1941, would you then have invited the Germans into it, carrying out your theory?

Dr. RIDENOUR. No, Senator; I certainly shouldn't have done that.

Senator TYDINGS. Or the Japanese?

Dr. RIDENOUR. No, indeed. I think we must really put two interpretations on my remarks, and I have put two on them tacitly. During time of actual war, what you certainly want to strive for is the fullest possible circulation of information within our own allied group of people who are concerned with a particular thing. That is what we had in radar. We didn't publish the stuff in the newspapers, but

we did circulate it entirely among all the people who were working on radar.

Senator MILLIKIN. Could you qualify the bulk of your testimony in that way?

Dr. RIDENOUR. Yes, sir. During a war, this is my feeling what it is desirable to do.

Senator MILLIKIN. Do you think it is desirable to make free general exchange during the period of what you call international suspicion?

Dr. RIDENOUR. Yes, sir; I do, because it is precisely then that we wish our national accomplishment to be the greatest, our rate of national accomplishment to be the greatest. And the greatest rate of national accomplishment in any given field is that when the largest number of people are working on it on the basis of the most thoroughly diffused information possible.

Senator MILLIKIN. Would you give the same answer as applying to the period you describe as "during an armament race"?

Dr. RIDENOUR. Yes, sir.

Senator MILLIKIN. So that the one place where you go back a little bit is during time of actual war, and you qualify that by free circulation among your allies, but not beyond that?

Dr. RIDENOUR. Yes. You see, if we were a second-rate nation this would not be wise, but if our rate of achievement and that of nation A which is not ours were different in our favor, then we want everybody to progress at the maximum rate.

Senator JOHNSON. Isn't that a good way to become a second-rate nation?

Dr. RIDENOUR. I do not feel so. The purpose in my testimony is to attempt to demonstrate how you maintain your position as a first-rate nation. You see this thing that is called a secret in connection with the atomic bomb is not a secret in the sense of something permanent and durable.

Senator JOHNSON. If it isn't a secret it isn't a secret and we need not waste time on that. But it is the things that are secret, and certainly there is knowledge that is secret?

Dr. RIDENOUR. There is knowledge that is classified secret in this field. I think there is very little knowledge that cannot be found out by looking for it.

Senator TYDINGS. Doctor, if you are buying a horse, isn't it pretty good psychology on the part of the seller to tell you only about the good points of the horse and not disclose the fact that the horse is blind and has stringhalters in his left hind leg; and, on the other hand, isn't it pretty good psychology on your part to point those things out to the seller in order to arrive at an understanding. Or do you think these individual equations can completely be thrown aside when you are dealing with a nation?

Dr. RIDENOUR. I am afraid, Senator, that all of you men, and perhaps rightly, make the tacit assumption that we shall be better off with respect to our own progress, if we maintain this secrecy. The whole burden of my testimony is that I feel we shall not be better off with respect to our own progress in a world of suspicion and trouble and everything else.

Senator TYDINGS. Let me qualify it by saying if this was an ideal world, of course I would agree with you completely but there are some forces arise in this world of ours from time to time that almost threaten us with extinction, and knowing that there are evil men who frequently come to power, even the son of a good king may be a very cruel and intolerant fellow, we have to take into consideration not only the situation that exists today but what may happen tomorrow or next year. We have had so many lessons throughout the 2,500 years of recorded history that it isn't wise to disarm, for example, unless the other fellow does. Why does Russia, the United States, Britain, France, and China maintain armies today when they have already disarmed Germany and Japan? Obviously they maintain them against each other. That is a simple piece of logic, isn't it?

Dr. RIDENOUR. Right.

Senator TYDINGS. If they are not willing to disarm, why should we tell them how to get stronger than they are now, when we are keeping up our Army not because of Germany or Japan, but because of Russia, Britain, France, and China, and each of them is in the same position?

Dr. RIDENOUR. My argument is entirely that we will improve our relative position by so doing.

Senator TYDINGS. I am telling you that you have got a lot of trust in human nature.

Dr. RIDENOUR. No, sir; I have a lot of trust in our scientific and engineering talent.

Senator TYDINGS. I agree with you that up to a point we ought to make science as free to operate as it can, but I don't think we ought to take them through Oak Ridge, for example, or Hanford or any of those places.

Dr. RIDENOUR. Well, I was asked about Oak Ridge and Hanford. I certainly do not insist on this. If I were dictator, I wouldn't object to it. But what I am trying to speak of mostly is a policy of scientific publication in this field, which is no different from our policy in any other field.

Senator TYDINGS. You know, some of these countries in the world haven't sent us any special invitations to visit their scientific laboratories so far. There are few who urge that we come over to see what they are doing. They are not anxious to invite us, and I think that speaks pretty strongly for the fact that we may be going down a one-way street.

The CHAIRMAN. Although I think it should be said that Russia did send an invitation to our scientists here to come over, did they not, last summer?

Dr. RIDENOUR. Yes, sir.

The CHAIRMAN. And Dr. Langmuir headed that mission?

Dr. RIDENOUR. He was certainly a member.

The CHAIRMAN. You read his testimony, did you?

Dr. RIDENOUR. Yes, I did.

Senator TYDINGS. I think that was awfully nice of Russia, and I hope they will keep it up.

Dr. RIDENOUR. I hope we will do things like that, too; but I think they are very much less important than the policy of maintaining scientific research, engineering developments, and scientific publica-

tion on the same basis in this field as it has been maintained in every other, because this is what has put our Nation where it is today.

I made a crack about our IFF not being any good, our radar identification equipment. In fact, the compartmentalization with respect to the information on Japanese identification equipment was much more severe than ours. The Japanese Army and Navy had different frequencies, and a Japanese Army plane would not look friendly to a Japanese battleship, which seems to me the high point in absurdity.

Senator TYDINGS. I hope that is one piece of information you didn't send over to Japan.

Dr. RIDENOUR. Oh, they knew it. Toward the end, the Army didn't seem to be much worried about this, because the Navy didn't have many ships left.

Senator JOHNSON. Have you read Dr. Jewett's testimony before this committee, which appeared yesterday?

Dr. RIDENOUR. No, sir.

Senator JOHNSON. He made a distinction between basic scientific knowledge and technological knowledge. You don't seem to make as much of a distinction as he did.

Dr. RIDENOUR. Well, sir, I think this is an extremely hard distinction to draw; a sensible distinction can usually be drawn.

Senator JOHNSON. I would be very glad, for one, to have you read Dr. Jewett's testimony and give this committee, or at least give me, your analysis or views on what he had to say.

Dr. RIDENOUR. Yes, sir; I would be very glad to do so.

Senator JOHNSON. I was very much in hopes that you were in complete accord with him, but I am afraid you are not. I am disappointed that you are not.

The CHAIRMAN. Will you send a letter to us commenting on Dr. Jewett's testimony?

Dr. RIDENOUR. Yes; I will. I have a high regard for Dr. Jewett, and if we are out of line, maybe I am out of step.

Senator JOHNSON. I may be the mistaken person; I hope that I am.

The CHAIRMAN. Are there any further questions?

Thank you very much, Doctor.

Now, Major de Seversky, you have some pictures that you have waited quite a while to show. We will see them now.

(Whereupon, at 4:20 p. m., the committee recessed.)

APPENDIX

(Dr. Alexander Sachs, who appeared before the Special Committee on Atomic Energy on November 27, 1945, subsequently requested that he be permitted to revise and amplify his statement, so as to give a more complete report of the early history of the atomic bomb project. The chairman of the committee, Senator Brien McMahon, complied with that request. The revised statement, which follows the question-and-answer form of the original—see pt. 1 of the hearings on atomic energy, pp. 1-29—was made part of the record and appears below.)

REVISED STATEMENT OF DR. ALEXANDER SACHS

DR. SACHS. I am by profession, gentleman, a practical economist, economic adviser, and industrial consultant. I was previously economist and vice-president of the Lehman Corp., of which I am still a director and a special economic adviser in my new capacity. Throughout the decade prior to the war I was associated with them.

I have also been interested in the problems of our national economy and national welfare as affected by international conditions and problems. From its advent phase on, the Great Depression of 1929-33 struck me as fraught with greater gravity and deeper portent than prior depressions in our business cycle history. For I felt that its roots lay in the untenability of the whole postwar reconstruction of the twenties that was effected on a world scale, and furthermore, I felt with growing concern that the financial and economic collapse would engulf the political order that was established by the peace treaties. Thus imbued, I came to be known or nicknamed as the "Economic Jeremiah." In the course of that depression I had gone to Europe to observe on the spot the financial crisis of 1931 and my advice came to be sought by leading figures. In particular I was a special adviser in an informal capacity to Lord Reading and Lord Lothian, who as members of the new National Government formed in the summer of 1931, were concerned with the impact of the world depression on England.

From that trip I came back with a sense of foreboding as to the further repercussions of that depression upon the United States, holding that the break-down of the postwar monetary and economic reconstructions was bound to aggravate the spiraling depression in the United States as it was undermining the political and economic order of the world. The fulfillment of successive analyses and forecasts regarding the depression led to my being introduced in 1932 to Mr. Roosevelt. Thus began an association which continued from then through this war as an informal adviser without any special label. In that work I tried to live up to a concept that President Roosevelt had formulated in his message of January 1937 on Government reorganization. He described therein that men who are to serve a President as assistants and advisers should not only command personal confidence but: "They should be possessed of high competence, physical vitality, and a passion for anonymity." In particular I tried to live up to the last requirement, a passion for anonymity, and throughout have avoided any public self-referentialness, feeling that my job was to be on tap to and for the President without trying to influence the course of events beyond trying to point out advance implications and consequences to those who were shaping the course of events.

As to the interaction between the economic and political forces that produced the world crisis, I had in 1932 submitted to the President-elect this summary: "The statesmen of the world have continued to be overtaken by a sort of high-tension paralysis—like the trivial oscillations of the trench war battlefronts up to America's entrance in the great war—only to find that the imperious and

menacing march of events swept aside the half-willed and half-thought schemes, and even attacked improvised defenses that were resorted to too late, as in the German case to save Germany for democracy. The outstanding feature of this great depression is that the economic order developed since the Reformation and the great society developed since the fall of the Roman Empire have come to be threatened not by the destructive impact of external or natural forces, but by a disintegration from within because of an incipient failure of concerted will and political wisdom."

Thus imbued, I came to suggest early in 1933 in connection with the formulation of the National Recovery Act—for which I was called in in my capacity as an economist—that an important use for public-works funds to be provided was the reconditioning of the Navy, the mechanization of the Army, and the improvement of national defense. General Hugh Johnson, who during the depression was an assistant in an economic capacity to Mr. Baruch and had thus become interested in my interpretations and forecasts of economic developments, was given by the President a leading role in the NRA and he and the President asked me to serve as organizer and first head of NRA's Division of Economic Research. In the drafting phase of the act, I at first urged upon them the inclusion of those national defense provisions.

Senator AUSTIN. What year was that?

Dr. SACHS. That was in 1933, in the legislation of April and May. Hugh Johnson in the Blue Eag'le, pages 197-198, credits me with having suggested that this provision about making available funds for naval construction and other defense be written into the NRA bill. Hugh Johnson was a little bit too generous in thinking that I had sole responsibility for the idea. The fact was that in a patient argument with the President the conclusion was reached that the advent of Hitler to power boded ill for all democracies, and that it was necessary that we take time by the forelock.

I have always been of the view that the real warmongering, combined with defeatism, is done by the pacifists, and that one who is concerned about the protection of national interests without aggressive aims is the real practical pursuer of peace.

Later on—and I had been in the habit of reporting to the President regarding the progress of international developments—in 1936 he called me in to help in working out a solution for the problem of public utilities and electric power. I had proposed the idea of a power pool, and even then we discussed that in the event of war danger we would want to have a mechanism for the coordination of private and public power. The distinguished figures representing the public at that White House Conference in September 1936 were Mr. Owen D. Young and Mr. Lamont, and I had been another one that was selected alongside those representing the public-utility interests and the governmental authorities concerned with power. The international situation was a subject of discussion a year later with the renewed outbreak of Japanese aggression on China.

After Munich I had begun to send the President a series of memoranda. It was at the turn of the year in January 1939, that I had sent in a very long study on the international situation. In the preface to it I described the attitude underlying that memorandum and the predecessors on problems that had been discussed with him in 1936, and also in 1937 prior to the quarantine speech. My role was, if you will, to be a resonator for ideas that he had and also as a humble submitter of ideas of my own. In that preface I wrote:

"The orientation towards the world crisis that has been developed in prior reports and needs to be borne in mind continually is that we are already in what Thomas Hobbes, who lived through the British civil war 300 years ago, justly called 'war time tract' and 'war weather.' 'For war consisteth not in battle only but in a tract of time wherein the will to contend by battle is sufficiently known * * *. For as the nature of foul weather lieth not in a shower of rain but in an inclination thereto of many days together; so the nature of war consisteth not in actual fighting but in the known disposition thereto during all the time there is no assurance to the contrary.'"

The thesis then was that the aggressor powers, the Nazis and their allies as well, for Japan had begun its aggressions in 1931 and expanded them in 1937, were passing from the state of "white war" and limited war to totalitarian war.

On March 10, 1939, when I had been asked by St. John's College to deliver a talk on the world situation, I prepared certain notes of which I had sent the President a copy. Those were entitled "Notes on Imminence World War in

Perspective Accrued. Errors and Cultural Crisis of the Inter-War Decades." That memorandum dated March 10, 1939, had this opening sentence: "This interwar generation has been living on the edge of a smoldering volcano; and the predominant attitudes among both what is called the 'right' and what is called the 'left' have been variants of escapism, very much like peasants situated on the edge of a volcano who go on cultivating the slopes in the hope that the eruptions will not take place in their lifetime."

Then I reviewed the errors of the interwar period. Toward the end I said: "The present period is too late for that reversal of error which prevents the consequences of error. The real 'Munich' took place in 1936, in connection with the Rhineland. Then was the last opportunity missed for preventing that cumulative German aggression that was bound to culminate in a new and more terrible war by Germany. But what can and must be done for our salvation and safety is self-clarification and self-reorientation toward the onrushing dangers."

Then in the concluding sentence—and you must pardon the length, for I thought it was my business to try to think things out instead of trying to be popular—I urged preparedness:

"There is still time for western civilization, and especially for the exceptionally and fortunately situated United States, to use the time drafts that can still be made on the 'Bank of History' for the preparedness that has and will become more and more urgent and inevitable for all members of western civilization as a result of the past errors committed and in the course of the prospective unfolding aggressions of Nazi Germany."

It was in the following month, on April 15, 1939, that there was published in the Physical Review a note by Dr. Leo Szilard entitled "Instantaneous Emission of Fast Neutrons in the Interaction of Slow Neutrons with Uranium."

In keeping with the custom in scientific research, the date of its original sending was included, dated March 16, 1939. So it coincided with the time when Hitler seized Prague, and by seizing Prague became the controller of the crossways of the Continent.

The background of that article in the Physical Review was that at the turn of the year 1938 certain experiments had been concluded in Germany. These became known rather fully, thanks to Dr. Niels Bohr, of Denmark, who came to this country and reviewed them with his colleagues, for scientists are an international community. The word "international" in that connection is not as precise as it ought to be. Science rather is "trans-national"—moving across boundaries of nations—and progresses in terms of evolving common ideas. After all, our heritages of common moral, political, and intellectual ideas in their institutional forms date for our world from the Reformation and the Renaissance. That crystallization of Hebraic-Christian ideals, and that recovery of the Hellenic pursuit of science has functioned as a sort of spiritual and intellectual atmosphere for all nations of our civilization. The men of science depend upon the free flow of knowledge and ideas through that atmosphere. Through such personal communication as was provided by Dr. Bohr the refugee scientists working in this country were made aware more thoroughly than through the publications of the experiments by Drs. Hahn, Strassmann, and Meitner that had resulted in the fission of uranium.

What was subsequently done in this country represented a distinct advance. The work was by Dr. Szilard and, as independent confirmation, by Prof. Enrico Fermi, a Nobel Prize physicist from Italy. The Nazi contamination had advanced so far that return became difficult for him, as well as for all others who did not conform to the tribalistic notions of nazism. The mutual confirmatory work of Dr. Szilard and Dr. Fermi amounted to the suggestion that a chain reaction could be established in the process of atomic fission. Such a chain reaction had implications for war by reason of the kind of power that would be concentrated in and released by the process of atomic disintegration.

Because I had been imbued with the ideas already noted about the nature of the world crisis, I was concerned with what was happening to the victims of nazism and fascism, and I tried in my own small way to be helpful during the period when the scientists had to leave.

I gave you at first some high lights of the "Book of Genesis" of my concern, and after that came, if you will, the "Book of Exodus," the exodus of scientists who came to this country as a haven of refuge. Prior to that Dr. Szilard had worked in England at Oxford and Cambridge—at Oxford with F. A. Lindemann,

who played toward Mr. Churchill a role analogous to the one concerning this project played by me toward Mr. Roosevelt.

In the wake of this phase of the exodus, the scientists settled in democratic countries like ours were concerned not only with the progression of a technical problem, but with its political and moral implications. Dr. Einstein was preeminent among them. Professor Einstein's theoretical work, while it antedated the First World War, received practical confirmation in the astronomical tests that, interestingly enough, came just in the closing phase of World War I, as Prof. A. S. Eddington, of Cambridge, showed in his early books on relativity and space, time and gravitation. There was another great physicist, who was a friend of Dr. Szilard and part of that group, Prof. E. P. Wigner, professor of theoretical physics at Princeton.

Einstein, Wigner, and Szilard discussed the problem. I want to impress upon you gentlemen—if a member of the cognate older faith may refer to the Gospel of St. John—that “in the beginning was the word,” and the idea. In the beginning was a moral idea and a political concern on the part of the physical scientists and this social scientist whom they brought in. They brought me in because they had known of my interests and had heard that I was in a position to talk to the President and talk to him in terms of broad and fundamental concepts. The idea was, How can this be brought to the attention of the President?

The Germans were organized to carry on experimentation without limit. The Nazis were not at all concerned about the magnitude of expenditures. Ironically, despite all the beblinkered concern on the part of members of my own expertise, economics, as to the postwar problem of reparations, the fact was Germany was spending on armament in any and every year once it got going, more than was involved in the total amount of its remittances on reparations. Money was no object. They had the scientific governmental institutions. Many of the scientists who later led here and in England in this work had been carrying on such work at the Kaiser Wilhelm Institutes of Physics and Chemistry.

Our idea was that if they should be able to discover a concentrated power that could be used as an explosive, then the real safety of the United States and the rest of civilization would be gravely imperiled. For bear in mind that the essence of this period of foul weather internationally, to use Thomas Hobbes' expression for this wartime weather, was that the Nazis were rushing to conquer and not permitting others time for the organization of defense.

Therefore, these physical scientists and myself—I was brought into the picture in the summer of 1939 and was conditioned for what was taking place because I had for a long time been interested in theoretical physics and had followed the scientific publications—then felt that it was important to bring these matters to the attention of the President. In turn I felt that it was essential that an opinion should be written by the one man whom the world recognized as the preeminent scientist of our day, and not only the preeminent scientist, but, as the Senator this morning remarked, one of the greatest humanitarians because he had left nazism before expulsion orders were given to him. He had anticipated the trend of events. He did have the political foresight and did see what it implied. So after discussion Dr. Einstein wrote a letter regarding this, dated August 2, 1939. I had also asked Dr. Szilard to write a memorandum describing the significance of the current and evolving scientific research, which was written on August 15, 1939.

Then I sought and waited for a proper opportunity to see the President. I had been in touch with him through the summer, but I felt at the time that the mere delivery of memoranda was insufficient. Our system is such that national public figures—you gentlemen know it from your work as legislators, and it applies to the executive and the administrative in government—are, so to speak, punch-drunk with printer's ink. So I thought there was no point in transmitting material which would be passed on to someone lower down. This was a matter that the Commander in Chief and the head of the Nation had to know and act on. I could do it only if I could see him for a long stretch and read and discuss the material, so that it would come in by way of the ear and not as a sort of mascara on the eye.

Then, of course, with the outbreak of the war on September 1, 1939, the President had the problem of the existing neutrality legislation, as you recall. So only when that was solved did I accept an appointment, because it meant that then I could see him at leisure and present all the relevant material. I brought over the material to him, and met with him on October 11, 1939. I wrote the letter in anticipation of my seeing him so that I would be able to read it. The opening sentence was:

"With approaching fulfillment of your plans in connection with revision of the Neutrality Act, I trust that you may now be able to accord me the opportunity to present a communication from Dr. Albert Einstein to you, and other relevant material bearing on experimental work by physicists with far-reaching significance for national defense."

"Briefly, the experimentation that has been going on for half a dozen years on atomic disintegration has culminated this year (a) in the discovery by Dr. Leo Szilard and Professor Fermi that the element uranium could be split by neutrons and (b) in the opening up of the probability of chain reactions—that is, that in this nuclear process uranium itself may emit neutrons. This new development in physics holds out the following prospects:

"1. The creation of a new source of energy which might be utilized for purposes of power production.

"2. The liberation from such chain reaction of new radioactive elements, so that tons rather than grams of radium could be made available in the medical field.

"3. The construction, as an eventual probability, of bombs of hitherto unenvisioned potency and scope: As Dr. Einstein observes, in the letter which I will leave with you, 'a single bomb of this type carried by boat and exploded in a port might well destroy the whole port together with some of the surrounding territory.'

"In connection, then, with the practical importance of this work—for power, healing, and national defense purposes—it needs to be borne in mind that our supplies of uranium are limited and poor in quality as compared with the large sources of excellent uranium in the Belgian Congo, and, next in line, Canada and former Czechoslovakia. * * *

I also informed him we had learned that in the wake of the successful experiments of Drs. Hahn, Strassmann, and Meitner, the last of whom afterward also joined the exodus, the Germans upon capturing Czechoslovakia and seizing Prague, had embargoed the export of uranium from Czechoslovakia.

I also mentioned the people who had been at work on this and who had been consulted.

"* * * Mindful of the implications of all this for democracy and civilization in the historic struggle against the totalitarianism that has exploited the inventions of the free human spirit, Dr. Szilard, in consultation with Prof. E. P. Wigner, head of the physics department at Princeton; and Prof. E. Teller, of George Washington University; sought to aid this work in the United States through the formation of an association for scientific collaboration, to intensify the cooperation of physicists in the democratic countries—such as Professor Joliot in Paris, Professor Lindemann, of Oxford, and Dr. Dirac, of Cambridge—and to withhold publication of the progress in the work on chain reactions."

The CHAIRMAN. Doctor, what was the date of the embargo on uranium?

Dr. SACHS. Right in April, right after the seizure of Prague on March 15, 1939. Bear in mind that the scientific world community was already astir and included Professor Joliot, married to a daughter of Madame Curie; Professor Lindemann, of Oxford, afterward Lord Charwell, who played this corresponding role to Winston Churchill.

"As the international crisis developed this summer, these refugee scholars and the rest of us in consultation with them unanimously agreed that it was their duty as well as desire to apprise you at the earliest moment of their work and to enlist your cooperation. * * *

"In the light of the foregoing, I desire to be able to convey in person, in behalf of these refugee scholars, a sense of their eagerness to serve the Nation that has afforded them hospitality, and to present Dr. Einstein's letter, together with a memorandum which Dr. Szilard prepared after some discussion with me and copies of some of the articles that have appeared in scientific journals. In addition, I would request in their behalf a conference with you in order to lay down the lines of policy with respect to the Belgian source of supply and to arrange for a continuous liaison with the administration and the Army and Navy Departments, as well as to solve the immediate problems of necessary materials and funds."

There are two more documents that are pertinent to the enlistment of the President's interest at the time. One of the things that I submitted to the President, in addition to the scientific material was, of course, this review of mine of the whole world situation on the imminence of war and the nature of this war, which is really a Thirty Years War from 1914 on, with only a brief interlude, a brief armistice, in the twenties. From 1931 on there was a resumption

of war first by Japan in the seizure of Manchuria, and then came the succession of wars, the Italian war against Abyssinia, the interventionism by the Axis Powers in Spain, the war against Austria, and finally the seizure of Czechoslovakia.

In 1936 there were lectures delivered on the history of science, reviewing the progress since the turn of the century in the physical sciences. The book was published by Cambridge University Press after Munich in 1938. Due to the work that I had done in England and my relationship to leading figures, I used to get publications in a variety of fields, including science. This book published in 1938 contained two lectures on the history of recent developments in physics, and the development of the theory of atomic structure by Lord Rutherford, whose work initiated the technical side of the physical research since the turn of the century. Some of the greatest work of Lord Rutherford was done right nearby when he was professor of physics at McGill University, and it was for this work that he got the Nobel Prize.

There were these two lectures by the subsequently deceased Lord Rutherford which were revised by an assistant of his, and then there was a separate lecture in addition on Forty Years of Atomic Theory, by F. W. Aston, of Cambridge, who died only a few days ago, as you may have seen the notice. F. W. Aston, reviewing the work that had been done by 1936 and describing what was being done in England and elsewhere, ended up his lecture with a warning and a prophecy. I showed this book to the President with a view to high lighting that, as with other fruits of the tree of knowledge, there is an ambivalence to atomic power with poles of good and evil. The concluding paragraph is as follows:

"There are those about us who say that such research should be stopped by law, alleging that man's destructive powers are already large enough. So, no doubt, the more elderly and ape-like of our prehistoric ancestors objected to the innovation of cooked food and pointed out the grave dangers attending the use of the newly discovered agency, fire. Personally, I think there is no doubt that subatomic energy is available all around us, and that one day man will release and control its almost infinite power. We cannot prevent him from doing so and can only hope that he will not use it exclusively in blowing up his next door neighbor."

The President remarked, "Alex, what you are after is to see that the Nazis don't blow us up." I said, "Precisely." He then called in General Watson, lovable "Pa" Watson, another one of that period who has gone from us, and said, "This requires action." General Watson then went out with me, and the informal group was established.

Senator VANDENBERG. What was the date of this?

Dr. SACHS. October 11, 1939, sir.

He selected, with the approval of the President, one man representing the Army concerned with science, and one representing the Navy: Colonel Adamson for the Army and Commander (since Admiral) Hoover for the Navy.

Holding that as an expert I ought not to be injecting political views, I have throughout my work remained an associate regardless of party and other affiliations. I have the honor to know ex-President Hoover, and I was very pleased to find a namesake of his concerned with these scientific problems, as President Hoover during his incumbency as Secretary of Commerce did a great deal for the advancement of science and scientific research.

As the central figure, the President named a Government individual who was concerned with problems of science, the Director of the Bureau of Standards, Dr. Lyman J. Briggs, who rendered great service during the critical period.

I got in touch with Dr. Briggs that very night, before having to go again to the White House to report progress to the President. For the potentialities of this were very much in the mind of the President, and he had remarked, "Don't let Alex go without seeing me again."

I saw him later that night, and the resultant idea was to hold a meeting in the near future. A meeting was scheduled after this October 11 conference at the White House, for October 21.

I reported to Professor Wigner, who throughout this period occupied a pivotal role because he is highly esteemed and was perceptive on what you might call the political problems. I reported to him in a letter of October 17, and I sought throughout the interval to broaden the group of scientists who were to attend that conference.

Senator VANDENBERG. How about the Einstein letter you referred to?

Dr. SACHS. The Einstein letter of August 2, from which I quoted in part in my own letter, was left with the President, along with my letter.

The CHAIRMAN. Have you a copy of it?

Dr. SACHS. That is part of a record which I will leave with you gentlemen, which was a report I prepared immediately after the announcement about the use of the atomic bomb in August for the White House, for the Department of Commerce—Mr. Wallace as the successor in charge of the Department that had such an important role through the Bureau of Standards—and for the War Department.

The CHAIRMAN. Does that contain your letter?

Dr. SACHS. It contains all the documents, sir. It contains Einstein's letter, and it contains other memoranda.

I had throughout this period sought to be a historian, because the President said to me, "Pa Watson is going to be too busy to be a historian; you had better do that."

I made contemporaneous reviews, and would submit them as galvanizers of action.

I have a copy of Einstein's letter, a duplicate, which has his signature, and I will leave that copy with you.

Senator VANDENBERG. Could you state in a sentence or two the import of Einstein's letter?

Dr. SACHS. Yes, sir. [Reading:]

"Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which have arisen seem to call for watchfulness and, if necessary, quick action on the part of the administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendation."

He then describes the new phenomenon, and states that the sources of practical supply are outside the United States; that the United States has only very poor ores of uranium in moderate quantities, and that there is some good ore in Canada, and the former Czechoslovakia. As to that, he reports:

"I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under Secretary of State, von Weizsaecker, is attached to the Kaiser Wilhelm Institute in Berlin, where some of the American work on uranium is now being repeated."

In other words, there was political interest being taken in the work. So Dr. Einstein said that one of the ways in which the administration could be helpful was to entrust this task to a person "who has your confidence and who could perhaps serve in an unofficial capacity." His task might comprise the following:

"(a) To approach Government departments, keep them informed of the further development, and put forward recommendations for Government action, giving particular attention to the problem of securing a supply of uranium ore for the United States.

"(b) To speed up the experimental work, which is at present being carried on within the limits of the budgets of university laboratories, by providing funds, if such funds be required, through his contacts with private persons who are willing to make contributions for this cause, and perhaps also by obtaining the cooperation of industrial laboratories which have the necessary equipment."

These scientists, as you see, gentlemen, were no doctrinaires, but indicated a practical perceptiveness—ready to use whatever means were available so that the Government and the Nation secured a supply and funds for going ahead with this thing.

The next meeting that was held was on October 21 in Washington under the chairmanship of Dr. Briggs of the Bureau of Standards, and there was a survey made of the whole situation. Many scientists were there who were not as concerned as these refugee scientists, for, as I tried to explain, gentlemen, the latter, in addition to their interest in the advancement of science, were interested in the imperiled position of the United States and civilization. They were infused with a concern in the Quaker sense of the word of devoted interest and responsibility. Many of the other scientists said: "This is very remote; we have got to wait and see; there are other lines of progress rather than the chain reaction that may be more attractive." The discussion wandered all over attractive side issues.

The one who occupied the intermediary and catalytic role in behalf of the President had then to ask these American men of science and the Government officials, including the Army and Navy representatives, to indulge—and I re-

member using the phrase of the Irish poet Yeats, echoing Coleridge—in a “willing suspension of disbelief.”

The issue was too important to wait, because if there was something to it there was danger of our being blown up. We had to take time by the forelock, and we had to be ahead of the Germans.

One great advantage that we had was that these refugees, these scientists themselves, responded to that very spirit of freedom that brought the Pilgrim Fathers over here, the search for the freedom of speech and religion and, if you will, free science and free thought. They were saturated by ideas and motives which the regimented scientists could not have, and so the transplanted and the American scientists, if given the means, would make advances much faster.

In the wake of that conference, a subcommittee was appointed, notwithstanding those expressions of doubt. The subcommittee was presided over by Dr. Briggs, and on behalf of the services, Keith F. Adamson, lieutenant colonel, United States Army, and Gilbert C. Hoover, commander, United States Navy. A report was written to the President dated November 1, 1939, on the stationery of the National Bureau of Standards of the Department of Commerce, which reviewed the situation technically and culminated with this observation:

“3. The energy released by the splitting of a mass of uranium atoms would develop a great amount of heat. If the chain reaction could be controlled so as to proceed gradually, it might conceivably be used as a continuous source of power in submarines, thus avoiding the use of large storage batteries for under-water power.”

(I would not have wanted to limit it to this form, but a continuous source of power was the fundamental idea.)

“4. If the reaction turned out to be explosive in character it would provide a possible source of bombs with a destructiveness vastly greater than anything now known.

“The military and naval applications suggested in paragraphs 3 and 4”—in this case he was expressing the not quite suspended disbelief of the representatives of the Services; voicing their greater skepticism, Dr. Briggs said that the military and naval applications “must at present be regarded only as possibilities because it has not yet been demonstrated that a chain reaction in a mass of uranium is possible. Nevertheless”—and in this respect these representatives were willing to go ahead—“in view of the fundamental importance of these uranium reactions and their potential military value, we believe that adequate support for a thorough investigation of the subject should be provided.”

There had been a previous adverse report that I had known about, which was given by a technical adviser of one of the Services in the summer, and it was because of that adverse report that they didn't see any reason for being interested, although they wanted to be kept informed, that I was brought in to go directly to the Commander in Chief.

So they concluded:

“We believe that this investigation is worthy of direct financial support by the Government.”

But, alas, we had no money.

“The Lea bill now before Congress if enacted would provide for carrying out important investigations of this kind in cooperation with the universities.

“We recommend the enlargement of the committee to provide for the support and coordination of these investigations in different universities. We suggest the following be invited: President Karl Compton, Massachusetts Institute of Technology; Dr. Alexander Sachs, 1 William Street, New York” (that was my address at Lehman Bros., who were very kind to let me devote time, and did not ask me to tell them what is was about. Mr. Robert Lehman is particularly to be thanked for this, and a man who afterward became an adviser of the War Production Board, and later Deputy Chairman, Mr. Arthur H. Bunker, who was then executive vice president of the Lehman Corp.)

The people who were asked to be added were Prof. Karl Compton, myself, Prof. Albert Einstein—I am reading this in the order given there; I belong very much at the foot of any such list—Prof. Albert Einstein of the Institute for Advanced Study, and Dean George B. Pegram, Columbia University.

As a sequel to the major finding and recommendation, the committee proposed that initial support take the form of:

(a) Supplying for immediate and experimental work four metric tons of pure-grade graphite; and

(b) If later justified, supplying 50 tons of uranium oxide.

Later on there were all kinds of difficulties about getting the supply, to which I referred. Late that year and in the following year there was another newcomer, an industrialist-engineer by the name of Boris Pregel, who made available his very valuable supplies and experience to Columbia University for the experiments of Dr. Szilard and Professor Fermi, for which he was thanked by Dean Pegram.

The first phase was to coordinate the group of physical scientists for the purpose of presenting the idea to the President. The second phase was the securing of action by the Government, and that was climaxed by the report, which was a go-ahead signal, that Dr. Briggs wrote on November 1, 1939.

If you bear in mind how narrow has been the time, how correct was the concept of the memorandum from which I read of March 10, 1939, that the job was "time-borrowing, the issuance of drafts on the 'Bank of History,'" it becomes plain that if the work had not been thought through before the advent of the war, and if the President had not taken action immediately after, and if the report of the Bureau of Standards and its technical head had not come forth on November 1—the bomb could not have come when it did toward the end of the war to abbreviate the war in 1945. From all this you will realize that the time-borrowing was very essential, and along with it the finding and improvement of the organization media for the successive tasks of the year 1939 and the year 1940 and beyond. In the ensuing period I was an adviser of the President also on problems of strategy. I was also a special consultant to General Donovan, Director of the Office of Strategic Services, for whom I had written in 1941 the first report on the intellectual work that was being done in outside institutions on problems of totalitarian war economics, as well as strategy, before the organization of the Office of Coordinator of Information, that afterward became the Office of Strategic Services.

Through these connections I was able to keep in touch, and I was in turn kept in touch, on the basis of great confidence, with the White House on what was going on, so I knew what was happening even to the very last. I discussed the problem of the form of the use of the bomb with the President early in November 1944, when I submitted a memorandum on the Final Phase of the European War and Emerging Phases of Far Eastern War Liquidation—which contained a forecast that the war would end in April or May, and that there would be no last-ditch stand, but the whole German system would collapse.

Though I have kept in touch, my official role as the representative of the President continued up to the time when, as you will see, I submitted to him the idea that it must be given over to an organization in charge of all scientific development, and suggested Dr. Bush, of whose keen interest and ready aid I had learned in the course of the difficult months of 1940.

Many of the pivotal figures are not now alive; the President is dead. General Watson, who rendered very great service, is dead. I well remember his report that in talking to military and naval men who had said, "Well, this is still so remote; what is this thing?—let's wait and see," "Pa" Watson would say, "But the Boss wants it, boys." That was the theme song of "Pa" Watson. He is dead, and the secretary who used to call me up and pass on White House messages is also dead.

These documents that fortunately were written represent the main available records of the flux of events, apart from scraps, and the scraps that are available in the files are insufficient to give a correct picture. One gets a picture from some of the things that have been published that there was a linear progression. Like all human undertakings, it was full of set-backs, difficulties, conflicts between perceptiveness and willingness on the one hand, and doubts and negotiations on the other, and it required continuous prodding. Such work as I was able to do, I was able to perform because everyone knew I was not concerned about anything but the progress of the work and had made myself anonymous. If I may again quote the New Testament, there is a verse in First Peter, "Be ready always to give answer to anyone that asketh of you the reason of the hope that is in you, with meekness and fear." I felt that I and the others had to go on with this work, and that it must go on, and so I sacrificed my time and concentrated on that. Later on, as a matter of fact, when the war broke out, I resigned from my administrative post and became a private economic adviser and was the better able to devote myself to war work to a considerable extent.

Prior to that, in the summer of 1941, I had given to the Navy a plan that was worked out with the aid of a great engineer, Dr. Emil Mayer, for the use of detector radiosonic buoys for the establishment of an Atlantic security lane originally for the lend-lease shipments. This substantially was afterward

adopted by the Navy through technical work under Professor Hunsacker of MIT and the fostering concern from 1942 on of Mr. Lewis Douglas, then Deputy Administrator of the WSA.

Thus with regard to the adoption of all such technical devices I want to etch in this consideration: that in the beginning there had to be a political concept and a moral concern, and that later it was necessary to provide proper vehicles for action and also to induce acceleration of action.

The third stage in the atomic project was the coordination phase of the university researches with limited governmental aid and pressure—by Einstein and the speaker—for a new framework and an accelerated tempo for the project.

While a number of the university representatives were encouraged by the governmental interest, the fundamental tenor and the tempo of the work remained, on the whole, continuous with the past—that is, they were regarded as mere laboratory researches.

The time of this phase was approximately coincident with what was called then the "phony" war. This was the time of the war which embraced the period between the fall of Poland and the Nazi invasion of the Lowlands.

You can well realize that the President during this period was pressed by and preoccupied with numerous internal and international problems. Our liaison for the project, General Watson, orally conveyed the general tenor to the President of Dr. Briggs' report. While he had done that, he thought when, after an interval, he transmitted it to me on February 8, 1940, that a more pointed conclusion was still necessary. He added that he had asked for a special recommendation from Dr. Briggs.

Meanwhile, some progress was made in the coordination of the university researches by the Coordinating Committee mentioned in the concluding point 8 of Dr. Briggs' report. The appointment of Dean Pegrarn served to focalize activities in Columbia on this project and frequent conferences were held there by the speaker with Drs. Pegrarn, Fermi, and Szilard.

In mid-November of 1939, our group had projected an octet of experimental projects in the hope that the subsidiary questions could be cleared within a period of 6 months. In notes that were made at the time, I listed the nature and scope of these subsidiary problems and the recommended leading figures from nearby educational institutions working on these problems. Of the new men brought in the most important was Prof. Harold C. Urey, who had won the Nobel Prize for his work on heavy water.

After the turn of the year, the Columbia project became the recipient of governmental aid in the form of limited funds intended for the purchase of materials, as is borne out by the reply that Dr. Briggs made on February 20, 1940, to General Watson's note of February 8, 1940.

But Dr. Einstein and myself were dissatisfied with the scope and the pace of the work and its progress. The speaker conferred with Dr. Einstein at Princeton in February. I went out to see him there and developed an inquiry as to the importance of the work that was being carried on at the time in Paris, work that had been described in a contemporaneous issue of *Science*. While we felt that it was very important that this free trade in ideas—to use an expression of Justice Holmes in one of his great and discerning decisions—that this exchange of ideas among free scientists should be carried on because they served as links and as stimuli to future work, their accessibility through publications to Germany constituted an important problem. Nonetheless, it was advisable to secure comparative evaluations and in response to my question about the work of the French, Dr. Einstein said that he thought the work at Columbia was the more important. He further said that conditions should be created for its extension and acceleration.

Accordingly, I sent, on February 15, 1940, to General Watson a plea for larger aid and an intimation that presently Dr. Einstein would give a favorable evaluation of the work which had been completed at Columbia.

(The letter referred to is as follows:)

FEBRUARY 15, 1940.

Gen. EDWIN M. WATSON,
Secretary to the President,
The White House, Washington, D. C.

DEAR GENERAL WATSON: Thank you very much for your letter of the 8th and the accompanying report of Dr. Briggs to the President, both of which will be treated as confidential. Had the recommendations from the second part of point

5 through points 6 and 8 been placed ahead of the more technical points 1-4, the practical meaning of the letter would have been clearer and more forceful; namely, that in the opinion of Dr. Briggs and his colleagues it was distinctly worth while to go ahead. Due to too academic a presentation, I feel that that practical point was lost.

As the last issue of Science contained a quotation from Science Letters bearing on work in Paris, and as, since our meeting, there has been even more searching and significant work in this country, I shall take the occasion to submit within the next month an up-to-date appraisal of the situation which, according to Dr. Einstein in a recent conversation, holds forth even greater promise than we had thought.

With kind regards and appreciation,
Yours sincerely,

ALEXANDER SACHS.

Dr. SACHS. Ensuing conferences which I had with Dr. Einstein prompted the suggestion that he prepare another review of the situation for submission to the President. I had felt that Dr. Einstein's authority was such that, combined with his insight and concern, it would affect the tempo of the work. His review, which was dated March 7, was written as a letter to me. I will read the opening and closing paragraphs of this letter, addressed to me at my office at the Lehman Corp.

"In view of our common concern in the bearings of certain experimental work on problems connected with national defense, I wish to draw your attention to the development which has taken place since the conference that was arranged through your good offices in October last year between scientists engaged in this work and governmental representatives."

He also reported that he had learned of the further work that was going on in Germany since the outbreak of the war, the work on uranium. He pointed out that this work was being intensified in Germany. I shall quote a portion here:

"I have now learned the research there is being carried out in great secrecy and that it has been extended to another of the Kaiser Wilhelm Institutes, the Institute of Physics."

The sources of such information are not only personal communications but also scattered references in technical publications that can be made to throw light on what goes on. By this process even under the totalitarian system secrets come out. Similarly, under our freer system things can come out in an impersonal way. They did come out even while we were taking terrific measures, and very rightly so. Yet by inadequate attention to technical sources those measures proved in one not unimportant instance rather ineffective. I refer specifically to the unwitting disclosure by the Minerals Yearbook of 1943. On page 828 of that book, in the course of a very technical statement about uranium, there is such a reference to the use of uranium for potential war purposes in 1943.

Senator TYDINGS. Was that our book, or was it a German book?

Dr. SACHS. It was our book, the Minerals Yearbook for 1943, on page 828. At the very time that newspapers and editors were not even to breathe the word "atom," the Minerals Yearbook of 1943, page 828, said, with reference to uranium, "Uranium production in 1943 was greatly stimulated by a Government program having materials priority over all other mineral procurements, but most of the facts were buried in War Department secrecy." Then it goes on to say, "Most of the 1943 uranium supply was used by physics laboratories for research on uranium isotopes as a source of energy." These technical books went everywhere, they were available by the ordinary routine to the technicians who would not have to read between the lines.

Thus secrets leaked out. To a different degree this sort of thing obtained even in the hermetically sealed German system. It is inherent in the situation.

As I said, Dr. Einstein wrote me on March 7, 1940. He stated that research on uranium had intensified in Germany.

"Since the outbreak of the war, interest in uranium has intensified in Germany. I have now learned that research there is being carried out in great secrecy and that it has been extended to another of the Kaiser Wilhelm Institutes, the Institute of Physics. The latter has been taken over by the Government and a group of physicists, under the leadership of C. F. von Weizsaecker, who is now working there on uranium in collaboration with the Institute of Chemistry. The former director was sent away on a leave of absence apparently for the duration of the war.

"Should you think it advisable to relay this information to the President, please consider yourself free to do so. Will you be kind enough to let me know if you are taking any action in this direction?"

I shall skip the next paragraph. Then he wrote:

"I have discussed with Professor Wigner of Princeton University, and Dr. Szilard the situation in the light of the information that is available. Dr. Szilard will let you have a memorandum informing you of the progress made since October last year so that you will be able to take such action as you think in the circumstances advisable. You will see that the line he has pursued is different and apparently more promising than the line pursued by Monsieur Joliot in France about whose work you may have seen reports in the papers."

I had, throughout, followed the policy not only of being an expert on tap, but of going to other people's experts to see what they were doing. When it came to scientific work, I left that to the scientists. I did not presume, when I forwarded these memoranda written by Dr. Einstein, Dr. Szilard, and the others, to act other than as a synthesizer for them.

I passed on Dr. Einstein's review of the situation to the President on March 14, 1940, asking for an opportunity to confer with him on the latest phases of the experimental work.

(The letter referred to was entered in the record of the committee and appears below:)

MARCH 15, 1940.

The PRESIDENT,
The White House, Washington, D. C.

DEAR MR. PRESIDENT: As a sequel to the communication which I had the honor to submit to you on October 12, Prof. Albert Einstein sent me another regarding the latest developments touching on the significance of research on uranium for problems of national defense. In that letter he suggests that I convey to you the information that has reached me that since the outbreak of the war, research at the Berlin Institute of Physics, which has been taken over by the Government, was placed under the leadership of C. F. von Weizsaecker, son of the German Secretary of State.

In the realization that these further views of Dr. Einstein have a definite bearing on the favorable report submitted to you by Dr. Briggs as chairman of the committee which conferred with experimental scientists concerned and myself, I am enclosing his communication for your kind perusal. May I also ask whether and when it would be convenient for you to confer on certain practical issues brought to a focus by the very progress of the experimental work as indicated in the concluding paragraph of Dr. Einstein's letter?

In view of your original designation of General Watson in this matter, I am transmitting it through his good offices.

Yours sincerely,

ALEXANDER SACHS.

Dr. SACHS. The reply of General Watson on March 27, 1940, was to the effect that the governmental committee was awaiting "a report of the investigations being conducted at Columbia University" and hence "the matter should rest in abeyance." I did not feel that I could rest.

Senator TYDINGS. "In abeyance"?

Dr. SACHS. Yes. For the sense of foreboding about Nazi aggression that had been voiced before the outbreak of the war—as I disclosed previously—impelled me to relate the expectations of new invasions in the wake of spring to the instant project.

At the beginning of April, opportunity was afforded the speaker in the course of a visit to the White House to unfold views on the probable course of German aggression as encompassing in this war—as distinguished from the last war—the elimination of neutrals so as to secure complete control of the coast from Norway to France. It had this bearing on the uranium project: It was suggested that diplomatic arrangements be made for the shipment of uranium supplies from Belgium to the United States, instead of shipment on the eve of invasion to France, to avoid their probable capture by the Germans in their military onrush through France.

Taking the project as a whole, it was urged that instead of delimited aid in the form of specific material purchases or reimbursements for expenditures by universities, a fund be made available from governmental sources or by persuading foundations to allocate a fund in order that research could be planned on an adequate scale and on a long-term basis.

I had also another thought in mind in making that suggestion that the late spring months were not too early for the planning of the enlargement of the research personnel; to wit, around April and May the scientists were being booked up for the next year's work in the universities, and if we did not take them then, we were not going to have them later on. So, our job was to divert academic talent from teaching to research, to public research. Otherwise, the right kind of people, the people we wanted, would have completed their negotiations with faculties for the next academic year.

The tenor of these considerations and recommendations was embodied in an aide-memoire which I prepared in Washington and left with the President as a review of the situation: "Import of War Developments for and Application to Natural Defense of Uranium Atomic Disintegration," April 20, 1940.

The fourth phase was the phase which I have called in this report written immediately after the events, in the role of contemporaneous historian which the President assigned to me—"efforts by the originators of the project to gain the adherence of the governmental and advisory group to organizational changes needed to attune the research to the urgencies of unfolding World War events."

The representations made to the President at the end of March and early April, as just summarized, led him within a few days to revert to and act upon my preceding correspondence that had been pitched in the same key.

Accordingly, on April 5, 1940, he acknowledged what had been conveyed to him and proposed that a new conference be held in Washington between Dr. Einstein and the speaker on the one hand, and Dr. Briggs and the special representatives of the Army and Navy on the other hand.

The closing paragraph of that letter indicated that the President wanted the research continued: That is, the preliminary questions about which a few in the coordinating group still retained tints of doubt were in his mind disposed of.

To General Watson was delegated the making of arrangements for the conference, but the President wanted to be advised directly of the results of the conference.

Under even date, General Watson asked the speaker for a list of scientists to be invited, inclusive of suggestions by Dr. Einstein. The inquiries made by the speaker of Dr. Einstein and other members of the coordinating group led to the submission to General Watson of the requested list.

Throughout my work I was in touch with Dr. Wigner of Princeton, Dr. Szilard and Dean Pegrarn of Columbia and, later on, also Urey.

Following the receipt on April 13 of the two letters from the White House of April 5, Dr. Einstein was written to on April 15. My letter opened with a statement regarding the transmission to the President of Dr. Einstein's communication of March 7 to me. It referred to favorable action taken by the President upon his return from the Canal Zone trip where he had been on vacation. I had gotten in touch with him in the course of that trip, as he had given to this anonymous adviser the privilege of getting through with his messages, and the message so conveyed had contributed to the decision by the President "to adopt the procedure suggested" in the speaker's original communication.

Cognizant of the resistances in the group to the proposed enlargement of the organizational framework, the speaker urged Dr. Einstein to participate in person in the forthcoming conference. However, after a conference which the speaker had with Dr. Einstein at Princeton, it became clear that indisposition on account of a cold and the great shyness and humility of that really saintly scientist would make Dr. Einstein recoil from participating in large groups and would prevent his attendance. So, he delegated me to report for him, too.

As a substitute, I had asked him to enable me to record the consensus of our views in the form of a written communication to Dr. Briggs. That communication, dated April 25, 1940, to Dr. Briggs, which Dr. Einstein signed, referred to the discussions he had had with Dr. Wigner and myself on the progress of the work of Dr. Fermi and Dr. Szilard.

The purport and purpose of the letter was to impart a new impetus and to suggest an appropriate adjustment of the organization side of the research to the interlinked necessities of the emergent phase of the research and of the international situations.

I should like to quote from that letter.

"I am convinced as to the wisdom"—

The CHAIRMAN. Whose letter was that?

Dr. SACHS. This is Dr. Einstein's letter, which I brought with me, to Dr. Briggs.

"I am convinced as to the wisdom and urgency of creating the conditions under

which that and related work can be carried out with greater speed and on a larger scale than hitherto.

"I was interested in a suggestion made by Dr. Sachs that the Special Advisory Committee supply names of persons to serve as a board of trustees for a nonprofit organization which, with the approval of the governmental committee, could secure from governmental or private sources, or both, the necessary funds for carrying out the work.

"Given such a framework and the necessary funds, it (the large-scale experiments and exploration of practical applications) could be carried out much faster than through a loose cooperation of university laboratories and Government departments."

You must bear in mind that this was before the fall of France and the Government executives had no money.

We were trying to take this thing out of where it was. This was the viewpoint of those who, having made their venture of faith, sought assistance adequate to the need, as distinguished from other scientists who were content with what I called, in the memorandum to the President, a bit-by-bit procedure. Since we realized the import and pressure of international events, we wanted the thing lifted out of the somewhat monastic type of research that goes on in universities, a slow-motion process on very limited scale. We wanted both larger scale and much faster tempo.

Originally, the April meeting was scheduled by Dr. Briggs for April 22, and so far as nongovernmental people were concerned, was to be limited to Dr. Einstein, Dean Pegrum of Columbia, and myself. Then by telegram of April 20, the meeting was postponed to the 27th. In the interim I sought to enlarge the group and I requested that an invitation be sent to scientists and executives in universities involved in the current uranium research.

That request was granted, as appears from my letter to the President of May 11, 1940.

(The letter referred to was entered in the record of the committee and appears below:)

MAY 11, 1940.

The PRESIDENT,

The White House, Washington, D. C.

DEAR MR. PRESIDENT: In furtherance of your kind letter to me of April 5, the conference suggested by you was arranged and held under Dr. Briggs' chairmanship on April 27, between the governmental and nongovernmental groups concerned with the bearing of uranium experiments on national defense. With the conclusion of the first experiment, which was conducted at Columbia University by Drs. Szilard and Fermi, with governmental aid, the whole project is now entering upon a new stage. Assuming that the governmental committee will now, upon your inquiry, report in favor of further and larger governmental action, may I, in accordance with your own gracious expression of a desire to be advised of developments, submit the following considerations and suggestions:

1. With the invasion of Belgium by the very power which has organized the residue of its scientists for uranium work, the danger—alluded to in my original letter to you of October 11, 1939—that America may be cut off from uranium supplies of the Belgian Congo has increased. In addition, the successful completion of the above-mentioned preliminary experiment renders it practicable and advisable that the action to be taken shall be adequate and comprehensive.

2. Such action inherently involves not only larger financial support to be accorded by the Government but also the formation of an organizational framework under which the work can proceed with the flexibility required for a going enterprise. Interestingly enough, the latter practical aspect has been emphasized by Dr. Einstein in conversations with myself and was communicated by him in a letter to Dr. Briggs, of which I am enclosing a copy for your kind perusal and attention. In this connection you might find of interest the enclosed copies of two communications which I have received from Dr. Szilard, the first of which contains a synoptic statement of the implication of the work for national defense that was made orally at the above-mentioned conference of April 27, and the second an outline of the next tasks to be undertaken.

3. The resultant requirement for forming an organization for directing the work outside of governmental institutions and for assuring that work by scientists in the universities is carried out with due secrecy has to be dovetailed with the designation of persons to serve as trustees of a nonprofit organization that is to supervise the allocation of funds and to coordinate the various branches of the work.

4. These interlinked needs suggest to me that it would be desirable to bring one of your legal aides into the circle of discussion, along with General Watson, who is now serving so efficiently as a liaison for the representatives of the service departments and the Bureau of Standards.

In view of the urgency of a decision on these points, I should greatly appreciate conferring with you in the course of next week, at your convenience.

Yours sincerely,

ALEXANDER SACHS.

Dr. SACHS. That, then, is the background against which the conference was held, a background which was lit up by portentous international events. The second week of the month opened with the German invasion of Norway and Denmark on April 9; the third week witnessed counter operations by the British, the landings in Norway on April 16 and April 18.

Since the concern for national defense and the survival of civilization motivated my mediation of the project between the scattered scientists and the President, it is understandable that in the flux of erupting international forces I should seek to transpose the laboratory questions to the larger theater of international policy and military operations.

Two contemporaneous crystallizations of that preoccupation are available. The first is a memorandum letter prepared at my request by Dr. Szilard under date of April 22. The second is the already referred to memorandum for use with the President, dated April 20, 1940, and bearing the title "Import of War Developments for and Application to National Defense of Uranium Atomic Disintegration."

Skipping the very technical side, I want to mention the—

The CHAIRMAN. Doctor, I am sorry, but we have to recess at 12 o'clock. So, if you will, we would like to have you bear that in mind.

Dr. SACHS. All right, sir. I will pick an appropriate place.

The memorandum-letter by Dr. Szilard aimed to describe the next phase of the research and its dual alternatives and their respective applications to national defense. The first case deals with chain reactions in which the neutrons are slowed down so only a small fraction of uranium can be utilized. In the second case, the neutrons are not slowed down and so the bulk of the ordinary uranium can be utilized. It is the latter case which has the greatest significance for national defense and particularly for the production of atomic bombs. The former significance would appear to lie in power production. Both would also present the complication that personnel handling such atomic engines would be exposed to the radiations.

The second alternative also presented a dual utility for concentrated power and concentrated explosives. As to the second use, the concluding paragraph of that memorandum constitutes a most illuminating formulation:

"A chain reaction of this second type would make it possible to bring about explosions of extraordinary intensity. If, for purposes of aggression, a bomb based on such a chain reaction were set off at sea near the coast, tidal waves brought about by the explosions might lead to the destruction of coastal cities."

The coincident memorandum of the speaker was concerned with high lighting the bearing of the war developments on the organizational aspects of the uranium research, and evoking applications for naval warfare with a view to throwing into sharper relief the urgencies of providing more central direction and greater adequacy of scope and speed in the prosecution of the project.

I had previously been called in to discuss what would be the results if control of the Mediterranean was achieved by the aggressor. In that connection there was a coincident idea advanced by a person who had been in the Army and who was concerned about this problem, a very great authority and friend of mine, General Donovan. General Donovan and myself had independently perceived that the Mediterranean would for war prosecution against Germany be significant north-south, as distinguished from east-west. We saw that the democracies would be pushed out from the Continent, that the next war phase would push France out as a major belligerent power.

This conclusion did not require so much foresight, as it required a memory with which I happen to be endowed. For the French military people engaged in the last Peace Conference had seen that and stated it. Furthermore, in the book on the Peace by André Tardieu to which Clemenceau wrote an introduction, there is a prevision of the 1940 plight and defeat of France. Clemenceau was a layman who had his own views about military strategy: You will remember he was the man who had remarked that war is too serious a thing to leave it

solely to the military—Clemenceau had seen that development and he expressed himself on it as an insightful layman, who while entertaining complete respect for the performance of the military, can synthesize the military considerations with the political considerations.

Clemenceau had insisted at the Peace Conference, "If you do not give the French the protection at the Rhine, then the other democracies will have no base of operations, no base of support, no jumping-off place for operations by the overseas democracies." Thus mindful of the last war, we agreed we would not even have a base on the Continent. Therefore, the significance of the Mediterranean was going to be north-south and not east-west.

In the light of and following such discussions on the fate of our access by sea to the Continent, I broached the problem of the supply of uranium for the United States. I pointed out that the biggest supply of uranium was in the hands of the Belgians. I pointed out that even if in anticipation of invasion they were to send it to France, it would not come to us. Hence we ought to open, ahead of invasion, diplomatic negotiations.

Incidentally, that industrialist-scientist I mentioned, Boris Pregel, who at the outbreak of the war was in France and was a French citizen, had, it later appeared, asked the French Government in 1939 to make arrangements with the Belgians.

That prescience on the part of these newcomers and refugees, gentlemen, was operative in our cause because they were united by a political sensitivity along with their specific expertise as scientists and technologists.

Now, the memorandum which I submitted to the President opened with a description of the meetings and the work that was being done by other scientists; by the scientists in England, men like Drs. Chadwick and Lindemann, and so on. That work would be available for coordination with research in America. In other words, there was suggested at that time the idea of Anglo-American collaboration. In that already alluded to Cambridge lecture in 1936, it was foreseen that there would eventually be developed a new source of energy; and that lecturer was also aware, profoundly and humanly aware, of the dualism, the good and evil, in such development.

The memorandum then dealt with the tendency to reservations and understatement of the results of research and their implications, the effect of which on governmental representatives was to cause them to recoil from the very suggestions that were being pressed by Dr. Einstein and myself for providing a larger and more resourceful organizational framework for adequate and faster prosecution of the task.

In the effort to overcome the tempo dampening and scale dampening that the other attitude entails—the attitude of conservative hesitation, proper enough in an ordinary task but not for this kind of thing, which required the already designated "willing suspension of disbelief"—in that effort, the speaker submitted the following observations and considerations which in a later presentation to the President appeared to be contributive toward a resolution of the organizational difficulties:

"The present writer, as a nonphysicist"—this is a quotation from my memorandum—"would not of course venture an opinion alongside those cited. But as an economic historian and as a practical economist versed in the conduct of technological research, he has ventured to convey to the scientists mentioned and to the governmental authorities his hypothesis that the difficulties which loom so large now might well arise from the characteristic physical limitations of the pre-pilot plant operations that are carried on in the typical university laboratories. If the project is fraught with promise and importance for national defense, then it seems to him worth while to approximate very soon the conditions of industrial pilot-plant operations. This might entail the building of equipment, machinery, and even the construction of adequately scaled and adequately protected physical plant.

"Once we relate the uranium research to national defense, it should be regarded in type and tempo to the most advanced technological research that has been carried out by the American chemical and electrical companies."

I need hardly insert parenthetically that it was this scale of operation which was carried out with such distinction later on by General Groves. Returning to the memorandum:

"What has taken place in Poland, Denmark, and Norway, and will doubtless go on through other European countries that will be invaded, is that the pacific-minded countries have not brought their national defense up to the quantity and

quality required for technological warfare. When the import of the European war is assimilated by the American people and national defense is undertaken as a national enterprise, then we may be confident that we will match in war with the progressiveness of our civilian technology and come to surpass it, which means surpassing the German military technology."

In the conviction, then, that "an adequate organizational framework is itself the precondition for the ascertainment and effectuation of the value of nuclear research for national defense," the speaker proceeded to sharpen the possible applications of that research for naval operations—

Senator RUSSELL. What was the date of that?

Dr. SACHS. April 20, 1940, before the invasion of France.

As I say, I proceeded to point out the possible applications for naval operations, on the assumption that the war would in time become global on the part of the Axis, inclusive of Japan, against the democracies, inclusive of the United States.

In that event, the applications in the dual form of telescoped power drive and magnified explosives should aid the United States to overcome "the disadvantage under which we labor due to the enormous distances between continental United States and our possessions, and between our possessions and the Japanese homeland."

This was not warmongering; this was adjustment to the import of events as I saw them, as I followed the phenomenal developments.

If I may quote again from the Bible, from the Twenty-fifth Jeremiah: the nations were successively "taking the winecup of this fury at the Lord's hands and drinking it." I could see that we would all be engulfed; that on the Continent, only Great Britain would be left; and that we would be the only major continental-insular power left in the universe and that then we would have to take action. I saw that we must not let Germany get ahead with atomic research on the kind of weapon they were working on, a weapon whose essence is the elimination of time for the defense, the elimination of that borrowed time that we all needed so badly in this war.

Inasmuch as the attempt to relate the applications to strategic and logistic configurations presupposed naval data, Dr. Briggs' good offices with Admiral Bowen and Commander Hoover brought answers to questions I submitted in a letter. I did not have a copy of that letter for inclusion in my report.

As the sequel to my April 1940 activities was to place the atomic project on a new plane, this new stage of the work in progress provides the occasion for drawing attention to a needed revision in the fast-crystallizing misconceptions of the project's history. The historical review I have given from the contemporaneous record that I kept for the President as a guide to his decisions and actions shows that the development of the atomic bomb was not the linear progression from a single decision that people have spoken and written about. You will remember the story in Alice in Wonderland about the Queen and Bill Lizard: how the Queen started with the end, or the sentence to be imposed, and then worked back. So there is a tendency when it comes to writing history for people to say in the instant case: We have got the bomb and we used it; therefore, the order of development must have been present throughout. Actually there was no such straight line, but rather a zigzag of lines. Moreover, every bit of effort that was applied to evolve and effectuate the eventual right policy was indeed indispensable. Every right effort, however apparently infinitesimal, becomes in retrospect infinitely important for what gave us not only the weapon but the timely use for shortening the war.

As to the role played by the bomb, while it assuredly shortened the war, it must also be recognized that Japan had already been, on normal military calculations, beaten. The timing was so right because of what had been done toward beating Japan by the Navy, the Air and other military power, and also by the economic and other factors. We must not in our concern with the new weapon tend to eliminate all the other elements that constitute the whole organization of our national defense and offense. Thus we needed those bases protected by the Navy and the Air Forces to use for the bombing and so the application of the bomb was conditioned by the success of the other war operations with the other war technologies.

All the same, the bomb presents a new factor—a most vital factor. But I cannot now go into those questions and instead I must return to the history in the crucial phase.

The conference of April 27, 1940 on organization framework and the inadequacy of what we had then, resulted in new submissions to the President for a resolution of the difficulties.

The conference that was held on April 27 at the Bureau of Standards under Dr. Briggs' able and conciliatory chairmanship did serve to dispel doubts that had been entertained by some members. It also marked further progress in evoking a willingness to entertain consideration of large-scale expenditures that might run up to six figures. That was fantastic, alongside the cost theretofore—the thousands that were being spent and the money that was being furnished by those who were on the margin, who were spending out of their own pockets in connection with this work in corresponding amounts. Yet the majority, accustomed to the small scale of physical laboratories at the universities and the correspondingly reduced scales of the budgets of governmental scientific laboratories, did not appear ready to design a large-scale and comprehensive program, and instead insisted on "bit-a-bit" procedures with ranked preferences and time deferments.

By the beginning of May the uranium research at Columbia, which was the pathfinding research, had reached the point where expansion was deemed advisable and desirable by the whole quartet of scientists concerned—that is, by the direct experimenters, Drs. Fermi and Szilard, and by Dean George Pegram and Prof. Harold Urey.

After a number of conferences by the speaker with the Columbia group, a sort of minute was drafted as of May 10 embodying the consensus as to the successive stages. In this case, I myself did the secretarial work.

The first point in this minute was:

"The first large-scale experiment would have as its aim to demonstrate beyond any doubt whatever that a nuclear chain reaction could be maintained in a system composed of carbon and uranium. This would require about 100 tons of graphite and some 10 to 20 tons of uranium metal. It would also be necessary to design a rather elaborate mechanism to stabilize the chain reaction and to safeguard against overheating as well as the possibility of an explosion."

The second point was:

"The next stage is to carry out a general survey of all nuclear constants in order to confirm the values previously obtained and to narrow down the limits of experimental error beyond observed values of the constants. This would strengthen the assurance of the group in the ultimate success of the experiment.

"Then as preparatory ground for that experiment would come the advancing of structural details and the carrying out of technological tests on samples of materials which have to be used in large quantities in the ultimate experiment. This in turn would require getting bids for the manufacturing of the material in needed quality and quantity."

As to quality, the problem of refinement was throughout a very grave one: it was the industrial know-how which had to be acquired, as well as the fundamental scientific research.

In financial terms, the first stage would require expenditures of \$30,000 to \$50,000; the second stage would require from \$250,000 to upward of \$500,000.

It was the speaker's view that in the interest of time-efficiency and even of economy, the second could be prepared for while the first was going on, providing that adequate funds were made available to begin with. The proposal which had been submitted for a nonprofit organization directed by a mixed board of trustees seemed, under the conditions antedating the prospect of large defense appropriations, particularly suited to methodical and economical direction of the work.

The lack of resolution of the organizational difficulties led the speaker to submit an analysis of the situation and resultant recommendations in a communication to the President dated May 11, 1940, together with a note of transmittal to General Watson of even date.

The point of departure was—I am coming to the end of this section, that may serve as a terminal point.

The CHAIRMAN. Very well, Doctor.

Dr. SAGHS. The point of departure was that, according to the advices given to the speaker by Dean Pegram, the graphite experiment, which had been partly financed by the Government, was a success. As the communication was coincident with the German march through Belgium, the invasion having begun on May 10, the situation adumbrated in the initial presentation of October 11, 1939, had come to pass. I mean the situation I had presented when I stated that we should acquire uranium supplies from all Belgian sources had come to pass. A problem of access to uranium supplies that would be needed on a larger and larger scale had been thrust forward. This in turn threw into sharper relief

the previously described need for that change in the organizational framework "under which the work could proceed with the flexibility required for a going enterprise."

The President was therefore requested to designate a legal aide to facilitate the establishment of a nonprofit body which would secure the resources for carrying on the work under conditions where the tenure of the research posts would be secure and their equipment and material be amply provided for. I had in mind that large group of scientists that would have to be brought in at that period when they were looking for other university posts. Along with that there should be provision for the necessary secrecy as distinguished from the normal eagerness and competitiveness in early publication of indicated results.

You must see that the job was to transform the conditions and to anticipate the time-order in normal use. Even for getting the scientists, you had to take into account the fact that we were preventing them from having what is the biggest asset to the scientist—the knowledge that the results of their research will get published when they do important things. So you have to give them adjustments in salaries. There was no time to delay. If we delayed, then we would be losing the scientists. Additionally, at that time—this was before the invasion of France—you would have to see to it that all this work, in view of its potential value and its potential danger, was not made known to the potential enemy through the scientific magazines, such as *Science* and the *Physical Review*, and related foreign publications.

Is this a good stopping point, Mr. Chairman? I could go on. What do you say, sir?

The CHAIRMAN. Doctor, the Senate meets at 12 o'clock.

Dr. SACHS. All right, let me go on, then. This is a very short section.

The CHAIRMAN. All right.

Dr. SACHS. This is part 6 of my history, assembled at the end, in August, from the notes and reviews that were made contemporaneously with the developments. The heading is: Resolution of the Difficulties and Resetting of the Uranium Project into the New Organization Established by the President on June 15, 1940, for the Direction of All Scientific Developments Related to National Defense.

The CHAIRMAN. What was the date that the small-scale stage ended and that you were to go forward on the large scale?

Dr. SACHS. Between May and June it was decided that we needed to go forward on the larger scale. The appointment of a new organization, the Office of Scientific Research and Development, came, I think, on June 15, having been preceded by suggestions of such a scheme that I transmitted to General Watson.

Senator AUSTIN. This was 1940?

Dr. SACHS. This was in 1940.

In keeping with the practice of full knowledge and cooperativeness with the Presidential representatives from the Government services to direct the joint committee on the uranium project, the letter to the President of May 11 was given a counterpart in the communication to Dr. Briggs of May 13, 1940. That is, I did not do anything with the President without sending a copy or speaking about it to Dr. Briggs, as the administrator-scientist, or to General Watson, as aide to the President.

My letter to Dr. Briggs drew attention to Dean Pegram's favorable report on the graphite experiment and inferred that the governmental committee would report favorably to the President on the project. That would be reported directly to the President and I was convinced enough that it would be certain to be recommended.

Recognizing that university research is inherently characterized by what I called a "traditional discursive attitude and leisurely tempo," the contemporaneous facts of the invasion of Belgium threw into sharper relief the requirements of national defense. Applied to this project, those requirements were for a resourcefulness of operation and an acceleration of pace, and also a secrecy that could not be had in the university projects, generally carried on with limited means and in an atmosphere of mutual interchange. And I want to say here that the scientists, Dr. Szilard, Dr. Wigner and Dr. Einstein, were all of the same view, that there had to be secrecy against leaks to the enemy.

In furtherance of the foregoing, another letter was written to General Watson on May 15, the second and revised version of which is included here.

(The letter referred to was entered in the committee's record and appears below:)

MAY 15, 1940

Gen. EDWIN M. WATSON,
Secretary to the President,
The White House, Washington, D. C.

DEAR GENERAL WATSON: Confirming the intimation that I had the honor to convey in my letter to the President and in my covering note to you, I have just received a letter from Dean Pegram, of the department of physics of Columbia University, stating that the initial experiment "has now been concluded with satisfactory result," and that "the absorption cross-section of carbon was found to be encouragingly small * * * only about one-third of the upper limit previously reported in the literature." The detailed meaning of that has been set forth in the letters of Dr. Szilard of May 10 and of April 22, which I forwarded to the President; a copy of the latter was also sent to you. Please advise me before any conference on this is arranged.

In connection with an independent matter having to do with economic and fiscal policies for effectuating national reconstruction and defense, I should appreciate your expressing to the President my readiness to submit certain social-minded economic ideas that had interested him in 1936 and 1934, as to incentive devices for evoking large-scale plant investment for national defense and the training and reconditioning of the requisite skilled labor. To the original proposals drafted in 1932, there was added in early 1933—when submitted for the National Recovery Act—a provision authorizing public-works expenditures for national defense, in view of the altered international situation. The ideas and proposals in connection with the original FHA plan submitted in 1933 were later expanded in the second FHA plan that, at the President's behest, was worked out for Governor Eccles' advisers. In keeping with the pattern of these earlier plans, the role of government can be adjusted to specific requirements.

For the instant purpose, the organizational instrumentality proposed is the establishment of a Scientific Council of National Defense, composed of executives, engineers, and economists, acting in behalf of the Government, who should be invested with administrative powers for the testing and execution of technical projects of utility for national defense.

Yours sincerely,

ALEXANDER SACHS.

Dr. SACHS. The main communication of the speaker contains the first adumbration of a plan similar to that later developed by the President for the direction of the scientific work related to national defense. The new suggestion was made in the settling of proposals which the speaker was evolving for submission to the President with respect to amortization and other incentive-tax devices for national defense plant construction. It was my belief that industry had to be related to and integrated for national defense and I had been asked to submit some suggestions. I made many suggestions in my professional capacity as an economist with reference to these problems, apart from my interest in this uranium research.

In respect to the specific problem of an organizational framework that would carry forward uranium research on a bigger scale and at a faster tempo, the new conclusion and recommendation of the writer was as follows, against the background that the Government was then thinking of going to the Congress with a request for bigger appropriations:

"For the instant purpose, the organizational instrumentality proposed is the establishment of a Scientific Council of National Defense, composed of executives, engineers, and economists, acting with administrative powers for the testing and execution of technical projects of utility for national defense."

In acknowledging that letter, General Watson on May 16 added an observation regarding the broader suggestion for a mixed executive and administrative group for scientific phases of national defense.

The CHAIRMAN. Was that group formed?

Dr. SACHS. That group was formed on June 15. There was an intervening communication and I had received an authorization after an O. K. and an encouraging word from the President to represent the Government in negotiations with the Belgian company representatives here for the acquisition of uranium.

The CHAIRMAN. Doctor, there has just been a quorum call from the Senate and I think we will have to stop at this point.

Dr. SACHS. May I complete that phase of the story?

The culmination of the foregoing phases of the uranium project came on the day following the Germany Army's entry into Paris. On June 15, the President

established a new committee for the correlation of the scientific efforts of the country concerned with problems of national defense and placed that committee under the chairmanship of Dr. Vannevar Bush, President of the Carnegie Institution of Washington, whose name I have mentioned in the course of my discussion here. This committee included representatives of the Army and Navy and distinguished scientists and, initially, was to be attached to the Council of National Defense, in keeping with the suggestions I had made.

Accordingly, the President advised Dr. Briggs on June 15 that "since the problem on which you are engaged is part of this larger picture," Dr. Bush was requested by him to take over the uranium project and to reconstitute the committee.

Now, I make my summary: Thus was found a larger framework in accordance with the tenor of the speaker's recommendations. Dr. Bush's committee after our entry into the war became the Office of Scientific Research and Development. Associated with him and with Dr. James B. Conant, of Harvard, was the General Policy Committee, which included the then Vice President, Henry A. Wallace, Secretary of War Stimson, Gen. George C. Marshall, and Army and Navy representatives. The other group of the Army came in 1942.

The uranium project as initially presented by Dr. Einstein and the speaker in October 1939, having by the spring of the next year been reported on favorably by the testing and coordinating committee that the President had appointed under Dr. Briggs' chairmanship, was thus launched on a permanent and progressive career in the wake of our decision after the fall of France to embark on expanding defense.

From then on it became invested with the importance, the resources and the secrecy available to the Government of the United States in defense and later in war for the translation of an idea into a reality and into an instrument of national policy in war and peace.

The CHAIRMAN. Thank you very much, Doctor.

X

ATOMIC ENERGY

INDEX TO HEARINGS BEFORE THE SPECIAL COMMITTEE ON ATOMIC ENERGY UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

SECOND SESSION

PURSUANT TO

S. Res. 179

A RESOLUTION CREATING A SPECIAL COMMITTEE TO
INVESTIGATE PROBLEMS RELATING TO THE
DEVELOPMENT, USE, AND CONTROL
OF ATOMIC ENERGY

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¹ See also revised statement of Dr. Sachs, pt. 5 of hearings on atomic energy, p. 553 ff.

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ATOMIC ENERGY ACT OF 1946

HEARINGS BEFORE THE SPECIAL COMMITTEE ON ATOMIC ENERGY UNITED STATES SENATE

SEVENTY-NINTH CONGRESS
SECOND SESSION

ON

S. 1717

A BILL FOR THE DEVELOPMENT AND CONTROL
OF ATOMIC ENERGY

PART 1

JANUARY 22 AND 23, 1946

Printed for the use of the Special Committee on Atomic Energy



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ATOMIC ENERGY ACT OF 1946

TUESDAY, JANUARY 22, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to call, at 10 a. m., in room 424B, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Austin, Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

We have under consideration this morning S. 1717, and I will ask the reporter to insert the bill in the record at this point.

(S. 1717 is as follows:)

A BILL For the development and control of atomic energy

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

DECLARATION OF POLICY

SECTION 1. (a) FINDINGS AND DECLARATION.—Research and experimentation in the field of nuclear fission have attained the stage at which the release of atomic energy on a large scale is practical. The significance of the atomic bomb for military purposes is evident. The effect of the use of atomic energy for civilian purposes upon the social, economic, and political structures of today cannot now be determined. It is reasonable to anticipate, however, that tapping this new source of energy will cause profound changes in our present way of life. Accordingly, it is hereby declared to be the policy of the people of the United States that the development and utilization of atomic energy shall be directed toward improving the public welfare, increasing the standard of living, strengthening free competition among private enterprises so far as practicable, and cementing world peace.

(b) PURPOSE OF ACT.—It is the purpose of this Act to effectuate these policies by providing, among others, for the following major programs;

(1) A program of assisting and fostering private research and development on a truly independent basis to encourage maximum scientific progress;

(2) A program for the free dissemination of basic scientific information and for maximum liberality in dissemination of related technical information;

(3) A program of federally conducted research to assure the Government of adequate scientific and technical accomplishment;

(4) A program for Government control of the production, ownership, and use of fissionable materials to protect the national security and to insure the broadest possible exploitation of the field;

(5) A program for simultaneous study of the social, political, and economic effects of the utilization of atomic energy; and

(6) A program of administration which will be consistent with international agreements made by the United States, and which will enable the Congress to be currently informed so as to take further legislative action as may hereafter be appropriate.

ATOMIC ENERGY COMMISSION

Sec. 2. (a) There is hereby established an Atomic Energy Commission (herein called the Commission), which shall be composed of five members. Three members shall constitute a quorum of the Commission. The President shall designate one member as Chairman of the Commission.

(b) Members of the Commission shall be appointed by the President, by and with the advice and consent of the Senate, and shall serve at the pleasure of the President. In submitting nominations to the Senate, the President shall set forth the experience and qualifications of each person so nominated. Each member, except the Chairman, shall receive compensation at the rate of \$15,000 per annum; the Chairman shall receive compensation at the rate of \$20,000 per annum. No member of the Commission shall engage in any other business, vocation, or employment than that of serving as a member of the Commission.

(c) The principal office of the Commission shall be in the District of Columbia, but the Commission may exercise any or all of its powers in any place. The Commission shall hold such meetings, conduct such hearings, and receive such reports as will enable it to meet its responsibilities for carrying out the purposes of this Act.

RESEARCH

Sec. 3. (a) RESEARCH ASSISTANCE.—The Commission is directed to exercise its powers in such manner as to insure the continued conduct of research and developmental activities in the fields specified below by private or public institutions or persons and to assist in the acquisition of an ever-expanding fund of theoretical and practical knowledge in such fields. To this end the Commission is authorized and directed to make contracts, agreements, arrangements, grants-in-aid, and loans—

(1) for the conduct of research and developmental activities relating to (a) nuclear processes; (b) the theory and production of atomic energy, including processes and devices related to such production; (c) utilization of fissionable and radioactive materials for medical or health purposes; (d) utilization of fissionable and radioactive materials for all other purposes, including industrial uses; and (e) the protection of health during research and production activities; and

(2) for studies of the social, political, and economic effects of the availability and utilization of atomic energy.

The Commission may make partial advance payments on such contracts and arrangements. Such contracts or other arrangements may contain provisions to protect health, to minimize danger from explosion, and for reporting and inspection of work performed thereunder as the Commission may determine, but shall not contain any provisions or conditions which prevent the dissemination of scientific or technical information, except to the extent already required by the Espionage Act.

(b) FEDERAL ATOMIC RESEARCH.—The Commission is authorized and directed to conduct research and developmental activities through its own facilities in the fields specified in (a) above.

PRODUCTION OF FISSIONABLE MATERIALS

Sec. 4. (a) DEFINITION.—The term "production of fissionable materials" shall include all methods of manufacturing, producing, refining, or processing fissionable materials, including the process of separating fissionable material from other substances in which such material may be contained, whether by thermal diffusion, electromagnetic separation, or other processes.

(b) AUTHORITY TO PRODUCE.—The Commission shall be the exclusive producer of fissionable materials, except production incident to research or developmental activities subject to the restrictions provided in subparagraph (d) below. The quantities of fissionable material to be produced in any quarter shall be determined by the President.

(c) PROHIBITION.—It shall be unlawful for any person to produce any fissionable material except as may be incident to the conduct of research or developmental activities.

(d) RESEARCH AND DEVELOPMENT ON PRODUCTION PROCESSES.—(1) The Commission shall establish by regulation such requirements for the reporting of research and developmental activities on the production of fissionable materials as will assure the Commission of full knowledge of all such activities, rates of production, and quantities produced.

(2) The Commission shall provide for the frequent inspection of all such activities by employees of the Commission.

(3) No person may in the course of such research or developmental activities possess or operate facilities for the production of fissionable materials in quantities or at a rate sufficient to construct a bomb or other military weapon unless all such facilities are the property of and subject to the control of the Commission. The Commission is authorized, to the extent that it deems such action consistent with the purposes of this Act, to enter into contracts for the conduct of such research or developmental activities involving the use of the Commission's facilities.

(e) EXISTING CONTRACTS.—The Commission is authorized to continue in effect and modify such contracts for the production of fissionable materials as may have been made prior to the effective date of this Act, except that, as rapidly as practicable, and in any event not more than one year after the effective date of this Act, the Commission shall arrange for the exclusive operation of facilities employed in the manufacture of fissionable materials by employees of the Commission.

CONTROL OF MATERIALS

SEC. 5. (a) FISSIONABLE MATERIALS.—

(1) DEFINITION.—The term "fissionable materials" shall include plutonium, uranium 235, and such other materials as the Commission may from time to time determine to be capable of releasing substantial quantities of energy through nuclear fission of the material.

(2) PRIVATELY OWNED FISSIONABLE MATERIALS.—Any person owning any right, title, or interest in or to any fissionable material shall forthwith transfer all such right, title, or interest to the Commission.

(3) PROHIBITION.—It shall be unlawful for any person to (a) own any fissionable material; or (b) after sixty days after the effective date of this Act and except as authorized by the Commission possess any fissionable material; or (c) export from or import into the United States any fissionable material, or directly or indirectly be a party to or in any way a beneficiary of, any contract, arrangement, or other activity pertaining to the production, refining, or processing of any fissionable material outside of the United States.

(4) DISTRIBUTION OF FISSIONABLE MATERIALS.—The Commission is authorized and directed to distribute fissionable materials to all applicants requesting such materials for the conduct of research or developmental activities either independently or under contract or other arrangement with the Commission. If sufficient materials are not available to meet all such requests, and applications for licenses under section 7, the Commission shall allocate fissionable materials among all such applicants in the manner best calculated to encourage independent research and development by making adequate fissionable materials available for such purposes. The Commission shall refuse to distribute or allocate any materials to any applicant, or shall recall any materials after distribution or allocation from any applicant, who is not equipped or who fails to observe such safety standards to protect health and to minimize danger from explosion as may be established by the Commission.

(b) SOURCE MATERIALS.—

(1) DEFINITION.—The term "source materials" shall include any ore containing uranium, thorium, or beryllium, and such other materials peculiarly essential to the production of fissionable materials as may be determined by the Commission with the approval of the President.

(2) LICENSE FOR TRANSFERS REQUIRED.—No person may transfer possession or title to any source material after mining, extraction, or removal from its place of origin, and no person may receive any source material, without a license from the Commission.

(3) ISSUANCE OF LICENSES.—Any person desiring to transfer or receive possession of any source material shall apply for a license therefor in accordance with such procedures as the Commission may by regulation establish. The Commission shall establish such standards for the issuance or refusal of licenses as it may deem necessary to assure adequate source materials for production, research, or developmental activities pursuant to this Act or to prevent the use of such materials in a manner inconsistent with the national welfare.

(4) REPORTING.—The Commission is authorized to issue such regulations or orders requiring reports of ownership, possession, extraction, refining, shipment, or other handling of source materials as it may deem necessary.

(c) **BYPRODUCT MATERIALS.**—

(1) **DEFINITION.**—The term "byproduct material" shall be deemed to refer to all materials (except fissionable material) yielded in the processes of producing fissionable material.

(2) **DISTRIBUTION.**—The Commission is authorized and directed to distribute, with or without charge, byproduct materials to all applicants seeking such materials for research or developmental work, medical therapy, industrial uses, or such other useful applications as may be developed. If sufficient materials to meet all such requests are not available, the Commission shall allocate such materials among applicants therefor, giving preference to the use of such materials in the conduct of research and developmental activity and medical therapy. The Commission shall refuse to distribute or allocate any byproduct materials to any applicant, or recall any materials after distribution or allocation from any applicant, who is not equipped or who fails to observe such safety standards to protect health as may be established by the Commission.

(d) **GENERAL PROVISIONS.**—(1) The Commission is authorized to—

(i) acquire or purchase fissionable or source materials within the United States or elsewhere;

(ii) take, requisition, or condemn within the United States any fissionable or source material and make just compensation therefor. The Commission shall determine such compensation. In the exercise of such rights of eminent domain and condemnation, proceedings may be instituted under the Act of August 1, 1888 (U. S. C. 1940, title 40, sec. 257), or any other applicable Federal statute. Upon or after the filing of the condemnation petition, immediate possession may be taken and the property may be treated by the Commission in the same manner as other similar property owned by it;

(iii) conduct exploratory operations, investigations, inspections to determine the location, extent, mode of occurrence, use, or condition of source materials with or without the consent of the owner of any interest therein, making just compensation for any damage or injury occasioned thereby.

(2) The Commission shall establish by regulation a procedure by which any person who is dissatisfied with its action in allocating, refusing to allocate, or in rescinding any allocation of fissionable, source, or byproduct materials to him may obtain a review of such determination by a board of appeal consisting of two or more members appointed by the Commission and at least one member of the Commission.

MILITARY APPLICATIONS OF ATOMIC POWER**SEC. 6. (a)** The Commission is authorized and directed to—

(1) conduct experiments and do research and developmental work in the military application of atomic power; and

(2) have custody of all assembled or unassembled atomic bombs, bomb parts, or other atomic military weapons, presently or hereafter produced, except that upon the express finding of the President that such action is required in the interests of national defense, the Commission shall deliver such quantities of weapons to the armed forces as the President may specify.

(b) The Commission shall not conduct any research or developmental work in the military application of atomic power if such research or developmental work is contrary to any international agreement of the United States.

(c) The Commission is authorized to engage in the production of atomic bombs, bomb parts, or other applications of atomic power as military weapons, only to the extent that the express consent and direction of the President of the United States has been obtained, which consent and direction shall be obtained for each quarter.

(d) It shall be unlawful for any person to manufacture, produce, or process any device or equipment designed to utilize fissionable materials as a military weapon, except as authorized by the Commission.

ATOMIC ENERGY DEVICES

SEC. 7. (a) LICENSE REQUIRED.—It shall be unlawful for any person to operate any equipment or device utilizing fissionable materials without a license issued by the Commission authorizing such operation.

(b) **ISSUANCE OF LICENSES.**—Any person desiring to utilize fissionable materials in any such device or equipment shall apply for a license therefor in accordance with such procedures as the Commission may by regulation establish. The

Commission is authorized and directed to issue such a license on a nonexclusive basis and to supply appropriate quantities of fissionable materials to the extent available to any applicant (1) who is equipped to observe such safety standards to protect health and to minimize danger from explosion as the Commission may establish; and (2) who agrees to make available to the Commission such technical information and data concerning the operation of such device as the Commission may determine necessary to encourage the use of such devices by as many licensees as possible. Where any license might serve to maintain or foster the growth of monopoly, restraint of trade, unlawful competition, or other trade position inimical to the entry of new, freely competitive enterprises, the Commission is authorized and directed to refuse to issue such license or to establish such conditions to prevent these results as the Commission, in consultation with the Attorney General, may determine. The Commission shall report promptly to the Attorney General any information it may have of the use of such devices which appears to have these results. No license may be given to a foreign government or to any person who is not under and within the jurisdiction of the United States.

(c) **BYPRODUCT-POWER.**—If in the production of fissionable materials the production processes yield energy capable of utilization, such energy may be used by the Commission, transferred to other Government agencies, sold to public or private utilities under contract providing for reasonable resale prices, or sold to private consumers at reasonable rates and on as broad a basis of eligibility as the Commission may determine to be possible.

(d) **REPORTS TO CONGRESS.**—Whenever in its opinion industrial, commercial, or other uses of fissionable materials have been sufficiently developed to be of practical value, the Commission shall prepare a report to the Congress stating all the facts, the Commission's estimate of the social, political, and economic effects of such utilization, and the Commission's recommendations for necessary or desirable supplemental legislation. Until such a report has been filed with the Commission and the period of ninety days has elapsed after such filing, within which period the Commission may adopt supplemental legislation, no license for the use of atomic energy devices shall be issued by the Commission.

PROPERTY OF THE COMMISSION

SEC. 8. (a) The President shall direct the transfer to the Commission of the following property owned by the United States or any of its agencies, or any interest in such property held in trust for or on behalf of the United States:

(1) All fissionable materials; all bombs and bomb parts; all plants, facilities, equipment, and materials for the processing or production of fissionable materials, bombs, and bomb parts; all processes and technical information of any kind, and the source thereof (including data, drawings, specifications, patents, patent applications, and other sources, relating to the refining or production of fissionable materials); and all contracts, agreements, leases, patents, applications for patents, inventions and discoveries (whether patented or unpatented), and other rights of any kind concerning any such items;

(2) All facilities and equipment, and materials therein, devoted primarily to atomic energy research and development; and

(3) All property in the custody and control of the Manhattan engineer district.

(b) In order to render financial assistance to those States and local governments in which the activities of the Commission are carried on and in which the Commission, or its agents, have acquired properties previously subject to State and local taxation, the Commission is authorized to make payments to State and local governments in lieu of such taxes. Such payments may be in the amounts, at the times, and upon the terms the Commission deems appropriate, but the Commission shall be guided by the policy of not exceeding the taxes which would have been payable for such property in the condition in which it was acquired, except where special burdens have been cast upon the State or local government by activities of the Commission, the Manhattan engineer district, or their agents, and in such cases any benefits accruing to the States and local governments by reason of these activities shall be considered in the determination of such payments. The Commission and any corporation created by it, and the property and income of the Commission or of such corporation, are hereby expressly exempted from taxation in any manner or form by any State, county, municipality, or any subdivision thereof.

DISSEMINATION OF INFORMATION

SEC. 9. (a) BASIC SCIENTIFIC INFORMATION.—Basic scientific information in the fields specified in section 3 may be freely disseminated. The term "basic scientific information" shall include, in addition to theoretical knowledge of nuclear and other physics, chemistry, biology, and therapy, all results capable of accomplishment, as distinguished from the processes or techniques of accomplishing them.

(b) RELATED TECHNICAL INFORMATION.—The Commission shall establish a Board of Atomic Information consisting of one or more employees and at least one member of the Commission. The Board shall, under the direction and supervision of the Commission, provide for the dissemination of related technical information with the utmost liberality as freely as may be consistent with the foreign and domestic policies established by the President and shall have authority to—

(1) establish such information services, publications, libraries, and other registers of available information as may be helpful in effectuating this policy;

(2) designate by regulation the types of related technical information the dissemination of which will effectuate the foregoing policy. Such designations shall constitute an administrative determination that such information is not of value to the national defense and that any person is entitled to receive such information, within the meaning of the Espionage Act. Failure to make any such designation shall not, however, be deemed a determination that such undesignated information is subject to the provisions of said Act;

(3) by regulation or order, require reports of the conduct of independent research or development activities in the fields specified in section 3 and of the operation of atomic energy devices under licenses issued pursuant to section 7;

(4) provide for such inspections of independent research and development activities of the types specified in section 3 and of the operation of atomic energy devices as the Commission or the Board may determine; and

(5) whenever it will facilitate the carrying out of the purposes of the Act, adopt by regulation administrative interpretations of the Espionage Act except that any such interpretation shall, before adoption, receive the express approval of the President.

PATENTS

SEC. 10. (a) Whenever any person invents a device or method for the production, refining, or other processing of fissionable material: (i) he may file a patent application to cover such invention, sending a copy thereof to the Commission; (ii) if the Commissioner of Patents determines that the invention is patentable, he shall issue a patent in the name of the Commission; and (iii) the Commission shall make just compensation to such person. The Commission shall appoint a Patent Royalty Board consisting of one or more employees and at least one member of the Commission, and the Commissioner of Patents. The Patent Royalty Board shall determine what constitutes just compensation in each such case and whether such compensation is to be paid in periodic payments rather than in a lump sum. Any person to whom any such patent has heretofore been issued shall forthwith transfer all right, title, and interest in and to such patent to the Commission and shall receive therefor just compensation as provided above.

(b) (1) Any patent now or hereafter issued covering any process or device utilizing or peculiarly necessary to the utilization of fissionable materials, or peculiarly necessary to the conduct of research or developmental activities in the fields specified in section 3, is hereby declared to be affected with the public interest and its general availability for such uses is declared to be necessary to effectuate the purposes of this Act.

(2) Any person to whom any such patent has been issued, or any person desiring to use any device or process covered by such patent for such uses, may apply to the Patent Royalty Board, for determination by such Board of a reasonable royalty fee for such use of the patented process or device intended to be used under the Commission's license.

(3) In determining such reasonable royalty fee, the Patent Royalty Board shall take into consideration any defense, general or special, that might be pleaded by a defendant in an action for infringement, the extent to which, if any, such patent

was developed through federally financed research, the degree of utility, novelty, and importance of the patent, the cost to the patentee of developing such process or device, and a reasonable rate of return on such research investment by the patentee.

(4) No court, Federal, State, or Territorial, shall have jurisdiction or power to stay, restrain, or otherwise enjoin any such use of any such patented device or process by any person on the ground of infringement of such patent. In any action for infringement of any such patent filed in any such court, the court shall have authority only to order the payment of reasonable royalty fees and attorney's fees and court costs as damages for any such infringement. If the Patent Royalty Board has not previously determined the reasonable royalty fee for the use of the patented device or process involved in any case, the court in such case shall, before entering judgment, obtain from the Patent Royalty Board a report containing its recommendation as to the reasonable royalty fee it would have established had application been made to it as provided in subparagraphs 2 and 3 above.

ORGANIZATION AND GENERAL AUTHORITY

SEC. 11. (a) ORGANIZATION.—There are hereby established within the Commission a Division of Research, a Division of Production, a Division of Materials, and a Division of Military Application. Each division shall be under the direction of a Director who shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at the rate of \$15,000 per annum. The Commission shall delegate to each such division such of its powers under this Act as in its opinion from time to time will promote the effectuation of the purposes of this Act in an efficient manner. Nothing in this paragraph shall prevent the Commission from establishing such additional divisions or other subordinate organizations as it may deem desirable.

(b) GENERAL AUTHORITY.—In the performance of its functions the Commission is authorized to—

(1) establish advisory boards to advise with and make recommendations to the Commission on legislation, policies, administration, and research;

(2) establish by regulation or order such standards and instructions to govern the possession and use of fissionable and byproduct materials as the Commission may deem necessary or desirable to protect health or to minimize danger from explosion;

(3) make such studies and investigations, obtain such information, and hold such hearings as the Commission may deem necessary or proper to assist it in exercising any authority provided in this Act, or in the administration or enforcement of this Act, or any regulations or orders issued thereunder. For such purposes the Commission is authorized to require any person to permit the inspection and copying of any records or other documents, to administer oaths and affirmations, and by subpoena to require any person to appear and testify, or to appear and produce documents, or both, at any designated place. Witnesses subpoenaed under this subsection shall be paid the same fees and mileage as are paid witnesses in the district courts of the United States;

(4) create or organize corporations, the stock of which shall be wholly owned by the United States and controlled by the Commission, to carry out the provisions of this Act;

(5) appoint and fix the compensation of such officers and employees as may be necessary to carry out the functions of the Commission. All such officers and employees shall be appointed in accordance with the civil-service laws and their compensation fixed in accordance with the Classification Act of 1923, as amended, except that expert administrative, technical, and professional personnel may be employed and their compensation fixed without regard to such laws. The Commission shall make adequate provision for administrative review by a board consisting of one or more employees and at least one member of the Commission of any determination to dismiss any scientific or professional employee; and

(6) acquire such materials, property, equipment, and facilities, establish or construct such buildings and facilities, modify such building and facilities from time to time, and construct, acquire, provide, or arrange for such facilities and services for the housing, health, safety, welfare, and recreation of personnel employed by the Commission as it may deem necessary.

ENFORCEMENT

SEC. 12. (a) Any person who willfully violates, attempts to violate, or conspires to violate, any of the provisions of this Act or any regulations or orders issued thereunder shall, upon conviction thereof, be punishable by a fine of not more than \$10,000, or by imprisonment for a term of not exceeding five years, or both.

(b) Whenever in the judgment of the Commission any person has engaged or is about to engage in any acts or practices which constitute or will constitute a violation of any provision of this Act, it may make application to the appropriate court for an order enjoining such acts or practices, or for an order enforcing compliance with such provision, and upon a showing by the Commission that such person has engaged or is about to engage in any such acts or practices a permanent or temporary injunction, restraining order, or other order shall be granted without bond.

(c) In case of contumacy by, or refusal to obey a subpoena served upon, any person pursuant to section 11 (b) (3), the district court for any district in which such person is found or resides or transacts business, upon application by the Commission, shall have jurisdiction to issue an order requiring such person to appear and give testimony or to appear and produce documents, or both; and any failure to obey such order of the court may be punished by such court as a contempt thereof.

REPORTS

SEC. 13. The Commission shall, on the first days of January, April, July, and October, submit reports to the President, to the Senate and to the House of Representatives. Such reports shall summarize and appraise the activities of the Commission and of each division and board thereof, and specifically shall contain financial statements; lists of licenses issued, of property acquired, of research contracts and arrangements entered into, and of the amounts of fissionable material and the persons to whom allocated; the Commission's program for the following quarter including lists of research contracts and arrangements proposed to be entered into; conclusions drawn from studies of the social, political, and economic effects of the release of atomic energy; and such recommendations for additional legislation as the Commission may deem necessary or desirable.

DEFINITIONS

SEC. 14. As used in this Act—

(a) The term "atomic energy" shall include all forms of energy liberated in the artificial transmutation of atomic species.

(b) The term "Government agency" means any executive department, board, bureau, commission, or other agency in the executive branch of the Federal Government, or any corporation wholly owned (either directly or through one or more corporations) by the United States.

(c) The term "person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, any government other than the United States, any political subdivision of any such government, and any legal successor, representative, agent, or agency of the foregoing, or other entity.

(d) The term "United States" includes all Territories and possessions of the United States.

APPROPRIATIONS

SEC. 15. There are hereby authorized to be appropriated such sums as may be necessary and appropriate to carry out the provisions and purposes of this Act. Funds appropriated to the Commission shall, if obligated during the fiscal year for which appropriated, remain available for expenditure for four years following the expiration of the fiscal year for which appropriated. After such four-year period, the unexpended balances of appropriations shall be carried to the surplus fund and covered into the Treasury.

SEPARABILITY OF PROVISIONS

SEC. 16. If any provision of this Act, or the application of such provision to any person or circumstances, is held invalid, the remainder of this Act or the application of such provision to persons or circumstances other than those to which it is held invalid, shall not be affected thereby.

SHORT TITLE

SEC. 17. This Act may be cited as the "Atomic Energy Act of 1946".

The CHAIRMAN. Senator Austin, I believe, has something that he wishes to insert in the record.

Senator AUSTIN. Mr. Chairman, I ask unanimous consent to have printed in the record that part of the official report of the House of Commons Debates, Dominion of Canada, held at Ottawa, Canada, on Monday, December 17, 1945, which relates to the passage of a resolution by the House of Commons relating to the agreement made by the President of the United States, Prime Minister Attlee, and Prime Minister Mackenzie King. I offer this for the record because it does confirm the opinion of this committee with respect to the proper interpretation of that agreement, and I call attention to just one sentence for the purpose of making it clear on the record that that is so, but I want the whole matter within pages 3697 to 3718 published in our hearings. The matter I call attention to appears on page 3701, Mackenzie King speaking. He is discussing the subject of the exchange of scientific information, and he says, among other things:

However, we stated our readiness to share, on a reciprocal basis, with others of the United Nations, detailed information concerning the practical industrial application of atomic energy, just as soon as effective and enforceable safeguards against its use for destructive purposes could be devised.

The CHAIRMAN. Without objection, it will be printed in the record as requested by Senator Austin, and I am sure it will be helpful to us.

(The excerpt from the Canadian House of Commons Debates referred to above is as follows:)

ATOMIC ENERGY

APPROVAL OF AGREED DECLARATION SIGNED AT WASHINGTON, NOVEMBER 15, 1945

Right Hon. W. L. MACKENZIE KING (Prime Minister) moved:

"That it is expedient that the houses of parliament do approve the agreed declaration on atomic energy signed by the President of the United States, the Prime Minister of the United Kingdom, and the Prime Minister of Canada, at Washington on November 15, 1945, and that this house do approve the same."

He said: Mr. Speaker, the House of Commons is being asked by the motion now before it to approve the agreed declaration on atomic energy which was signed at the White House, Washington, on the 15th of November of this year, by the President of the United States, the Prime Minister of the United Kingdom and the Prime Minister of Canada.

The statement which embodies the declaration was read to honorable members of this house by my colleague, the Minister of Justice, on the afternoon of the day on which the declaration was made. Copies of the declaration in English and in French were tabled in pamphlet form on December 1. The declaration has received the widest publicity. I think it may be truly said that it has met with general approval.

As the declaration is one of far-reaching significance and historic interest, it is desirable that it should be formally approved by both houses of our parliament. Apart from other positive advantages, such approval should serve effectively to meet the criticism that the Prime Minister of Canada in joining with the Prime Minister of the United Kingdom and the President of the United States in the discussions at Washington and in signing the declaration "either assumed that parliament and the Canadian people had no views on the atomic bomb question or that their views didn't matter; that it was within his sole right and power to determine what should be done." I am happy to say that this uncalled for criticism seems to have met only with the rebuke it so obviously deserves.

Research into atomic energy: No discovery, in all time, has equalled in interest that of the release of atomic energy. No discovery has been fraught with possibilities which may prove to be either so bareful or so beneficial to mankind.

It may serve as a helpful introduction to an understanding of the problems which the discovery of atomic energy has created, if I say a word or two concerning the discovery itself, and the circumstances which led to the part the release of atomic energy came to have in military warfare. My introductory words may also help to give some idea of Canada's contribution to atomic research and processes, and to explain the strategic position which Canada, along with the United Kingdom and the United States, has come to hold in working towards a solution of problems to which the use of atomic energy has given rise.

All the world now knows that the sudden termination of the war against Japan was due to the appalling destruction of life and property wrought, in August of the present year, by the use of the atomic bomb against the cities of Hiroshima and Nagasaki.

Until recently the world believed that the atom was the ultimate indivisible particle of matter; a particle of matter so minute as to admit of no division. When the war began in 1939, scientists of many nations had come to recognize that the release of energy by the "splitting" of the atom, or what is scientifically referred to as "atomic fission" was a possibility. The war gave impetus to research into the means of releasing atomic energy and later to the production of atomic bombs.

At the outset, research was carried on mainly in the universities of the United Kingdom. During 1940 there was an interchange of information on war research between Britain, the United States and Canada. By the summer of 1941 such progress had been made in research in the application of atomic energy that it was felt that full use should be made of university and industrial laboratories in seeking to find, just as rapidly as possible, the means of producing atomic bombs. In October of 1941, upon the suggestion of President Roosevelt, there began a coordination and joint conduct of British and American efforts. In 1942 the United Kingdom authorities proposed that an important section of research into atomic energy should be carried on in Canada as a joint enterprise. The special Montreal laboratory of the national research council was thereafter organized, and staffed by over 300 workers. It was by far the largest organization ever created in Canada to carry out a single research project. Other research projects were undertaken at McMaster, Toronto and McGill universities, and at the national research laboratories in Ottawa.

Developments in the United States and Canada: By the summer of 1942, the expanded program of research seemed to justify a decision to proceed with the construction of large-scale production plants in the United States. The Americans alone were active in large-scale work.

At Quebec, in September 1943, an agreement was signed between Mr. Churchill and Mr. Roosevelt which bound their two countries to collaborate with the object of producing, as quickly as possible, a military weapon for use in the war. Under this agreement a combined policy committee was set up. Upon the invitation of Mr. Roosevelt and Mr. Churchill, in which I had concurred, Mr. Howe, the Minister of Munitions and Supply, was made a member of the combined policy committee as the representative of Canada.

Up to the present, uranium is the mineral that has been used as basic material for the atomic bomb process. Thorium is a probable second basic material for that purpose, although it is not as yet a proven material. The largest proved deposit of uranium ore is in the Belgian Congo, and the next largest is in Canada. As soon as the significant use of uranium in the atomic bomb process was disclosed to Mr. Howe and myself, we secured the approval of the cabinet of the purchase of the Eldorado uranium properties in the Great Bear lake area, and reserved for the government control of all such minerals as might be discovered in Canada in the future. This was a strategic factor of high importance, since this second largest known source of raw material thereby became accessible to the large manufacturing plants already built in the United States.

The work of the several research projects has been closely coordinated with the development of a pilot plant at Chalk River for the investigation of atomic energy processes. This work is of considerable importance. It includes the study of the utilization of thorium as a starting point for the production of "active material". This pilot plant is unique in character and is suitable for a field of research that has not been explored elsewhere.

Three governments in partnership: Here may I quote from a statement prepared by Mr. Churchill while he was at the head of the coalition government. It was made public by his successor after Mr. Attlee's assumption of office.

Mr. Churchill's statement is as follows:

"In the United States the erection of the immense plants was placed under the responsibility of Mr. Stimson, United States Secretary of War, and the American army administration whose wonderful work and marvellous secrecy cannot be sufficiently admired. The main practical effort and virtually the whole of its prodigious cost now fell upon the United States authorities who were assisted by a number of British scientists.

"The relationship of the British and the American contribution was regulated by discussion between me and President Roosevelt, and a combined policy committee was set up. The Canadian government whose contribution was most valuable provided both indispensable raw material for the project as a whole, and also necessary facilities for the work of one section of the project which has been carried out in Canada by the three governments in partnership."

Elsewhere in his statement Mr. Churchill said:

"By God's mercy, British and American science outpaced all German efforts. These were on a considerable scale but far behind. The possession of these powers by the Germans, at any time, might have altered the result of the war."

It is worthy of notice that the determination to embark on large-scale undertakings for production of atomic bombs was agreed upon while some details of the project were still in the laboratory stage. The outcome was a most impressive demonstration of the collaboration of scientific skill and technical capacity conducted under conditions of the highest secrecy.

This aspect of the production of the atomic bomb was referred to by Mr. Churchill in the following words:

"The whole burden of execution including the setting up of the plants and many technical processes connected therewith in the practical sphere constitutes one of the greatest triumphs of American—or indeed human—genius of which there is record. Moreover, the decision to make these enormous expenditures upon a project which however hopefully established by American and British research remained nevertheless an awful uncertainty stands to the everlasting honour of President Roosevelt and his advisers."

The two uses of atomic energy: What was aimed at in the combined efforts of the scientists was the development of methods for the release of atomic energy, either to produce an explosion, or as a source of power. The immediate purpose of the construction of large-scale production plants, and the work of the combined policy committee, was the use of atomic energy for military purposes.

It is now known that the release of atomic energy can be effected so rapidly that a few pounds of "active material" will produce an explosion equivalent to that of the setting off of several thousands of tons of TNT. On the other hand, the energy released can, it is believed, be so controlled as to produce a steady flow of heat obtainable at a temperature high enough to operate steam-driven electrical generating plants. One ton of "active material" used in this way would generate as much power as about three million tons of coal.

In a passage which will carry its appeal to every human heart, Mr. Churchill has vividly expressed the sentiments to which these amazing facts give rise:

"This revelation of the secrets of nature long mercifully withheld from man should," he said, "arouse the most solemn reflections in the mind and conscience of every being capable of comprehension. We must indeed pray that these awful agencies will be made to conduce to peace among the nations and that, instead of wreaking measureless havoc upon the entire globe, they may become a perennial fountain of world prosperity."

This is the problem presented by the discovery of the release of atomic energy. Here is the challenge to our day and generation.

Sharing-of information: Up to a certain point the processes for releasing atomic energy are the same whether the purpose is an industrial, commercial, or humanitarian use, or whether it is that of mass destruction. Up to this point of departure the processes are already quite widely known. The scientific knowledge upon which these processes are based has been shared by a number of nations.

Beyond this point of common development, the construction of atomic bombs consists of a series of highly technical manufacturing processes which are still very secret. Knowledge of these technical manufacturing processes is popularly referred to as the "know-how." It is this know-how which is possessed in whole or in part by Britain, the United States, and Canada, and which has not been made known to other nations. The reason for not imparting to other nations, without certain guarantees and controls, the know-how in the production of atomic bombs is because of the potentialities of vast destruction involved.

It should not be supposed that the control of the raw materials presently enjoyed by Canada, the United Kingdom, and the United States will, for any length of time, prevent developments in other countries. Neither should it be imagined that the processes in manufacturing atomic bombs—now secret—will prevent, indefinitely, similar developments in other countries. Even with international measures of supervision and control, it will be but a matter of time before all processes are known to practically all nations. Hence the need for immediate action to seek every available means to end all possibility of war itself.

Preliminary discussions on atomic energy: I come now to the declaration on atomic energy signed at Washington, on November 15th last.

As hon. members are aware, I visited President Truman at the White House on September 30th, the day before I sailed from New York for England. During this visit, matters related to the atomic bomb were referred to in conversation between the President and myself. Mr. Truman invited me to visit him again on my return from abroad. He also told me that he was looking forward to a visit from Mr. Attlee, the Prime Minister of the United Kingdom.

Upon arrival in London, I learned from Mr. Attlee that, toward the end of September last, he had made known to the President his view on the vital importance to the world of the discovery of atomic energy. He had expressed the opinion that the application of atomic energy to warfare made it essential that those in responsible positions in the countries under whose auspices the development had taken place should consider the problems to which it had given rise. In conveying to the President the tentative conclusions at which the British government had arrived, Mr. Attlee had suggested that personal discussion might follow.

On October 3, in a message to Congress, President Truman said:

"I therefore propose to initiate discussions, first with our associates in this discovery, Great Britain and Canada, and then with other nations in an effort to effect agreement on the conditions under which cooperation might replace rivalry in the field of atomic power."

While I was in London, communications were received from President Truman inviting Mr. Attlee and myself to come to Washington at as early a date as could be arranged to discuss with him the problems related to atomic energy.

In his Navy day speech on United States foreign policy, on October 27, President Truman, referring to his message to Congress, added that discussion of the atomic bomb with Great Britain and Canada, and later with other nations, could not wait upon the formal organization of the United Nations.

The conference at Washington: Mr. Attlee and I arrived in Washington on the morning of Saturday, November 10th. Mr. Attlee had left London by plane on the afternoon of the previous day. I had left London on Saturday of the previous week to cross by ship. We arrived in Washington at the same hour. During our stay in Washington, every courtesy was extended to Mr. Attlee and myself by the President and the Secretary of State, Mr. Byrnes. From the hour of our arrival to the day of the signing of the declaration, meetings and conversations were held continuously.

In our consideration of the problems discussed, the President and Mr. Byrnes had the assistance of Dr. Vannevar Bush, director of the office of scientific research and development, and scientific adviser to the President's committee on atomic energy. Prime Minister Attlee was accompanied by Sir John Anderson, chairman of the advisory committee in the United Kingdom on atomic energy. Sir John Anderson is perhaps the best informed of anyone in the United Kingdom on the whole subject, and on the circumstances attending the work with the Americans and ourselves in the researches on atomic energy. Mr. Attlee was also assisted by Lord Halifax, the British ambassador. I was joined in Washington by Mr. Howe, the Canadian member of the combined policy committee, and Dr. C. J. Mackenzie, president of our national research council. I was also assisted while in Washington, by the Canadian Ambassador, Mr. L. B. Pearson; by Mr. Norman Robertson, the Under-Secretary of State for External Affairs, who had accompanied me to England, and by Mr. Hume Wrong, Associate Under-Secretary of State for External Affairs, who joined Mr. Robertson and myself on our arrival in Washington.

I should like to acknowledge the invaluable assistance given me by all these gentlemen and by members of our embassy staff in Washington.

The agreed declaration: In asking hon. members to support the motion which is now before the house, approving the Washington declaration on atomic energy, I feel I cannot do better than to set forth essential features of the declaration itself and, in so doing, indicate governing considerations which were constantly in the minds of all who participated in the discussions.

There was recognition at the outset that the vast significance of the discovery of the release of atomic energy was not yet fully comprehended; that very few realized the far-reaching effect of the discovery upon the future of the world. It was agreed that the discovery had placed at the disposal of mankind means of destruction hitherto unknown, and against which there could be no adequate military defence, and in the employment of which no single nation could, in fact, have a monopoly. In a word, it was agreed that civilization could not survive an atomic war. It was also recognized that it was impossible to isolate the problem of the atomic bomb from the problem of the use of other weapons of destruction. The atomic bomb was seen as the latest word in destructiveness, but not necessarily the last.

The truth is that no system of safeguards that can be devised will of itself provide an effective guarantee against production of atomic weapons by a nation bent on aggression. Nor can we overlook the probability of the development of other major weapons of mass destruction, or of new methods of warfare which may constitute an ever greater threat to civilization than the military use of atomic energy. At Washington, we were therefore called upon to consider not merely the elimination of the atomic bomb as a weapon of war, but also the kind of world order which is necessary in an atomic age, if civilization is to survive.

In our deliberations we were seeking to take the first step in an effort to rescue the world from a desperate race in weapons of mass destruction. We were prepared to concede that the progress our three countries had made in the development and use of atomic energy demanded that our countries take the initiative in an international effort to prevent the further use of atomic energy for destructive purposes. We felt an equal obligation on the part of our countries to promote the use of recent and future exchanges of scientific knowledge, particularly in the utilization of atomic energy for peaceful and humanitarian ends. At the same time we sought to make very clear that the responsibility for devising means to ensure that the new discovery should be used for the benefit of mankind, instead of as a means of destruction, rested not on our nations alone, but on the whole civilized world.

The exchange of scientific information: In the agreed declaration we felt obliged to draw a distinction between the information essential for the development of atomic energy for peaceful purposes and the information concerning the practical industrial application of atomic energy.

Representing, as we did, the three countries which possess the knowledge essential to the use of atomic energy, we declared our willingness, as a first contribution, to proceed with the exchange of fundamental scientific information, and with the interchange of scientists, and scientific literature for peaceful ends, with any nation that would fully reciprocate. We stated our belief that the fruits of scientific research should be made available to all nations, and that freedom of investigation and the free interchange of ideas were essential to the progress of knowledge. The basic scientific processes essential to the development of atomic energy for peaceful purposes have already been made available to the world. We declared that all further information of this character that might become available from time to time should be similarly treated.

As I have already explained, the use of atomic energy for industrial, commercial and humanitarian purposes is dependent upon the same methods and processes as, up to a certain point, are required for the military exploitation of atomic energy. While we were prepared to share the information essential to the development of atomic energy for peaceful purposes, we were not convinced that the spread of the specialized information regarding the practical application of atomic energy in the manufacture of bombs, before it was possible to devise reciprocal and enforceable safeguards acceptable to all nations, would contribute to a constructive solution of the problem of the atomic bomb. On the contrary, we thought it might have the opposite effect. However, we stated our readiness to share, on a reciprocal basis, with others of the united nations, detailed information concerning the practical industrial application of atomic energy, just as soon as effective and enforceable safeguards against its use for destructive purposes could be devised.

Atomic energy and the arts of peace: The attention which has so far been directed to the strictly war aspects of atomic energy—that is, to the atomic bomb—should not be allowed to obscure the immense possibilities of development of atomic energy for the arts of peace. The atomic bomb is a weapon of destruction unsurpassed in human experience. But the energy locked up inside the atom, controlled and directed to useful and constructive ends, may make it possible to provide goods and services for people throughout the world on a scale which we

cannot now envisage. It may be the means of raising the standard of living; of providing physical comfort against hazards of weather and extremes of heat and cold. It may revolutionize some present-day means of transport and communication, making all countries of the world near neighbours in a more immediate sense than has been made possible even by the development of air transport.

It must never be forgotten, however, that the use of atomic energy for peaceful purposes cannot be developed without at the same time producing the very material which is used in a bomb.

Commission on atomic energy proposed at Washington: In order to attain the most effective available means of entirely eliminating the use of atomic energy for destructive purposes, and for promoting its widest use for industrial, commercial, and humanitarian purposes, we gave it as our opinion in the Washington declaration that at the earliest practicable date a commission should be set up under the united nations organization, to prepare recommendations for submission to the organization. We expressed the view that the commission should be instructed to proceed with the utmost despatch; and that, in particular, it should make specific proposals (a) for extending, between all nations, the exchange of basic scientific information for peaceful ends; (b) for the control of atomic energy to the extent necessary to ensure its use only for peaceful purposes; (c) for the elimination from national armaments of atomic weapons and of other major weapons adaptable to mass destruction; and (d) for effective safeguards by way of inspection and other means, to protect complying states against the hazards of violations and evasions. These tasks may well have to move forward by separate stages, building upon the confidence which the progressive exchange of information will provide.

Under the charter of the united nations the signatory powers have pledged themselves not to use force except in support of the purposes and principles of the charter. At Washington we expressed the view that by whole-hearted support of the united nations organization, and by consolidating and extending its authority, thereby creating conditions of mutual trust in which all peoples will be free to devote themselves to the arts of peace, there would be found the most immediately available means of maintaining the rule of law among nations and of banishing the scourge of war from the earth. We declared it to be the firm resolve of our three countries to work without reservation to achieve these ends.

Nothing can be truer than that without unremitting cooperation and the united effort of nations there will be no enduring and effective protection against the atomic bomb. Nor without this cooperation and united effort can there be protection against the indiscriminate use of poison or against the latest refinements in gas warfare, or protection against bacteriological warfare, all of which are even more frightful methods of human destruction than the atomic bomb. To ensure civilization from destruction it is not enough to banish atomic or gas or bacteriological warfare; we must banish war itself.

It is intended that the proposals of the Washington declaration for the establishment of a commission to prepare recommendations on the means of dealing with the problems raised by the development of atomic energy should be submitted to the first general assembly of the united nations. It is expected that the general assembly will open its first session in London on January 10. On the exact procedure to be followed in bringing up this vital matter for consideration by the united nations organization, I am unable to say anything at present.

Before leaving Washington on Thursday last December 13, to take part in the meeting in Moscow of the foreign ministers of the United States, the United Kingdom and the Soviet Union, the Secretary of State of the United States announced that he wished to discuss with the Soviet government its views on how they would be prepared to cooperate in the establishment of the commission and on the procedure which should be followed. On these questions we are in constant consultation with the governments of the United States and the United Kingdom, the other parties to the Washington declaration on atomic energy.

President Roosevelt's vision: While I do not wish at the moment to attempt to look too far into the future with respect to proceedings of the united nations organization, I am pleased to have this opportunity to speak of the past in reference to the creation of the united nations organization itself. I recall very well that while the war against Germany and Japan was still in progress, there were many who felt that President Roosevelt was pressing, with undue haste, the establishment of a united nations organization. Echoes of this criticism were heard at San Francisco last spring at the time of the united nations conference on international organization. It was not until after the conference was over, and the charter of the united nations organization had been brought into existence,

that the world learned of the discovery of the release of atomic energy and of its practical application against Japan. The use of the atomic bomb as a major weapon of military warfare presented, in an instant, to all nations wholly new problems of security. Against the use of the atomic bomb in war, nothing has thus far been suggested which could be regarded as a means of defence.

President Roosevelt's prophetic vision had once more come to the aid of humanity at a time of its greatest need. Had President Roosevelt waited until the war was over to call a united nations conference to bring the charter into being, we should not have had the united nations organization at hand today to assist in the solution of the problems which the atomic bomb has brought so conspicuously to the fore. Instead, the countries seeking a solution of its problems would have been more bewildered and baffled than they are. The world is but slowly recognizing what it owes to the late President.

Problems of the atomic era: If I have made myself clear with respect to the problems of the atomic era with which we are now faced, it will be apparent that they are primarily political problems affecting the relations between men and governments. Fundamentally they are a part of the age-old conflict between good and evil. As such their ultimate solution will be found only in the realm of philosophy and morals. One thing is certain: they admit of no mechanistic solution. By themselves, devices for the control of atomic energy are at best but temporary expedients. For this reason, I believe, it is an error to contemplate the control of the use of atomic energy in commodity and police terms, as if atomic energy were some new and dangerous drug. Technical scientific controls of production, processing and final disposition are indispensable, but they are obviously inadequate. It would, I believe, be criminal folly to allow ourselves to imagine that the peace and security of mankind can be attained by any scheme of commodity control.

As political problems affecting the relations of governments, the solution of the problems presented by atomic energy must be sought in the realm of world politics. The more deeply one ponders the problems with which our world is confronted in the light—"the terrible light," as Mr. Attlee said—of the implications of the development of atomic energy, the harder it is to see a solution in anything short of some surrender of national sovereignty. With a limited surrender of national sovereignty, there must be instituted some form of world government restricted, at least at the outset, to matters pertaining to the prevention of war, and the maintenance of international security.

The united nations organization is not a sufficient answer to the problems of peace and security which the world is now seeking. It is a first step, and an all-important step, in the direction of that cooperation between nations which is essential to the survival of civilization. It is not, however, the only, much less the final, step. The united nations organization is an indispensable medium and channel and forum through which the peoples of the world can work out new institutions and arrangements which their peace and security now require.

We do well to recall that the united nations charter had been signed before the world knew of the existence of the atomic bomb, much less anything about its ghastly military potentialities for mass destruction. The coming of the atomic bomb has opened our eyes to the appalling possibilities which will face the world if the united nations should fail to achieve effective international cooperation. It is to be hoped that such a prospect may be sufficient to cause every country, in the interests of its own citizens, to recognize that "over all nations is humanity." It is devoutly to be hoped that the nations will not delay too long in welcoming, albeit in the form of some self-denying ordinance upon individual national sovereignties, a measure of world sovereignty sufficiently effective to maintain international security and to end all possibility of war.

If we are agreed on the ultimate necessity of some measure of world government to maintain world security, we should, by every means in our power, support and strengthen every agency of international cooperation and understanding which can help to make the world community a reality. The peoples of all nations must address themselves to the task of helping to devise and shape institutions and relationships which will enable mankind to ensure, if not its salvation, at least its survival. We must work with all our might for a world order under the rule of law. This seems to be our only hope. Humanity is one. We must act in the belief that no nation and no individual liveth to himself alone, and that all are members one of another.

Mr. JOHN BRACKEN (Leader of the Opposition). Mr. Speaker, I am sure we have all listened with very great interest to the remarks of the Prime Minister as he outlined Canada's part in achieving the release of atomic energy and the various steps

leading up to the agreed declaration which is now before us, and his elaboration of the various clauses in the declaration.

At the outset I wish to compliment the Prime Minister, and all those associated with him, and particularly the scientists of Canada, on their respective parts in bringing about the results of that great discovery. With much of what the Prime Minister has said I am in entire agreement, and I should like to think that in that respect I speak for members in every section of the house.

The question of atomic energy, its production, its control and its use, everyone will agree, is of great importance at this time. The immediate question before this house is the declaration recently issued and signed by the President of the United States, the Prime Minister of Great Britain, and the Prime Minister of Canada. The resolution before us makes a statement and asks a question. It declares that it is expedient at this time that we approve the statement that has been presented to us. This statement, I am sure the Prime Minister will agree, is one which will have no effect in law at the moment, but is one which may be a guide to public opinion throughout wide areas of the world.

The Prime Minister has dealt with the history and the development of this recent gain in science. My remarks will deal more particularly with the political consequences of that development. The declaration before us contains nine clauses. I propose to analyse these very briefly and to make a brief comment on each as I proceed.

The first clause indicates the recognition of an important fact, perhaps the most important fact of the age in which we live, the fact that the modern developments in physical science are so far in advance of the modern developments in social science as to constitute a grave danger to the human race.

I believe it was Wells who, in one of his books, said that civilization is a race between education and catastrophe. If that were true twenty years ago, it is much more true today in the light of the new knowledge that science has given to the world. The question now is whether our growing control over the physical forces around us is to be used for the progress of mankind or for the destruction of mankind. That is the problem that has been dropped into the lap of this generation, and that is what makes this particular time the most interesting and perhaps the most challenging in which any generation of man has ever lived.

The second paragraph sets out that the responsibility arising from this discovery rests upon this generation. It rests upon us to see that all these discoveries are used for the benefit of mankind and not for its destruction. That paragraph indicates one other fact, that the initiative rests with those nations who happen to have been the first to discover the truth of the atomic bomb. But it indicates also, that the responsibility for ultimate success in controlling this new discovery rests with all the nations of the world.

The third paragraph is a statement of fundamental truth. It is in these words: that the only complete protection for the civilized world against the destructive use of scientific knowledge lies in the prevention of war.

I believe, Mr. Speaker, that with the statements contained in these three clauses of the declaration no one in this house will be in disagreement.

The fourth paragraph is a statement of proposed policy. In it we are asked to declare our willingness to proceed with the exchange of fundamental scientific information, and the interchange of scientists and scientific literature for peaceful ends, with any nation that will fully reciprocate. Here we face, an immediate question: Are the scientific data and the technological knowledge so far developed to be entrusted by those who have them to those who do not have them?

This is a question to which an answer must be given reasonably soon. If the present attitude of exclusion prevails for an indefinite period, suspicions and distrust will be engendered in those who do not have this knowledge. At the same time there are few who would favour the distribution of the data and the technical processes indiscriminately, without taking every reasonable precaution to preserve world peace. It would seem reasonable that any nation which is to be permitted to have the knowledge we possess, and from it to develop atomic energy on a commercial scale, ought first to be prepared to submit its mines and laboratories to regular inspection. It is difficult to see how this secret can be shared without serious risk until every one of the great powers of the world is prepared to permit the free dissemination of news and the free admittance for observation of representatives of our great news services. I think it is not going too far to say that to our newspaper men and women we owe our survival in the last half dozen years of war. Had they not been able to find out what our enemies were planning for us and report, as they did, we would have been conquered before waking up to what was going on in the world.

The fifth paragraph contains four statements; one a statement of belief, one a statement of fact, one a statement of intention, and one a statement of hope. The statement of belief is this:

"We believe that the fruits of scientific research should be made available to all nations, and that freedom of investigation and free interchange of ideas are essential to the progress of knowledge."

I think everyone will agree with that statement of belief. The statement of fact is:

"* * * the basic scientific information essential to the development of atomic energy for peaceful purposes has already been made available to the world."

That is, the "basic" scientific information is widely known. The statement of intention is this:

"It is our intention that all further information of this character that may become available from time to time shall be similarly treated."

But that is it is to be made available under conditions mentioned later on. The statement of hope is this:

"We trust that other nations will adopt the same policy, thereby creating an atmosphere of reciprocal confidence in which political agreement and cooperation will flourish."

All will approve, I am sure, of the general attitude expressed in this paragraph. The human race has never yet been denied the fruits of invention by conscious public policy, and denying them now would be unnecessarily holding back material progress. This new knowledge has potentialities for both good and ill. We cannot prevent its development. We must therefore control its use. We must make ourselves capable of turning this and other secrets of nature to constructive use.

Paragraph 6 contains a statement of opinion and an offer to share the scientific knowledge. The opinion is that the spreading of specialized information before it is possible to devise effective safeguards would not contribute to a constructive solution of the problem of the atomic bomb. The second part of the paragraph is an offer, as I have said, to share scientific knowledge on a reciprocal basis. It states:

"We are, however, prepared to share on a reciprocal basis with others of the united nations, detailed information concerning the practical industrial application of atomic energy just as soon as effective enforceable safeguards against its use for destructive purpose can be devised."

This brings us nearer to the nub of the problem we have to face. Is it possible or practical to develop the use of atomic energy for peaceful purposes and prevent its use for war purposes? We cannot now be certain that explosives produced for one purpose will not be used for the other. The problem of policing the use of this process is a complicated one, much more complicated than any political problem ever undertaken in the past. Can society draw a line of demarcation—and see that the line is observed—between developing atomic energy for peaceful purposes and outlawing it for the purposes of war? That is the challenge. It is a challenge we must accept, and as the lines suggest, we accept it by tying our faith to reciprocal agreements to banish its use in time of war.

The seventh paragraph is another statement of opinion. In effect it says, "We state it as our opinion that a commission should be set up to prepare recommendations aimed at the elimination of the use of atomic energy for destructive purposes, and to make possible its use for humanitarian purposes." If any member of parliament has any criticism of this clause I suppose it would be in order for those subscribing to the agreement to ask what better solution could have been proposed. Its authors at best see through the glass but darkly. They are only groping their way, with care and hesitation. I hope this clause does not reveal a disposition to try to escape from the responsibilities incumbent upon those who possess the secret. It is practically certain that the bomb will be used if another war breaks out. Unless we are visionaries this must soon be realized. If there is to be war, any nation wanting to live cannot afford to be without a means of defence or retaliation if it is attacked. The secret is ours today. Others will have it tomorrow, and many will have more dangerous ones later on.

Paragraph 8 suggests a procedure. It suggests that the proposed commission should proceed by separate stages, and more specifically that it should undertake first a wide exchange of scientists and scientific information; and second, to develop a full knowledge concerning natural resources and raw materials. This clause adds a note of realism to which I think most of us will subscribe. We are dealing with a secret process, at least a process that is now secret. If the secret

were no secret at all there would be little use in this elaboration of machinery. If it is still a vital secret in the hands of three nations a terrible responsibility rests upon these nations to devise the best safeguards possible for its use. There is no reason not to believe that some nations will relapse into a passive state, believing that entrusting the task to some international body will settle everything. The danger is that while the innocent will keep their promises, the aggressors will prepare to break their promises and war will be more likely than if no promises were made at all. A half-baked plan will mean that once more this generation will go to sleep on an inactive but still live volcano. That is what happened prior to the recent war.

Paragraph 9, as I interpret it, is an appeal to rationalism in a world made up of nation states. In that paragraph the necessity of three things is pointed out: the necessity of the rule of law among nations as well as among people within nations; the necessity of active and generous support to the united nations organization as the best means now known to humanity of achieving a world of peace; and the necessity of doing everything that humanity can devise to banish war. The paragraph concludes with this brief but strong resolve:

"It is our firm resolve to work without reservation to achieve these ends."

This clause sets before us a goal, but it does not guarantee that we shall attain it. It states the challenge that faces us. The united nations charter was founded on an agreement of the Big Three. That charter has been elaborated on the foundation of certain basic understandings. But the discovery of how to release atomic energy has shattered our faith in that foundation as it is now laid. The most vital problem, therefore, faces us still. Can the world, organized as it is today or as it may be organized in the future, so conduct itself as to save itself from destruction? Are man's own inventions to be the cause of his own destruction? Is the world to remain an age of unreason; or is man, with his new gadgets, to revert to times we thought were passed—times without the controls civilization could provide?

I am not one who feels that we must close this debate on a note of pessimism. I feel that many discussions outside this house have been characterized by too much alarm and despair and by too little hope and optimism. If man is to be destroyed by his own inventions, why weep about it beforehand? Rather, knowing the danger, let us set about with determination to avoid that end. Let us set out to find and to provide the most practical political solution that the collective mind of man is capable of making.

Some say: Let the problem be entrusted to the security council of the united nations organization. That would mean entrusting it to eleven sovereign states, leaving some forty others out of consideration. Let us not forget that warfare has experienced a great transformation in recent years. In the first great war, a country like Belgium could defend itself for weeks or months—this time, only for a matter of days. In future, days will not be allowed us to get ready—only hours, perhaps only minutes, possibly not even that. It is possible that non-aggressors will be less helpless than they have been in the recent past. Aggressors will at least know that if they make war there is every risk that an instrument is in being that may abolish their largest cities in a matter of seconds. That will surely be a restraining influence upon aggressors.

The choice for us seems to be between an association of powers in which it becomes the necessity of nearly all to prevent any one from dominating the scene—either that or a renunciation of some part of our sovereignty, some abridgement of our national sovereignty. If the latter is to be the solution, it ushers in the beginnings of a world state.

The nations of today were not built in a day. The national state as we know it has been a thousand years and more in the building. And a new international order will not be built in a day. But it can be started in a day—in fact, it has already been started; and while it is in the building, we must move with caution and with awareness. We are fortunate in being a member of the British commonwealth of nations and in being a neighbour of the United States. We all rejoice that the agreement before us today is one made between Britain, the United States, and Canada. Thus we in Canada must all feel, as a member of this triumvirate, that while we are in good company we share a terrible responsibility.

What does it all add up to? If my sixty years tell me anything, they tell me that humanity will neither be satisfied nor safe till there is world security against aggressors. Any realist must know that this security will come in one or other of two ways—the way of war, followed by slavery to a dominating state, or the way of understanding, followed by a cooperative world; by force of arms that will result in a world state, in which one part will be dominant, or by force of reason.

in which nations will live together, each contributing its proper share of the price of discipline, and each bearing the fruits of the consequent peace and progress of mankind.

Our path as Canadians is clear. Collective security for humanity is possible only in international collective agreement. We must pay the price of international collective agreement. That price is the sacrifice of some degree of national sovereignty. That price the nations will only grudgingly and slowly be willing to pay; but that price we have already commenced to pay. A world state we now living may never see, but the various peace pacts of the past, the international labour organization, the united nations organization, the food and agriculture organization, the Bretton Woods agreement, the proposed international trade conference—all these are steps toward international security. All these give up something, even though it be little, of national sovereignty. What we are enduring today is the labour pains of better world understanding, the beginnings of a world of peace and of potential progress such as man has never before witnessed.

We have two things to do, both of which require conscious effort and a degree of international tolerance and understanding never before demonstrated in the world. We must determine to have international peace, and we must determine to be relieved of the shackles that have tied us to war and hunger and disease in the past. We must go forward in faith, conscious that, while we may not reach the goal in our day, we are going at least in the right direction and knowing that we are doing our part in bringing the world nearer to the time when peace and prosperity rather than war will be the inheritance of mankind.

Mr. ANGUS MACINNIS (Vancouver East). Mr. Speaker, I regret that owing to a slight indisposition the leader of this group is not here this morning, and I regret it particularly because I know that he had prepared something on this subject. He has given a great deal of thought to it, and while I, or anyone else who may speak from this group, would express the same views, I am sure we cannot do it as well as he would have done it.

The question before us today has to do with approval of the agreement arrived at in Washington by the President of the United States, the Prime Minister of the United Kingdom, and the Prime Minister of Canada, in regard to the control and use of atomic energy. I approve, and I believe this group approves, the agreement. It makes provision for passing on information to the other nations as quickly as an understanding can be arrived at as to the proper use of atomic energy.

I believe the proper organization to control this matter is that of the united nations. However, I am sure, and I agree with the Prime Minister (Mr. Mackenzie King) when he says that what must be done is not only to prohibit the use of atomic energy in war, but rather to abolish war altogether. So long as we have wars, those who make them will use every means they can find to win them. The question which we should put our minds to, then, is not the prevention of the use of atomic energy for war purposes, but the prevention of war itself.

One thing that is disturbing at the present time in connection with atomic energy is the fact that research seems to be in the control of private organizations such as the Duponts in the United States, the Imperial Chemical Industries in the United Kingdom and Canadian Industries Limited in Canada. I believe it is quite improper to leave research of this kind in the hands of private organizations, particularly when those organizations have demonstrated in the past that they are not much concerned with the social uses to which the results of research may be put. These organizations have tremendous vested interests and large aggregations of capital which might easily be rendered obsolete by the development of a new power of this kind. I had hoped that one of the things that would be done would be to bring research in this matter under the full control of the united nations organization, following what has been done by the three nations which at present seem to have the knowledge of this power.

The leader of the opposition (Mr. Bracken) says we have come to the stage in world affairs where cooperation is not only necessary but imperative. Indeed, in my humble opinion the atomic bomb has brought us to the stage where world government at the international level is not only a desirable thing, but a necessity. The choice before us is either world government or world destruction.

Mr. SOLON E. LOW (Peace River). Mr. Speaker, the problem of securing peace on a world scale seems presently to be the responsibility of the United States, Great Britain, and Canada. In my consideration of the declaration made by the Prime Minister of Canada, the Prime Minister of the United Kingdom, and the President of the United States, and in my study of the whole problem of the atomic

bomb and of the world situation, I have come to several conclusions which I wish to outline briefly to the house.

The first of these is this: If the United States and Canada and Great Britain were to remain in exclusive possession of the secret of the technical production of the atomic bomb for some long period of time, I am satisfied that for that period of time the world would have peace. Of course we must admit that eventually the other countries of the world will discover the technique of manufacturing these terrible weapons, and at that time the supremacy of the Anglo-American people will disappear and the problem of securing peace for the world will no longer be their exclusive responsibility.

The second conclusion which I have reached from my studies is this: If all the governments of the world and the nations, large and small, were truly democratic, then I am convinced that an international agreement on the production and application of atomic energy and the organization of effective international control for the production of atomic energy in all countries of the world could be made effective. I am satisfied that that would then be possible, because democratic governments are amenable to the influence of public opinion and of parliaments like our own. It would be possible, because in democratic countries secret arming would be out of the question, mainly because in countries like our own and in those having democratic governments money cannot be spent without the approval of parliament.

Let us examine in a realistic way the situation in which one of the parties to an international agreement—particularly an international agreement concerning the atomic bomb—is a dictatorship. In a dictatorship you would find no free press, you would find no opposition to the government, either in the so-called parliament or throughout the country, such as we have in this country; you would find no regard for parliament. There are such totalitarian countries in this world, and I may say that Russia is not the only one. However, I am convinced that Russia is perhaps the most closed and most totalitarian country of all the major powers.

Under such circumstances I ask in all seriousness, of what value would be any international agreement on the atomic bomb? Of what value would be an international control committee? Who would discover and bring to light, let us say, secret armaments plants that might be established in a totalitarian country? Who would uncover preparations for a new war and bring them to light so that the world would know? Lastly, who would uncover the secret production of this outlawed atomic bomb? Those are questions to which we must give serious thought. Those are questions to which answers are not easily found.

On the other hand, if Canada becomes a party to an international agreement on the atomic bomb and obligates herself not to produce the bomb or to use it in case of war, there are a number of important things which it seems to me we ought to be ready to look squarely in the face. Under such circumstances, in the first place we must ask: Would the united nations organization be able to ensure the complete fulfilment of Canada's pact?

In the first place we have a comparatively free press in Canada. This free press certainly would publish the facts and the whole facts of what was going on. Sometimes we are irked at the actions of the press, but thank God in these days the press can say what it wishes to say. I uphold them in saying it, even though it may be criticism of me or of my actions or of those of the party that I represent.

We have here a free parliament. My first experience down here has assured me that this is a parliament in which men can and do speak their minds. The members of parliament will find out, or at any rate make a great effort at finding out, just what is going on. The government will daily be confronted with resolutions to place on the table copies of all documents relating to any of the processes concerning the atom bomb that might be going on. Somebody, because of that free parliament, will find out what is going on. In this house we have an opposition to the government, constantly watching to see that the government does not do anything of which the opposition disapproves, and ready always to divulge to the world the things that the government is doing. I have known oppositions to take great glee in divulging such things. I cannot understand how a government in a democratic country could keep very long any secret such as that of the manufacture of the atomic bomb.

We have also throughout the country political parties in opposition to the government, constantly on the watch to find out and divulge what the government is doing. If Canada were signatory to an international pact on the atomic bomb I am satisfied that an international commission could come into our country freely and as often as it wished; and could investigate thoroughly over as wide-

spread a territory as it wished, every plant, every arsenal, every laboratory. This would be in compliance with our solemn pact, and it is what would happen in a country such as ours, and in any other democratic country that can truly be said to be democratic. The commission could talk freely with people anywhere in Canada, and the people would give information to the commission freely because we do preserve in Canada, as in other democratic countries, a good measure at least, of personal freedom. People need not be afraid to talk. There is certainly no such fear in Canada—I have noticed that. No person in our country would be afraid to discuss almost any matter with an international commission, because we have guarantees of personal freedom—and we have no secret police, no death penalties for political offenses, or what is often referred to as military espionage.

One must conclude therefore that the united nations organization would come into Canada and other democratic countries and find them fulfilling to the letter the pact and pledges given with respect to the atomic bomb.

Now the question I must face and all of us must face is this, What about Russia or any other totalitarian power? Would it be possible for the united nations organization to secure fulfillment of Russia's pact on the atomic bomb, or that of any other totalitarian country? We must know that in such countries there is no guarantee of personal freedom, and therefore the people cannot talk freely. Every remnant of personal freedom has gone. There is no free press. The press is wholly controlled and muzzled by the government and cannot divulge what is going on. There is no free parliament; there is no opposition to the government either in the so-called parliament or throughout the whole land. They liquidate oppositions in such countries. They do not allow oppositions to work, and no commission for controlling the atomic bomb could possibly have free access to such a country. They would allow the commission to come in, perhaps, but the commission would be allowed to see only what the government wanted them to see. They would be accompanied and guarded. They would be allowed to go into this and that innocent-looking place, but they would have no freedom at all to look into the arsenals and laboratories or to visit the plants and factories. I would point out also that in Russia, as in some other countries, there are vast areas about which foreigners know little or nothing, which have been developing over many years but which are completely fenced around so far as getting information in or out is concerned. Do you suppose for one moment that an international control commission would be allowed to go into such an area? Would it not be possible for plants, any number of them, to be established in such an area for the manufacture of the atomic bomb? Why, of course. It is unthinkable to suppose that an international commission could possibly find out what was being done there, especially in the light of the fact that an international commission for control would be up against the secret police and the threat of death for any who give information and speak their minds freely. There are death penalties in Russia and in all totalitarian countries for "military espionage," a term which is often loosely used to include most innocent observation and discussion. The prohibitions in such countries do not end with death. They often result in deportation of friends and families. These things are a constant threat to the people.

Under all these circumstances I am forced to the conclusion that a country like Russia simply cannot be controlled by an international organization. I am convinced that so long as there are dictatorships amongst the great powers, an effective international solution of the atomic bomb problem is utterly impossible. Now, if the secret technical methods of the manufacture of the atomic bomb are turned over to the united nations organization, it seems inevitable that the secret of this most dangerous weapon in the world's history will be conveyed to the dictatorships without attaining in return, any real and effective guarantees in return that the bomb will not be made and used in a war of aggression. Remember that only a dictatorship—and this I must impress upon hon. members with all the vehemence at my command—could possibly prepare secretly an atomic Pearl Harbour. It could not be done in democracy. Therefore it is absurd to talk of international control so long as Russia and some other totalitarian countries remain as they are.

I have reached another conclusion, of which I must speak briefly. I think it is absurd to talk of government at an international level so long as Russia remains as she is. I should like to hear those who advocate government at the international level tell us exactly what it means. Just what does it mean to Canada, and what does it mean to the other nations of the world? "Government at the international level" has been bandied around freely and loosely. Taking the situation in Canada right now, I wonder if anybody would advocate Canada become-

ing a party to an international government with representation on a basis of population? I wonder where would Canada's twelve million people stand in relation to the 130 million people in the United States? Suppose we should become party to an international government in which the United States might be the dominant nation, and come in on a basis of population, would Canada be prepared to become the northern share-cropper area for the United States? Has anybody ever taken the pains to study what happened in the southern United States, and how they became the southern share-cropper area for the industrial north of the United States? I say that the people of Canada, if they knew the truth, would not support for one moment any such thought; and if they would not accept such an attitude towards our friends of the United States, to whom would they subordinate themselves as a nation? Would it be Russia? I am not prepared to grant that, not for one moment. So far as I am concerned, I can see only one end to such a complex as has been developed on this "government on the international level," and that is the destruction of the British commonwealth of nations of which we form a part—the only real security, the only guarantee of international security we have under the present circumstances. The situation may look black, but situations have looked black at various times in the past.

Mr. Speaker, there is a man not far from me, the hon. member for Yorkton, who speaks of my being "the worst bloody imperialist"—I do not know what he was going to say further, but I should just like to have him know that I am not going to lend a hand to selling my country down the river for any association with a doubtful international organization which rests upon the balance of a strong totalitarian country.

Mr. CASTLEDEN. There was no reference to the hon. member. He just imagined that.

Mr. Low. Of course the hon. member for Yorkton is very smooth in getting out of situations of a kind where his tongue runs away from him. I have seen him in those situations before.

Mr. ARCHIBALD. Anybody stirring up hatred in the world the way the hon. member for Peace River does deserves what he gets.

Mr. Low. I am talking straight to the communists, Mr. Speaker like the one who just cut in. I say to you that God has come to the aid of the United Kingdom and the commonwealth of nations times without number. The only way we can ever explain some of the interesting, important and almost supernatural events which have happened in the past through our history is to recognize that God's hand was in it. There have been times when it looked as though all was lost; times when great men such as Wellington and Pitt have been led to exclaim that all was lost and that there was no hope for the empire or the commonwealth; that we were bound to be defeated and destroyed. Well, Mr. Speaker, men have commonly said such things; they have said them in all ages.

Mr. REID. But it will last a long while yet.

Mr. Low. Yes; it will last a long while yet if we do our duty and do not sell ourselves and our birthright into slavery.

I say that the spirit of unity which was placed amongst us was put there for the purpose of rallying the various parts of the commonwealth to the aid of each other in times of stress. That spirit has rallied us all many times in the past, and it will do it again if we give it a chance. I should not like to see that spirit destroyed. It can easily be destroyed by such loose talk on "government at the international level" as we hear so often in this house.

Mr. ROSE. It came first from England, did it not?

Mr. Low. I am convinced that the Prime Minister has set his hand to a fairly wise declaration. I believe history will record that in its main clauses it was wise.

Now, having set its hand to this declaration, the government should, it seems to me, take under serious and earnest advisement the reform of its whole external policy somewhat along the lines which I shall now give and which, I may say, the Social Credit Association of Canada will endorse most heartily.

There have been numerous occasions, Mr. Speaker, on which people in and out of this house have declared that the Social Credit people are narrow nationalists. That is not so; I deny it most vigorously. Just because we are not ready to accede to every request and every suggestion to sell our birthright, to yield our sovereignty completely and become subject to the domination of tremendous forces outside Canada, does not mean to say that we are in any way narrowly nationalistic.

In the first place, the government should be determined to preserve within Canada, the spirit and the practice of true political and economic democracy. I claim that that is the best guarantee of the intentions of any country not to

become a dictator or to tolerate anything like a dictatorship. I repeat that we should be careful to preserve all the elements of true democracy, with all that that means, and we shall then have done our best to assure the nations of our peaceful intentions.

The second thing I suggest is that we give every assurance of the fullest international cooperation on the part of Canada, as a sovereign nation, for the achievement of an era of peaceful prosperity throughout the world.

Third, we should be prepared to extend as a nation to all other nations the hand of good will and brotherhood and justice.

Fourth, we should be prepared to send economic aid to all needy nations, if necessary without even expecting repayment. Give them every opportunity to balance their payments with us and I am satisfied we shall thereby convincingly demonstrate our peaceful intentions.

In the fifth place, I plead with the government not to yield to this diabolical doctrine of surrendering our sovereignty to any supranational government. We must be in a position in the next few years to act quickly and unfettered. The speedy action of Canada alone might be a means at some time in the future of saving the world.

Sixth, because it is not possible to devise a foreign policy which will be acceptable to the great majority of Canadians so long as they have no real knowledge and are torn between opposing opinions which are spread through the country, mainly through the propaganda of legions of foreign agents, the government must now provide the people with really accurate information. That is the only way the people can possibly make up their minds—on the basis of facts, conveyed by sound and accurate information about what is going on abroad.

Canada can never have a successful and sound external policy until the people of Canada are informed, and through their possession of accurate information are ready to instruct and to support their government.

Seventh, Canada should meticulously keep the peace, praying God that the Anglo-American people will be true to their great trust. At the same time they should be ready instantly, if necessary—and I emphasize this very particularly—to rain fire on those nations who disregard their solemn pledges and wantonly wage war.

I know that some hon. members, particularly in the group to my right, will declare that in saying this I am a warmonger. That is not so. I am a lover of peace. But the only way to guarantee nonaggression in such a world as we now have is to be strong, and just, and ready to act on a moment's notice if necessary.

Last but not least, I say to the government that their foreign policy as well as their domestic policy should be one of absolute trust in God and keeping our powder dry.

I support the resolution.

Mr. CASTLEDEN. And the brotherhood of man?

Mr. Low. Yes, sir.

Mr. FRED ROSE (Cartier). We have just heard from the leader of the Social Credit party what is practically a war declaration—in my opinion a very irresponsible way of talking in this atomic period. If he were concerned with his own province of Alberta—because we know against whom he made the war declaration—he would realize that parts of that province would be very much in the area of the war which he was advocating this morning.

Mr. Low. I was not advocating war. That is just the hon. member's own microbes interpretation.

Mr. ROSE. It is most regrettable that only a few months after the war we should have here a discussion of so serious a problem as the prevention of another war. People throughout the world, and that includes Canada, are disturbed by present events. I have here a letter from a woman in Ottawa, Mrs. Sheila Woodsworth, who writes to me as follows:

"I am afraid of the atomic bomb. Alone I can do nothing about it. I am writing to you in the hope that you will do all in your power to see that this great discovery is not left in the hands of a few countries but is controlled by a world organization. This seems to me the only hope for us and our children."

An hon. MEMBER: Who wrote it?

Mr. ROSE. I gave the name—Mrs. Sheila Woodsworth, of Ottawa. I do not know her. As I said before, it is most disturbing that a few months after the war, people feel impelled to write such letters as this to members of parliament, asking them to do something so that this atomic bomb shall not be used among peoples. The Washington declaration does not reassure me any more than it reassures that person; I do not think it reassures any member of this house. The fact is that

the declaration leaves in the hands of those who have it the power to use the atomic bomb at their discretion, and leaves the door open to an atomic armament race. It may sound very harsh, but it is a fact that it has left in the hands of the United States, Great Britain, and Canada not only a dangerous weapon of war, but a dangerous weapon of diplomacy.

War simply does not come by itself; someone once said that war is a continuation of politics in a different way. Politics goes on before war, and politics today is becoming an atomic diplomacy. We see it going on right now in Washington, more perhaps than anywhere else. And recently, we had the example when Ambassador Hurley practically demanded that the United States should use the advantage of the atomic bomb in her diplomatic dealings. Such voices are heard more and more in the United States. Pressure is being exerted on Washington for the United States government to use the atomic bomb as a diplomatic weapon to club everybody.

I follow closely the United States press. I spoke in Boston a week ago Sunday, and there you get the feeling that a new diplomacy is being advocated in the United States. There is the intervention in China, and Washington practically says: "We will keep those marines there until the situation fits into our pattern." One hon. member spoke about Anglo-American democracy. I would say that this is far from a democratic action. We read daily about the wiping out of Indonesian villages, of people poorly armed fighting for their freedom against British forces, and again we hear about Anglo-American democracy. This is not the type of pattern we had hoped for in the postwar period. It is not the type of pattern that will produce lasting security.

The Prime Minister praised the great work of President Roosevelt, and we all had the greatest respect for the late president, but I would remind hon. members of something that he said in March 1945. He knew that collaboration cannot be Anglo-American but must be collaboration among those powers that made victory possible, the powers that can preserve the peace together. Speaking about the trouble at the time he said:

"It is fruitless to try to place the blame for the situation on one particular nation or another. It is the kind of development which is almost inevitable unless the major powers of the world continue without interruption to work together and assume joint responsibility for the solution of problems which may arise to endanger the peace of the world."

The other day President Truman seemingly forgot these words when he said: "No more conferences of the big three; we don't have to get together any more."

There is no solution but in the continued unity of the big three. Only a few weeks ago when Cordell Hull, that great old statesman, accepted the Nobel prize, he said:

"We must never forget that to achieve the great goal of lasting peace it is imperative that there be continued unity, friendly understanding, and common effort among the people and statesmen of the major united nations who bore the principal burden in the war against the axis."

Unity and understanding among those who bore the burden in the war! But this declaration of Washington has been made by powers outside one great power that bore one of the greatest burdens, and this can only tend to create suspicion and bring about a situation that is not the best at the present time. Some people are always suggesting that the Russians are close-mouthed, that they do not say what they want to say, that they do not say what they mean, that they just keep everything to themselves, and so on. Hon. members who are interested have the same opportunities as I have for acquiring information. They can resort to the New York Times, as I do. If they will look at that newspaper in its issue of Wednesday, November 7, 1945, they will find reported therein a speech made by foreign commissar Molotov in which he referred to atomic diplomacy. What he says reflects the feeling of the Soviet people over the fact that they are being kept out, and are being given reason for suspicion. He said:

"A word must be said about the discovery of atomic energy and about the atomic bomb, the colossal destructive force of which was displayed in the war against Japan. Atomic energy has not yet been tried, however, for averting aggression or safeguarding peace, but it is not possible at the present time for a technical secret of any great size to remain the exclusive possession of some one country or some narrow circle of countries. This being so, the discovery of atomic energy should not encourage either a propensity to exploit the discovery and the play of forces in international policy, or an attitude of complacency as regards the future of peace-loving nations."

Plainly and simply, Mr. Molotov says that there are some nations who believe that they have an advantage because they have the bomb, but that it cannot be kept a secret. It shows that there is a good deal of suspicion in his mind. He ends his speech by saying, "We will have atomic energy and many other things." I would say that as a result of the great contribution which the Russians made to victory, it should have been possible for the three nations to get together, making the atomic bomb the possession of all, because we would then know that it would not be used by any one nation.

It has been disclosed that the Germans had some very dangerous type of poison gas but they did not use it because they knew that everyone had it. From the point of view of equilibrium in diplomatic and political relations, it would have been better if the atomic bomb had been placed in the hands of all rather than in the hands of the Anglo-American nations. It is true there is a conference of foreign ministers where the matter is being discussed, but this is taking place after the Washington understanding and agreement. It could have taken place before, and it should have occurred before.

One United States newspaper man, Leland Stowe, referring to the atomic bomb as a diplomatic weapon, gives the following picture, writing in the Montreal Standard on November 24, 1945. He is a newspaperman of great repute who has travelled throughout the world and has seen the various countries at war. He knows of their sufferings. He says:

"If the Soviets had the bomb and had followed Washington's precise course since August 6, how would the average American feel? I think the newspapers would be full of explosive condemnation of the 'imperialistic power-seeking' Russians—and an awful lot of us would be plenty scared.

"We would say: If the Russians don't intend to use the bomb, actually or for blackmail purposes, why didn't they invite President Truman and Prime Minister Attlee to a conference right away?

"We would say: Why is Moscow treating the Americans and British as if they were second-class allies? Military men would be derelict in their duty if they didn't say: We've got to build a bomb of our own in the shortest possible time. Don't trust the Russians. The very fact that they only talk about sharing, after they've had time to make many more bombs themselves shows they can't be trusted."

If I were a Russian I think I should feel exactly like that. But I am not worried about being a Russian. As one member of this house and as a Canadian interested in the peace of Canada and the world, I am afraid that the damage which has been done already will be hard to heal in the coming months, though I hope it may be healed. Scientists who have worked on the bomb have spoken publicly for the first time, and this is all to the good. Scientists who know exactly what is involved in this atomic energy, much better than at least many of us in the house can know, have advised that we hand over the secret to an international committee, not at some future date but right away. A number of scientists were engaged in this work. One very prominent man, Doctor J. R. Oppenheimer, who directed atomic bomb research at Los Alamos, New Mexico, said:

"It has momentarily strengthened us—"

Meaning the United States.

"—but not in the long run. Some people apparently have been reluctant to draw this to the attention of the world."

Then he recommends that it be placed in the hands of an international organization. Doctor Curtis, who was one of the leading scientists working on atomic energy at Oak Ridge, Tennessee, said that atomic energy should be turned over to an international organization to control all aspects of atomic power. There are many more. Only the other day Professor Szilard, appearing before the senate committee on atomic energy, said it would appear that we were producing bombs against the soviet union. One of the senators interjected, "No, no; we are friends." Professor Szilard replied, "Well, I assume we are producing them against the Soviet Union," and he was one of those who first thought of the possibility of the bomb. He went on to say: "Well, if we are, we are going to be at a disadvantage." He pointed out that it would take the United States twenty years to decentralize her industries, which would have to be done in the event of atomic war, but he said it would take Russia only two years, and therefore the advantage of having the bomb now would be completely lost. One of the most ridiculous arguments against passing on the "know-how" to other countries was presented by Major General Leslie G. Groves, who was in charge of the whole project of producing the atomic bomb. He gave some reasons why it should not be placed in the hands of an international organization; and do you

know what he said; He said it would erase national boundaries, end the sanctity of the home and destroy private commercial enterprise. That was the reason for his opposition to an international organization; that it would destroy the sanctity of the home and destroy private free enterprise. If these are the reasons then I would say that those who oppose handing this over to an international organization are relying on pretty weak arguments. After all, the atomic bomb would definitely destroy the sanctity of the home; everyone will agree with that.

I was not going to speak on this at all, but before I conclude I must say a few words about one group in this house who have been carrying on a most vicious agitation against a country which has been a loyal ally and which has been carrying out all the decisions reached at various conferences. People say you cannot trust the Soviet Union, that they are going to bolshevize the world. Well, right next door to Russia is Finland. We were told that was a country Russia was going to swallow. They had elections in that country. The communists did not come into power. A majority of those elected were neither communists nor socialists. They said Russia would swallow Hungary. Well, Hungary has not been swallowed. They had elections there and the small holders' party came out with the largest group. Then people said, "Aha! now there has been a free election, because the communists did not come out in the majority." In France, of course, the communists came through the election as the largest party and the Red Army is not there. Again, something was said about Austria, but in Austria the Russians actually placed their cards on the table. They recognized the free government at the head of which was Renner, a socialist. They had elections there, and what happened? We all know the results. Then the Soviet Union said they would withdraw from Manchuria, and they are allowing Chinese troops to go into that country. I should like to see the other countries living up to their promises and responsibilities as the Soviet people have been living up to theirs. Let the other countries prove their good faith. Let them prove it in Indonesia, in French Indo-China, in China, and everywhere else. They have not done so. The Social Credit group in this house, and particularly the leader of that group, assisted you ably by the hon. member for Wetaskiwin, have been carrying on a vicious agitation here.

Mr. HANSELL. What about me?

Mr. ROSE. I am sorry; I did not mean to overlook the hon. member for Macleod. They have been carrying on a most vicious agitation against the Soviet Union, actually speaking as though the Soviet people have been our enemies, carrying on the type of agitation which I have said before does not help bring about unity, does not help us when we try to build peace in the world, which will not solve anything but in my opinion will only help create more and more suspicion.

Some hon. MEMBERS. Carried.

Mr. ROSE. No, it is not going to be carried so quickly; this is one time I am going through with it. I will say that those who have been speaking against the Soviet Union are using the language of the Hitlerites. That is a sharp statement, isn't it? One day they will speak about the Soviet Union. The next day they will speak about bankers, international bankers, and they will mention any Jewish name they can think of in the banking world, forgetting the Mellons, the Chase National Bank, the Royal Bank, the Bank of Montreal—on the board of which there is not a single Jew—and all the rest of them. They are carrying on an agitation anti-soviet, anti-Jewish, anti-Socialist. Why, they even charged the Liberal party with becoming a socialist party. In every sense the sort of agitation they are conducting to-day resembles the agitation of the Hitlerites in the good old days. I have before me their attitude toward foreign affairs. Here in this house, of course, they have to polish it up a bit, but down in the province of Quebec they believe they can sell the people anything they wish. Here is their attitude, for instance, toward San Francisco, from their own paper, *Vers demain*, dated April 15, 1944:

"Nous pouvons être sûrs qu'à San-Francisco, il y aura d'autres délégués que les représentants officiels des nations invitées. Ils n'auront pas le droit de vote, mais ils seront là pour inspirer ceux qui auront le droit de vote. Les financiers y seront. Les Juifs y seront. Les socialistes y seront. Toute la bande infernale essayera de canaliser ce concil œcuménique de la matière."

I should like to translate that, because it is too good to be missed by some hon. members:

"We can be certain that at San Francisco there will be other delegates than those officially representing the various nations. They will not have the right to vote but they will be there to inspire those who have the right to vote. The

financiers will be there, the Jews will be there, the socialists will be there. All that infernal gang will be there to canalize this conference into their own channels."

And, speaking about the peace we want to have, in another edition of the same paper, under date of May 1, 1945, they say:

"La dernière paix, au traité de Versailles, fut façonnée par les Juifs internationaux, Schiff, Warburg et consorts: on sait ce qui en est sorti. Le monde chrétien, chrétien mais paganisé, de 1945 est-il en train de passer sous la même coupe?"

Then, speaking about the peace after the last war, they say that the last treaty, the treaty of Versailles, was fashioned by international Jews, Schiff, Warburg and Company, and that we know what has come out of it. Then they ask if the Christian world, Christian but paganized in 1945, is to pass through the same status.

Let me say that that was Hitler's argument. I have one extract here which actually uses material I saw in a nazi paper, and which states that the Jews, the Jewish financiers, such as Kuhn, Loeb and Company, had helped the Russians to carry out their revolution. Those are the stories, printed in that paper, which appeared in the nazi press. According to one of these papers the hon. member for Wetaskiwin (Mr. Jaques) was to speak over the air about Shylock and Marx.

Listen to that language. That is language we have not yet forgotten, language that is not yet dead. Here they come to the House of Commons and, while they do not use the same language, that is what they mean. It is language which can only create trouble. If we proceed on the basis of it we can have no peace, no stability.

It is the good fortune, however, of the people of Canada that those people are limited to one province. We understand that we must have peace, and Canada as a neighbour of the Soviet Union and the United States and as a member of the British commonwealth holds great responsibility. We must do everything in our power to cement that degree of unity needed throughout the world, and especially among those who have carried most of the burden in the ear. Otherwise we shall have chaos and disaster.

Mr. E. G. HANSELL (Macleod). Mr. Speaker, I shall not take much time this afternoon. I had not intended speaking at all until, as the hon. member for Peace River (Mr. Low) was speaking, I heard certain mumbblings in this section of the house. I did not have to strain my ears to hear the last speaker, the hon. member for Cartier (Mr. Rose), and I am not going to answer him.

Mr. ROSE. It is just a debt repaid.

Mr. HANSELL. However, he has attacked some of our supporters in the province of Quebec. All I wish to say is that whether they are our supporters or not, the people of Quebec have the happy faculty of speaking their minds. And they use the freedom Canada gives them as citizens. That is all.

There is no semblance of hatred whatsoever in the minds of hon. members of the Social Credit party; no hatred toward any people or any nation. We disagree with totalitarian dictatorship, and we have been outspoken in our disagreement. We wish no ill, and will fight against anything that will bring ill to any people or any nation anywhere.

May I compliment the Prime Minister (Mr. Mackenzie King) and the other signatories of the declaration now before us for consideration. I have read it with considerable care and, after reading it, it was my view that it is a magnanimous document, Great Britain, the United States, and Canada, represented by the heads of those nations, in that document have offered to the world all the benefits of atomic energy which they have discovered. I repeat that those benefits are offered to the entire world.

For a period of time, for economic reasons those countries could have retained this development of science. They could have brought to the western democracies the greatest standard of living yet dreamed of. But they have shown themselves willing to share this development with the world. The only place they have stopped in extending their gift is when it comes to destruction. And even in that respect, the declaration goes so far as to say that they will let the world have the benefit of their knowledge, when they are sure it is safe to do so.

Surely no nations could be more generous or more magnanimous to the rest of the world than have these three, when dealing with this matter.

Right Hon. W. L. MACKENZIE KING (Prime Minister). Mr. Speaker, I gather from the debate that the house is all but unanimous in support of the resolution, and that at most there is but one member, the hon. member for Cartier (Mr. Rose), who is opposed to it. It will be, I know a source of great satisfaction to all members of parliament—members of all parties—that both in the Senate and in

the House of Commons of Canada there has been unanimity in support of the resolution. That will help in all parts of the world.

May I convey to my hon. friend the Leader of the Opposition (Mr. Bracken) my congratulations upon the splendid address he delivered this morning. Clearly, it was one to which much thought had been given, and which will be helpful I am sure to all who are interested in this all-important question.

There was one reference my hon. friend made—I believe it was to paragraph 7 in the declaration—where it seemed to me, if I heard his words aright, that either he had not in mind the true interpretation of the language of the motion, or that he was expressing something that was not wholly what was in his mind. If I heard his words correctly, he said we were relying upon reciprocal agreements to see that the atomic bomb would not be used in future wars. Hansard will show whether I have understood my hon. friend correctly.

I noticed the hon. member for Vancouver East (Mr. MacInnis) took up the point and I thought quite rightly, said that the whole purpose of my remarks in interpreting the declaration had been to make clear that we cannot afford to rely upon any agreement anywhere; and that the only security against the use of the atomic bomb is the abolition of war itself. That was the point I wished to make very clear, namely, that so far as a major weapon of warfare of this kind is concerned, agreements amount to nothing at all, unless there can be some way in which apart from agreements an unscrupulous people may be prevented from violating an agreement into which they may enter or from using weapons of mass destruction. I repeat, the only safeguard for the preservation of civilization, now that the world is possessed of a weapon of war so devastating as the atomic bomb, is that matters be so worked out in the course of time, and in the near time, that nations will realize that those who take up weapons of this kind to destroy other nations are going to destroy themselves as well. In this last war, the use of the bomb by one country was replied to by the use of the bomb by others, but it was not the atomic bomb. In an atomic age, that same kind of conflict can only bring disaster to all mankind.

I am quite sure that my hon. friend on looking over his notes or Hansard will find that while expressing what was in his mind he was in agreement with myself on that particular point.

Mr. BRACKEN. I was not conscious that I was in disagreement; I am trying to find the reference to which my hon. friend alludes but I have not been able to find it as yet.

Mr. MACKENZIE KING. It may not be there, and I hope it is not, but if it is there I am quite sure my hon. friend did not mean in any way to disagree with what had been said by myself.

May I express also to the hon. member for Vancouver East my appreciation of the manner in which he spoke this morning, and, with one exception, of what he said; I shall allude to the exception in a moment. I should like to say that we all regret that the leader of the C. C. F. party (Mr. Coldwell) has been prevented from taking part in this debate, particularly for the reason which has prevented him from being here this morning. Fortunately, he has already spoken elsewhere on this question, and a good deal of publicity has been given to what he has said. I think his remarks have made it clear that he would strongly support of this resolution.

The one remark, if I caught it aright, of my hon. friend the member for Vancouver East to which I wish to take exception was his statement that research into atomic energy for use in war had been in the hands of the Duponts in the United States, Imperial Chemical Industries in Britain, and Canadian Industries Limited in Canada. That statement is absolutely untrue, and I want to make the strongest possible denial I can make of the statement. This particular field of research was a matter of the most complete cooperation between the universities and government departments; it was not in the hands of these industrial concerns to which my hon. friend has referred. It is quite true that in the building of some of the plants firms which were possessed of special skills and had been associated with one or other of the industries to which my hon. friend referred were employed to help on the work of construction, but so far as the research work is concerned that was a matter which was kept entirely under the control of Government departments of our three countries and the industries mentioned were not parties to the research work.

Mr. MACINNIS. Have they access to the research and the use of it?

Mr. MACKENZIE KING. No; and I wish to make that very clear. Will my hon. friend give the House his reason for believing that they have had such access?

Mr. MACINNIS. If I did not think that I had fairly good reason for saying that, I certainly would not have made the statement. I am very glad to accept the Prime Minister's statement that it is not true, although I do not think that is the best way of saying it.

Mr. MACKENZIE KING. May I say to my hon. friend that a thing is either true or untrue. If it is not true, then there is only one way of stating the fact.

Mr. MACINNIS. If I had said that about my right hon. friend, I am sure he would have objected.

Mr. MACKENZIE KING. I would never have made the statement that my hon. friend made.

Mr. MACINNIS. I would not agree with the right hon. gentleman.

Mr. MACKENZIE KING. That is a very serious statement to make, particularly by an hon. member who is leading his party. Unless the hon. member was prepared to give the grounds on which he based a statement of that kind, he should not have made it at all. I must thank my hon. friend and congratulate him upon having accepted unreservedly the correction which I have made in the particular I have.

I also want to thank the leader of the Social Credit party (Mr. Low) for so strongly supporting this resolution. I do not think it is necessary for me at this time to enter into a discussion as to the points of difference between the hon. member and the hon. member for Cartier (Mr. Rose). There is a time and a place for all things. I think a debate on the principles of democracy versus dictatorship might well have been left over for another occasion.

May I say to the hon. member for Cartier, who appears to have felt it necessary for him to speak on behalf of one particular country, that I think it is unfortunate for that country that he has taken the attitude which he has today, particularly when at the moment there happens to be in the capital of that country the foreign secretaries of both the United Kingdom and the United States. They have gone there to seek to dismiss altogether any ground of suspicion, and to do their utmost to secure, as respects the course to be taken to prevent the atomic bomb from being used for purposes of destruction, complete accord between the three countries which are represented at that conference.

In conclusion may I say this one word which I feel I should like to say at this time. I do not believe we can survey the past years without realizing that the most dangerous of all things that can happen to any country is that evil men should get control of its affairs. No one can look at what is being brought out at the trial at Nuernberg without realizing that the reason the German people are in the position they are in today, the reason we have had this terrible war, is that the government of Germany got into the hands of wicked men. If democracy is to save itself, I do not care what the country is, if any form of government is to save itself, the people must make it their first endeavour to see that the men whom they entrust with the responsibility of power are men who believe in what is right who are honest men, not men, as this group in Germany have been, a lot of gangsters at heart.

Speaking of science, I believe the world has reason to be thankful that men of science have made the great discoveries they have. The progress of the world has come in large part from scientific discoveries. Most things, through the measures in which they are used, have inherent in themselves their opposites something that may be made of great benefit to the world may also be used for diabolical purposes in other ways. It all depends upon who possess the control and what the motive is that lies behind their actions. The greatest of all scientists, so far as being a benefactor of mankind is concerned, was, I believe, that great man, Louis Pasteur. I have before quoted in this house a certain passage from Pasteur, I should like before we conclude this debate to quote it again because it seems to me to go to the very heart of the whole situation we have been discussing today. This statement was made by Pasteur over half a century ago. It will be seen to have a much wider application than could never have been dreamt of at the time it was made:

"Two contrary laws seem to be wrestling with each other nowadays: The one, a law of blood and of death, ever imagining new means of destruction, and forcing nations to be constantly ready for the battlefield—the other, a law of peace, work and health, ever evolving new means of delivering man from the scourges which beset him. The one seeks violent conquests, the other the relief of humanity. The latter places one human life above any victory; while the former would sacrifice hundreds of thousands of lives to the ambition of one. Which of these two laws shall ultimately prevail, God alone knows."

Mr. MACNICOL. Would the Prime Minister add the name of Doctor Banting?

Mr. MACKENZIE KING. I am very happy to add Doctor Banting's name to the list of scientists who will ever be remembered as among the great benefactors of mankind. In referring to Louis Pasteur, I was quoting from one who so far as the world's record is concerned stands, I believe, preeminent as a scientist and benefactor of mankind.

I believe that by enabling us to make prevail among nations the law of peace, work, and health, science will have given us the key to the solution of our world problems. The great scientists are known to be men of wide vision and of large heart. I am sure the motive that actuates them is in most cases, at least, that of service to their fellowmen. Again, in the words of Pasteur, I believe the final verdict upon their researches will be: "Science will have tried by obeying the laws of Humanity extend the frontiers of Life."

Mr. JOHN BRACKEN (Leader of the Opposition). Mr. Speaker, I am not sure that I caught the full significance of the Prime Minister's comments with respect to one of my observations. I am sure there is no difference of any consequence between us, but lest there should be I should like to refer to the matter. I think it was not paragraph 7 but paragraph 6 to which the Prime Minister must have been referring. The last sentence in paragraph 6 of the declaration reads as follows:

"We are, however, prepared to share, on a reciprocal basis with others of the united nations, detailed information concerning the practical industrial application of atomic energy just as soon as effective enforceable safeguards against its use for destructive purposes can be devised."

My comment on that was as follows: I said that it was an offer to share scientific knowledge on a reciprocal basis, and I added:

"The problem of policing the use of this process is a complicated one, much more complicated than any political problem ever undertaken in the past. Can society draw a line of demarcation and see that the line is observed—between developing atomic energy for peaceful purposes and outlawing it for the purposes of war? That is the challenge. It is a challenge we must accept, and as the lines suggest, we accept it by tying our faith to reciprocal agreements to banish its use in time of war."

Mr. MACKENZIE KING. That was the phrase I meant—tying our faith to reciprocal agreements to banish its use in time of war. I do not think we are tying our faith to anything but the abolition of war itself. That is my point.

Mr. BRACKEN. I think the Prime Minister will agree that I was dealing with the clauses as I came to them, and that what I said was not meant to be an all-inclusive statement, but rather an interpretation of the clause itself.

Mr. MACKENZIE KING. I quite agree.

Mr. BRACKEN. I might have made it more inclusive and said, banish its use in time of war and to banish war itself. But I went on to say that it must be our main effort to banish war itself. Since the Prime Minister has referred to it, and in order that there may be no doubt as to the record, perhaps I might be permitted to repeat what I said with respect to war itself. I said:

"What does it all add up to? If my sixty years tell me anything, they tell me that humanity will neither be satisfied nor safe till there is world security against aggressors. Any realist must know that this security will come in one or other of two ways—"

And so forth; I need not repeat it all, but I ended by saying:

"What we are enduring today is the labour pains of better world understanding, the beginnings of a world of peace and of potential progress such as man has never before witnessed.

"We have two things to do, both of which require conscious effort and a degree of international tolerance and understanding never before demonstrated in the world. We must determine to have international peace and we must determine to be relieved of the shackles that have tied us to war and hunger and disease in the past. We must go forward in faith, conscious that, while we may not reach the goal in our day, we are going at least in the right direction, and knowing that we are doing our part in bringing the world nearer to the time when peace and prosperity rather than war will be the inheritance of mankind."

Motion agreed to.

The CHAIRMAN. We have with us this morning our friend, Mr. Harold D. Smith, Director of the Bureau of the Budget, who will be the first witness on the domestic legislation.

Mr. Smith, will you proceed?

STATEMENT OF HAROLD D. SMITH, DIRECTOR, BUREAU OF THE BUDGET

Mr. SMITH. Mr. Chairman, and members of the committee, most of the previous witnesses before this special committee have discussed the scientific and technical aspects of the development and control of atomic energy. A knowledge of nuclear physics and engineering alone, however, cannot solve this problem that faces the Nation and the world. At the moment, our national safety and welfare depend more immediately on our legislative and administrative knowledge. It is the administrative aspects of this problem that I, as an administrator, would like to discuss today.

Modern science has put at the disposal of society forces which may determine the future of civilization. At the moment the greatest of these forces is atomic energy. We must now consider, as your committee is considering, how we may organize the Government in order to control such a force through democratic processes. Only by such control can we protect our safety and enhance our welfare without destroying the freedom of thought and speech which is the foundation of our constitutional system.

In dealing with a question of this scope and this novelty, it seems to me that the most important questions are of a rather general and even philosophical nature, and I would like, in the course of my remarks, to deal with the general background as well as the specific types of questions that are usually considered administrative in character.

I will not discuss the international aspects of this problem, except to say that I agree with those who have already expressed to your committee the hope that steps may be taken in accordance with the declaration of President Truman, Prime Minister Attlee, and Prime Minister King, to bring into being a system of international control through the United Nations Organization.

On the domestic side, I believe that we know enough about the general problem to conclude that we should set up a special civilian agency to take over from the War Department, as the President has recommended, the development and control of atomic energy.

From expert testimony before you and before the House Military Affairs Committee, there seems to be little disagreement on several points. Atomic energy is now the greatest destructive force known to man. It could already be used, rather uneconomically, for industrial heat and power purposes. Whether or not its future power uses are important, its indirect effects on scientific progress, including progress in medicine, will certainly be tremendous. Moreover, the same fissionable materials, which can be preserved indefinitely, can be used either for peaceful purposes or to make atomic bombs.

These facts lead me to believe that we must have a single agency to control the use of atomic energy for both military and civilian purposes. I believe that Secretary Patterson was correct in saying that the War Department should be relieved of such control, since the problems involved go far beyond the military sphere.

If we set up a special agency for this purpose, what should be (1) its functions, (2) its powers, (3) its relationship with the President and the Congress, and (4) its internal organization? I would like to

comment on each of these points in turn, and occasionally illustrate my comments by reference to S. 1717, the bill introduced by your chairman for the development and control of atomic energy.

FUNCTIONS

Most of the proposals on this subject have been in fairly close agreement regarding the functions of the suggested agency. For this reason may I note briefly what seems the general consensus. This agency should conduct research in nuclear physics and other subjects related to atomic energy. It should see to the manufacture of materials from which atomic energy may be derived. It should administer the system of regulation and controls to protect the public from the physical dangers involved in the use of these materials, and to make sure that the total supply is conserved and directed to furthering the public welfare in the most effective way.

There have been, of course, certain differences in emphasis with regard to the functions of the proposed agency. I believe those functions should include not only the development of atomic energy for the national defense but its development and control to promote the general welfare, further scientific progress, strengthen competitive enterprise, and safeguard world peace. For this reason I was glad to see that the bill introduced by your chairman included a statement of these purposes and provided that the agency's research program should include studies of the social, political, and economic effects of atomic energy and its use.

POWERS

To carry out these extensive functions, what powers should be vested in the agency itself, and how much should it be required to work through other agencies or through private enterprise?

The unusual character of the problem of controlling atomic energy, I am sure, justifies the granting of broad powers to the proposed agency. It seems to me, however, that S. 1717 wisely distinguishes between the type of individual freedom that ought to be protected against Government interference, and the type of freedom from control that may lead to the waste of our national resources or the concentration of irresponsible private power.

I agree with other witnesses that the Federal Government must control atomic energy, and that the normal system of private control of materials and patents ought not to operate in this field. At the same time, I believe that the Federal Government should not take on functions that can be accomplished equally well by private business.

Senator MILLIKIN. Mr. Chairman, may I interrupt? Do we have any knowledge of what patents have been allowed in this field?

The CHAIRMAN. Senator, I believe the company called the Kellex Co. has some patents that have been developed in this field.

Mr. NEWMAN. It may be that they have patents on some of the byproduct technical developments which came into the making of the atomic bomb as such. As to the basic patents and the assembly of the bomb, I would suspect that most of those patents are in the hands of the Government and have either been taken out by the War Department or someone else.

Senator MILLIKIN. Do we know whether there are any private patents or private applications for patents where the knowledge has been secured through our Government's effort?

The CHAIRMAN. I don't think so, Senator. I think it is a very apt subject for investigation and testimony.

Senator MILLIKIN. What is the Kellex Co.?

The CHAIRMAN. The Kellex Co. was an engineering company that did a great engineering job on the K-25 project that we saw down at Oak Ridge.

I wish Mr. Newman would look into the patent situation before we get through with these hearings.

Mr. NEWMAN. I think we should hear the Commissioner of Patents, for one thing, who knows more about what patents the Army has taken out than anybody else—they have been deposited with the Commissioner of Patents—and then a few of the private corporations which appear to have some of the patents on technical developments incidental to the research.

Senator MILLIKIN. It might be well also, Mr. Chairman, to have a survey of the foreign field on the subject.

The CHAIRMAN. Will you arrange to get that, too, Mr. Newman?

Mr. NEWMAN. Yes.

The CHAIRMAN. All right.

Senator MILLIKIN. Pardon me for interrupting.

Mr. SMITH. It therefore seems to me that the bill introduced by your chairman is correct in granting the Federal Government a complete monopoly over the production and ownership of fissionable materials (including patents on methods of production) while permitting, under its license, private ownership of source materials, by-products, or devices for the application of atomic energy. Thus the Government will have ownership of the strategic material, and may control related materials and their uses.

I am equally in agreement with the provisions of this bill which distinguish between basic scientific data, which scientists generally agree should not be restricted, and the technical data, which must be controlled by the proposed agency if they are related to the national defense or come within the terms of the Espionage Act. The emphasis of this bill on the greatest possible dissemination of even technical data is a step in the direction of the free exchange of information that must some day be achieved throughout the world.

Similarly, I believe the bill is justified in requiring that patents on atomic energy devices be subject to what amounts to a compulsory licensing system. If atomic energy is important enough to justify complete governmental control, no aspect of its use should be determined by private monopoly.

RELATION TO PRESIDENT AND CONGRESS

While I would like to see legislation on this subject limit the authority of the Government over private citizens, I do not think that it should restrict the normal executive control of the President over the proposed agency or its subordinate divisions. Congress must define the powers of the executive branch in order to keep our political system free and democratic. With respect to the authority of the President to direct

the executive agencies within the limits of statutory policy, however, the case is quite different. If such authority is restricted, there is no positive means for enforcing the wishes of the people and the Congress.

I have heard it argued that the extraordinary importance of this subject, the terrifying possibilities that it involves, are reasons for giving the proposed Atomic Energy Commission a status somewhat different from that of the other executive agencies of the Government, and for restricting in some respects the authority that the President should exercise over it. It seems to me that the contrary is true. When we adopted our Constitution, the executive agencies commanding the greatest concentration of power and requiring the highest degree of technical skill were the armed forces. Just as it has always been a fundamental principle of our constitutional and political system that the military power of the Nation should be directly subordinate to the civil power—that our President should be commander in chief of the armed forces—I believe that this agency, like the executive departments, should be fully under the direction of the President.

~~For this reason, I endorse the provision that the members of the Atomic Energy Commission serve at the pleasure of the President.~~ While they will be subject to his general executive direction, the bill properly provides that for several types of actions they must obtain his express approval. Thus the President must approve the manufacture of atomic weapons or their transfer to the armed forces, and he must approve regulations relating to the Espionage Act.

Each of these actions is related to the national defense aspects of atomic energy.

Senator AUSTIN. May I interrupt the witness for a question?

The CHAIRMAN. Surely.

Senator AUSTIN. I am not anticipating anything or making any prophecy in this question, but if it should develop that in the reorganization of the military department of the Government there should be, under the President, a Secretary of Common Defense, do you mean to have your policy applied through such a Secretary in the beginning where you say in your testimony that the President by this bill is properly given the authority over certain matters there? Do you contemplate that authority being exercised through such a reorganized system as we may have?

Mr. SMITH. Yes; I would think so; that is, with any of these matters that have military implications, the President would receive advice through the Secretary of National Defense, or whatever his title would be.

Senator AUSTIN. Thank you.

Senator JOHNSON. Well, Mr. Smith, I don't find any difference of opinion with respect to the defense measures or the defense implications, rather, of atomic energy resting under the authority of the President, but Congress has created the Federal Power Commission, the Federal Trade Commission, the Interstate Commerce Commission, the Federal Communications Commission, and other commissions, which have legislative functions and are supposed to be legislative agencies as being different from executive agencies, and it seems to me that the functions of the Commission that we are to create will have much in common with the Interstate Commerce Commission and these other legislative agencies, and that Congress, therefore, should have a peculiar control and a special control and a very defi-

nite control over the operations of this new commission in keeping with the age-old policy of having legislative agencies and executive agencies. What is your reaction to that?

Mr. SMITH. Well, Senator Johnson, while in general I would agree with you, the problem that I think we get down to is what we mean by control, and who really has it. I think, if I might develop this point here a little bit further along, you will see what I am driving at. If it is all right I would like to come back to a discussion of your question.

Senator JOHNSON. Certainly. I think that is one of the fundamental questions that is before this committee, and one that we will have to face, and face squarely.

Mr. SMITH. Yes, sir.

On the other hand, we do not know what types of problems will come up in the development of atomic energy for civilian purposes that will vitally affect the activities of other Federal departments. It therefore seems clear to me that, in order that the President may coordinate the work of this agency with that of the rest of the executive branch, he should have full authority to direct its activities whenever he needs to do so.

Like other executive agencies, the proposed Commission will be accountable to the Congress through the regular procedure for the review of its appropriations as well as by virtue of the fact that its only powers are derived from a statute of the Congress. In view of the great effect the use of atomic energy may have on our whole economic system, S. 1717 wisely requires that the licensing of any device for this purpose be reported to the Congress 90 days in advance. The Congress will then have an opportunity to enact emergency legislation if it wishes. The most important means by which the Congress may hold the agency accountable, however, is by dealing with it as a part of the general program of the President. The Commission's relations with other departments of the Government—the State Department, the armed services, the proposed National Science Foundation, the Departments of Justice and Interior and Commerce, and many others—will be equally as important as its internal operations.

INTERNAL ORGANIZATION

As I have already remarked, I believe that S. 1717 is generally sound with respect to the functions and powers of the proposed Commission, and its relationship to the President and the Congress. At the same time, I would like to question the provisions of this bill which establish the internal organization of the Commission.

We must admit that at this time we know very little about all the uses to which atomic energy can be put. In approaching the problem, however, we ought to make it clear that we know something about administrative organization. We certainly ought not to assume that we can ignore everything we have learned about the science of administration from the history of our Government, and from the practical experience of administrators.

In the light of such lessons, it seems to me that this measure should be amended in a number of respects.

First, this bill sets up four divisions within the proposed agency. I do not believe that the internal divisions of the Commission should be set up by statute at this time.

S. 1717 recognizes the need for flexibility by giving the Commission the power to assign functions to its divisions, or to create additional divisions. Nevertheless, the titles of the four statutory divisions suggest a definite pattern of organization. I do not feel sure that anyone can foresee at this time the pattern of organization the Commission should have several years hence. I would therefore recommend that the Commission have power to set up and abolish divisions as it sees fit, in order to enable it to adjust itself gradually to new problems as they arise.

Similarly, there will be a great many points at which the work of the proposed Commission will touch on the work of other Federal agencies. At such points it may be desirable from time to time to adjust the relationship between departments and agencies, or to shift functions or units from one to the other. For this reason, I would suggest that the bill contain a provision bringing the proposed Commission within the scope of the Reorganization Act of 1945. That act now contains a provision exempting agencies created subsequent to January 1, 1945.

The CHAIRMAN. Mr. Smith, do you mind an interruption at this time?

Mr. SMITH. No.

The CHAIRMAN. Do you feel that the divisions that are created under the bill are logical at this time as we know the problem?

Mr. SMITH. I feel that you are on much safer ground—this is my point—if you do not specify in your bill what the divisions should be. It seems to me that the Congress ought not to go so far as to define the internal organization of the agency at this time. I would rather leave the Commission and the administrative people flexibility, and I believe that you will be in a better position if you allow for such flexibility in view of the fact that there are uncertainties as to what the problems are. I think that is my point.

The CHAIRMAN. I understand your point, but I want to make it clear that you do not quarrel per se with the divisions that are suggested in the bill at this time, as they are suggested; it is only the philosophical concept or political concept of setting them forth by statute—

Mr. SMITH (interposing). Yes; I think my answer is that I couldn't do any better, if the divisions are to be defined, as near as I can see.

The CHAIRMAN. Then of course the bill does provide for the creation of additional divisions as they may become necessary.

Mr. SMITH. Yes.

The CHAIRMAN. Well, now, in the Department of Justice, the work of the Department is carried on in 6 different divisions. Are they set out by statute?

Mr. SMITH. I assume they are; I am not sure.

The CHAIRMAN. That works satisfactorily there.

Thank you for permitting the interruption.

Mr. SMITH. Second, I would recommend that the Commission be provided with a general executive or administrative officer. If an executive agency is headed by a board or commission, I cannot imagine how it may operate effectively without using some single person as a channel of direction and coordination, both in carrying out the plans it has determined, and in bringing up new ideas for consideration.

The CHAIRMAN. Now I am not disposed to quarrel with you about that statement, except that I would ask you, does the Federal Power Commission have such an officer?

Senator JOHNSON. That is the question I wanted to ask him, whether the Interstate Commerce Commission has such an officer. That is the fundamental question implied in my general observation a moment ago.

Mr. SMITH. My answer is that I know that the Federal Power Commission either has or has been trying to get such an officer.

The CHAIRMAN. I don't think they have now. The Civil Aeronautics—well, of course that was split, wasn't it, a few years ago? The Interstate Commerce Commission, Senator, I don't think has.

Senator JOHNSON. No. One of the Commissioners acts as Chairman, and of course that is very proper; someone would have to act as chairman of any commission.

The CHAIRMAN. The Federal Trade Commission functions as a commission, I think.

Mr. SMITH. I am willing to develop this any way you like, but if I could make the point, then I would like to come back to your question, because I would like to take on that question with you, as I think it is a very important one.

If the proposed Commission does not transmit its instructions to its divisions through a single person, the division heads will deal with individual members of the Commission themselves. They will naturally choose to deal with the member or members who they think will give them the answers they want, and to play one member off against another. When they start doing so, they almost inevitably establish a set of personal relationships that are likely to destroy the harmony that should exist among the Commission members.

I would urge, therefore, that S. 1717 be revised to provide that the President appoint an executive director who, under the Commission's supervision, shall direct and supervise all other officers and employees of the Commission. Since members of the Commission, which will be the policy-making body for the agency, will be confirmed by the Senate after appointment by the President, I propose that the executive director not be made subject to senatorial confirmation.

The CHAIRMAN. That is a very poor suggestion to make to a bunch of Senators. [Laughter.]

Mr. SMITH. Well, the Director of the Budget has a very bad reputation, I take it, for bad suggestions.

Senator MILLIKIN. I don't follow the reason—the suggestion may be good—that because the members of the Commission are subject to the confirmation of the Senate, it should follow from that that the chief executive officer should be exempted. In fact, I think you could argue that that is an additional reason why he should be confirmed.

Mr. SMITH. I wouldn't so argue. But if I could complete my points, Mr. Chairman, I will come back to these other questions.

The CHAIRMAN. Well, Mr. Smith, we are making notes of all these contested points, so we will be back.

Senator MILLIKIN. I would rather allow the members of the Commission to escape and confirm the executive director.

Senator JOHNSON. The trouble, Mr. Smith, is that the further you go the worse it gets.

Mr. SMITH. That is all right, Senator.

Third, I would recommend against the appointment of division heads by the President. I think this method of selecting them unwise partly because it would lessen the freedom with which the Commission may make changes in its pattern of organization. More important, experience has shown that Presidential appointment of subordinates within departments or agencies does not strengthen the President's direction of those agencies, but weakens it. Such appointments will destroy the unity of an organization and make it impossible for the President to hold responsible the man at its head.

Fourth, I recommend that you strike out of the bill the provisions requiring individual members of the Commission to sit on four statutory boards, and giving such boards final reviewing authority on certain subjects. I believe that the Commission should be given authority, in its discretion, to hear appeals for any purpose from any subordinate officers or boards. The Commission will, of course, wish to delegate enough responsibility to subordinate officers or boards to be able itself to deal effectively with the most important questions. If you wish to require the Commission to set up boards for certain specialized types of hearings, I strongly recommend that individual members of the Commission not be required to sit as members of such boards. Such specialized individual duties could only distract them from their more important collective responsibilities.

Fifth, the bill in question provides for a Commission of five full-time members. I agree wholeheartedly that the functions of this agency are too important to be entrusted to any persons who are not full-time officials of the Federal Government. At the same time, I believe that a board of three members will be more effective than a board of five. The smaller the number of members on the board the more attractive the positions will be to men of the highest ability.

The CHAIRMAN. Mr. Smith, the thought was advanced that it would be impossible to get the proper type of men to serve full time on a commission of this kind. Do you share that apprehension?

Mr. SMITH. No, I do not, Mr. Chairman; I do not.

The CHAIRMAN. Membership on this Commission, it seems to me, if it is finally created, might well be regarded as important a responsibility as any officer, including membership on the Supreme Court; would you not think so?

Mr. SMITH. I heartily agree with you; yes.

Sixth, the bill gives the proposed Commission the power to create corporations. I do not believe that it can accomplish anything by the creation of a corporation that it could not accomplish by setting up a division of its own organization. If exceptional powers, or exemptions from burdensome procedures, are needed, they can be granted to a division of the Commission as well as to a corporation. The act of December 6, 1945, both reduced the privileges of such corporations and made clear the intent of the Congress to restrict the number of corporations in the future. I therefore recommend that you strike out of S. 1717 the grant of power to create corporations.

While recommending certain deletions, I would like to say that I agree with your chairman with regard to one important provision that he left out of his bill. The purpose of this legislation is to put the development of atomic energy under civilian control. I therefore consider it sound not to include a provision exempting the agency from the laws which prevent officers of the armed services from accepting

civil offices without giving up their commissions. This bill, by remaining silent on this subject, does not discriminate against members of the armed forces. It merely requires them to choose between two types of careers which have different obligations, different rewards, and different conditions of tenure. The Congress may see fit to make individual exceptions to this rule from time to time. But it is a general rule that should be maintained, especially when the purpose is to transfer an agency from military to civilian administration.

Atomic energy is a new material force. Scientists tell us it has ushered in a new era. It is likely to have great effects, of course, on many aspects of our life. But while it is going to change a great many of the problems which face our political and administrative system, I do not think it changes the principles of that system. To develop and control atomic energy, we must take steps that are consistent with our basic concepts of democratic and representative government.

S. 1717 would deal with the problem within our constitutional framework. It makes the proposed Atomic Energy Commission, like other executive agencies, directly responsible to the President and the Congress. It grants the Commission enough power to do its job without endangering freedom of thought and speech. At the same time, it would give the Commission an awkward internal structure, which would lack the unity and simplicity that mark an effective and responsible organization.

As the bill is revised, I hope that it loses none of its present merits and gains by improvements in the organization that it proposes to establish.

Senator JOHNSON. Mr. Chairman, I have to leave at 11 o'clock, as I have a conflicting engagement at that hour, and I hope that Mr. Smith can now go into the question that I raised a moment ago: Congressional authority versus Executive authority over this Commission. I am very anxious that the Congress control this Commission with a tighter hand than it has controlled any agency of our Government heretofore, and it seems to me that Mr. Smith's recommendations go in the opposite direction to that.

The CHAIRMAN. You understand, Senator, that the bill provides for quarterly reports to the Congress of everything that is done, and also requires that before any atomic energy devices may be used, that the Congress must pass on that policy. I think if you will examine the bill you will find that the Congress not only must be kept fully informed, but has a right of veto power in many essential respects.

Senator JOHNSON. Yes; I have noted that with a great deal of satisfaction, but I want to hear the witness' arguments, and I want to hear his conclusions on those points; and it seems to me that his argument all the way is traveling in the opposite direction and looking toward Executive control instead of congressional control.

I would go far beyond the present language of the bill in establishing congressional control if I had my way about it. But the witness appears to have a different idea. I would like to have something on that, as he has suggested he would give us.

Mr. SMITH. Mr. Chairman, I think you are naturally aware that you are hearing from an administrator or an alleged administrator, whichever term you wish to use, and that I, naturally, in contrast to the position each of you hold, must speak from my own background of experience on a subject of this sort; and I think you will doubtless

gather from my testimony that I am greatly concerned about the organization you propose, because I frankly think that it has some serious defects.

Now coming to the problem that is raised here concerning congressional versus Executive control, I don't think they are two separate types of control but a single problem. And I will argue that unless you have adequate Executive control, you do not have adequate congressional control; and that unless you can get a responsible Executive set-up—because after all, you pass the law, you provide the framework, and then it is the President who is responsible for the faithful execution of the laws—your hands are pretty much tied unless you can get back from the administration the results that you should have from thoroughly responsible Executive action.

Now that is the thesis on which, not only in theory but in practice, I approach this subject. And I maintain that, in fields such as this, the Congress, unless it provides a sound administrative organization, has very few recourses; and that, on the other hand, the administration's hands are tied. That is my thesis, and I think there is an awful lot of fiction about this whole area of congressional control. I think it is a two-way proposition in which you lay down the rules and regulations, and then you have to see that somebody else lives up to the rules and regulations; and the rules and regulations, it seems to me, on the administrative side, have to be such that they have a considerable support in administrative experience.

The CHAIRMAN. Mr. Smith, the bill provides for the setting of a quota of production of fissionable materials for each quarter by the President, and the President, of course, must report that to Congress. Now do you think it would be practicable to have the Congress set the amount of fissionable materials that would be produced in each quarter?

Mr. SMITH. I would not think so, although I have not studied that particular phase of this bill. I thought you wanted my views on the administrative side of it, and I have pretty much confined myself to that.

The CHAIRMAN. Of course, this goes to the heart of Senator Johnson's objection, or at least his comment, that he would put more emphasis on congressional power and less on the Executive, and it certainly occurred to me that this is one of the most vital decisions that can be made in relation to atomic energy domestically, as to how much fissionable material shall be produced in any one quarter. I was trying to figure out how in the world Congress could do that with any degree of speed, with any degree of success.

I am frank to say that the more congressional supervision, the more congressional opportunity to correct mistakes in this situation, the more I am in sympathy with it, but I don't see, taking that for an example, how the Congress could fix a quota such as is proposed under the bill.

Mr. SMITH. I do not see how Congress can do that, either, and I know of no similar situation where Congress takes such an action. There are, I think, some situations where congressional committees make something related to administrative determinations, but that I wouldn't think of as being solely a congressional action.

The CHAIRMAN. I notice that you cut down or propose to cut down the Commission, as proposed in the bill, from five to three, the reason

being given that the smaller the number on the board the more attractive the position would be to men of the highest ability.

Well, of course, I have already expressed my feeling as to how important membership on the Commission would be. There are nine on the Supreme Court, and just about every lawyer I know of in the United States would like to get on there. I am wondering whether that is a good objection to the provision.

Mr. SMITH. Well, frankly, I don't think that it is one about which you should be too much concerned. Out of some experience, I feel that a Commission of three for this sort of thing is better than a Commission of five, and perhaps I would even argue that it is better than a Commission of five because I might believe in a Commission of one, and if you get more than five it is a question that you might go up to a hundred, and the first thing you know you would have a town meeting. Somewhere you have to draw an arbitrary line. My arbitrary line would be at three, and it seems to me that you might put those three at a rather high salary status, for example, where you might not feel like doing that for five.

There is some question as to what would be contributed by two additional members of a Commission. It is usually the case that either one or two men, actually strong men, run a show of that sort.

The CHAIRMAN. I notice that you recommend the creation of an administrator. I have no strong feelings on that. It might be that for administrative efficiency that might be necessary.

What other agencies are there in the Government that have that kind of a set-up now?

I might say that I do not see how the power to appoint an administrator and the provision for an administrator would have anything to do with the congressional control of the man except through the confirmation of him, which I think ought to be, because they confirm the members of the Commission. But laying that aside, what other agencies of the Government are there that do have that kind of set-up?

Mr. SMITH. Well, I don't think you can make comparisons here. I think the comparison with the Federal Power Commission, for example, is not a good one, and that there are dangers in that kind of comparison. It just happens that we made a very thorough study some time ago of the operation of the Federal Power Commission, and I think that it should have an executive; that you cannot do business even in a quasi-judicial agency without an executive. But here it seems to me that you have got something very much more important than that, if I see this problem, and I don't pretend to see it at all in any complete way. But it seems to me that here you have got a Commission which is performing a multitude of functions, that you might argue very well, by analogy with some other commissions in the Government about whose operations I am fairly familiar, both their good points and bad points; you might argue very well that if this Commission had only quasi-judicial or quasi-legislative functions, that you didn't need an executive. On the other hand, it seems to me that this Commission has vast administrative functions dealing with the operation of plants, and all of that sort of thing, and why should we deny, then, the administrative experience we have had in the Government—whether you wish to turn to Surplus Property, for example, or elsewhere where we are in trouble because we do not have executive responsibility thoroughly

quasi-judicial
 Reg.
 operation
 (adm)

fixed? And in my book it is inconceivable to me how any Commission—and we know the experience, for example, in commission forms of city government—can possibly operate without a central executive.

The CHAIRMAN. I can see the point. There are a great many manufacturing plants here which would have to be operated by this Commission, and it might be well if they had a general manager. Now, we could write that into the bill. Would you attempt to write in any statutory authority for the general manager, or would you leave that to the Commission to set his duties?

Mr. SMITH. Well, I think that just offhand I would be inclined to argue that there is much more need for some at least general statutory provision with respect to an executive than there is with respect to the heads of the divisions under him. I think the two things would be inconsistent, that you have to go one way or another. In the main, however, I would lean in the direction of having the Commission, depending upon the functions that were laid out for it, pretty much define the duties of the director.

Your committee has given much more study to this than I have, although I am pretty clear about the administrative side of it in terms of my own experience, but it seems to me that if you conceive of this Commission as performing quasi-judicial functions, then you have one kind of problem, while if you conceive of the Commission performing those and many managerial functions, such as the operation of these plants, your problem is entirely different. I think it is something probably pretty vast. Rather than bring something that in time contracts, it is very likely to expand. Then it seems to me that the need for an executive is a very important need.

The CHAIRMAN. Sort of general manager?

Mr. SMITH. Yes. One might think, in this connection, of something like the TVA experience, which is fairly well known, at least parts of it. I would lay down no particular pattern, but it does seem to me inevitable that you would have to come to some central executive.

The CHAIRMAN. Are there any further questions, gentlemen?

Senator AUSTIN. I have a query.

Do you not advocate the laying down, in the legislation, of general policies in any event? Whatever form this administrative set-up may take, must we not, as a Congress, give it in legislation the general, over-all objectives of this legislation to work toward?

Mr. SMITH. Yes, I certainly believe so, and I don't know quite how far you might go there. It seems to me you have laid down the functions. I think that question is pertinent to this matter of congressional control, about which I do not want to be misunderstood. I believe very sincerely in congressional control. In short, I believe in our form of government. The question, then, is, How do you get that? Well, it seems to me here in a new subject, that the Congress is better off if it lays down the general groundwork and the general rules and regulations, and prescribes the general policies within this field; then lays out a general framework, too, for the administration or carrying out of those policies. However, since on the side of the administration the Chief Executive is responsible, I would propose to give him considerable leeway in adjusting that organization, because there are so many unknowns here, always keeping in mind that the Congress then can come back and tighten up the reins here and there and make the necessary adjustments.

It seems to me—to take a very important, I think, analogy out of recent experience with respect to surplus property—that there we were going too far in connection with detailed specifications. It is a little difficult, I think, for an objective person, looking at that, to say, “Well, was the Congress to blame; was the administration to blame; or was everybody to blame?”

So it seems to me that in a field that is unknown and where experimentation is necessary, it is better strategy all around to provide in the beginning for some flexibility so that adjustments can be made, and thereafter, as the Congress watches the operation and develops notions as to reservations that ought to be applied here and there, then come in and make those adjustments as this new field begins to grow. It seems to me that that is a very practical approach to it, both from the standpoint of the Congress and the problems that will be faced on the side of the administration, and actually gives the Congress much more control than the more rigid approach that would tie administrative hands in the beginning so that there could be a kick-back, “Well, if the Congress hadn’t done this, we would have been able to do such-and-such kind of thing.” Those arguments, of course, get us nowhere. It is essentially a joint enterprise, as I see it.

Senator AUSTIN. Well, is it proper to interpret your view as envisaging the sort of work that an institute does in developing, in a new field, the new policies as experience suggests them, so that Congress gets from this institute that special service in research and experience that Congress cannot itself do or have?

Mr. SMITH. I think that is a very excellent analogy, a very excellent analogy, and I would think that the Congress might perhaps through a special committee such as this keep very close watch on what was going on and get regular reports, and then adjust the harness, so to speak, here and there as occasion demanded.

Senator AUSTIN. That is all.

The CHAIRMAN. Thank you very much, Mr. Smith.

Senator HICKENLOOPER. I have a question, Mr. Chairman.

The CHAIRMAN. Pardon me, Senator Hickenlooper.

Senator HICKENLOOPER. I am quite interested in your statement, Mr. Smith, with respect to the arbitrary selection of the numbers of this Commission. I would like to discuss that with you a minute.

It doesn’t occur to me that there is any arbitrary figure, as such. It seems to me there are certain categories that are essential to be represented on this Commission, and that the representation of those categories will automatically fix the number of the Commissioners if that policy is followed. In other words, we have science, which must or should be represented, in my opinion, on this Commission. We have the technique of production—you might say the engineers—which should be represented in a controlling position on this Commission. We certainly have the public and foreign disposition of this material that, in my opinion, should be represented on this Commission by either one or two members, certain foreign and certain domestic public uses of this material. Then, while this is controversial, I would say that as long as this bill is being set up, or any legislation is being set up, admittedly as temporary legislation because we don’t know where we are going, and as long as we don’t have satisfactory international agreements for the control of this thing,

and as long as it still is a weapon and only a weapon, that it is vital that the armed forces, those charged with the national defense of this country, be at least temporarily represented on this Commission. It would seem to me that you could classify the membership or the representation of this Commission into the categories that we might agree upon are outstanding.

Now, I notice your comment on the fact that no military representation is set up on the Commission. I happen to disagree thoroughly with that. You may be right, but it would seem to me that until we have some reasonable assurance of where we are going with this thing, that any domestic control of this must of necessity take in the military phase of it during this temporary or at least emergency period.

Now, if we begin to pick the numbers of this Commission just arbitrarily, we may leave out of representation some very vital category. That is my thought or comment on your suggestions there on the membership of the committee.

Mr. SMITH. Well, it seems to me that it depends a little on how you start. If you start with the thesis that this Commission is to represent various groups, as you evidently do from what you say, then you are quite right that it might be 7 or it might be 9 or it might be 5 or it might be 11. But I would not start that way. In my own experience—and I have served on quite a few boards and commissions—I should say the worst of them are those chosen to represent special groups and special interests.

Senator HICKENLOOPER. I agree with you thoroughly as a general social and civic set-up. I think that has been one of the frailties of our commissions and boards we have appointed, that we have special advocates on there for special pressure groups. I conceive this to be a totally different problem. We are pioneering in a field that none of us, not even the scientists nor the engineers, can accurately predict for very far in the future. They can project theory but not predict with any accuracy.

It would seem to me that if it is a temporary situation, then the great fields of this thing should have their experts on there rather than an arbitrary group of laymen who would have the authority.

Senator MILLIKIN. Could that not be accomplished by a technical advisory committee expanded to whatever the number may be to get the particular type of advice that the Commission needs?

Mr. SMITH. That would be my solution of it. I think what you want here are broad-gage people on this Commission, chosen because of their stature and general knowledge rather than because of any technical competence they have. I think the engineers and scientists ought to be advising on the technical side, and not become involved in major policy. I would say the technical people, in the main, are the worst people to deal with large policy issues.

Now, that isn't always so, but just saying that as a class. I happen to have a background in engineering myself, so I can be critical of engineers. I would get that kind of talent by organization approaches.

The CHAIRMAN. I would like to call your attention, Senator Millikin and Senator Hickenlooper, to this. The bill provides that—

Members of the Commission shall be appointed by the President, by and with the advice and consent of the Senate, and shall serve at the pleasure of the President. In submitting nominations to the Senate, the President shall set forth the experience and qualifications of each person so nominated.

He is not required to do that even with members of his Cabinet. In fact, I know of no such provision; it is a unique provision in our legislative history.

Senator HICKENLOOPER. I think it is a unique provision, Mr. Chairman, but I have read that, and it doesn't mean anything. I mean, it is useless in the bill as it is written.

The CHAIRMAN. It is a requirement on the President to fully acquaint the Senate with the qualifications that the members have.

I am not particularly wedded to it. It seemed to me to be a good thing to do in this specific case. But I merely call attention to it because I want to point out that at least there is some implied restriction on the President to send up those men who would be broad gage, as Mr. Smith suggested they should be.

Senator MILLIKIN. Mr. Smith, I assume that you prefer to limit your testimony more or less to the administrative features of the bill which is being considered.

Mr. SMITH. Yes; that is correct.

Senator MILLIKIN. In other words, you wouldn't care to go into whether there should be such a Commission, or the basic philosophy involved in it?

Mr. SMITH. No, I think not. Within just what general knowledge I have, and it is only general, of the other phases of the bills, and what you are attempting to accomplish, I can't very well either pick flaws or make suggestions.

With respect to the administrative side of it, I think we have accumulated some experience that leads me to be a little concerned. The experience is enough of a guide for me to predict that if you started a certain way you would come out eventually in a certain way, and whatever the trials and errors and tribulations would be in the meantime might not be too helpful from the standpoint of the total program, and I think that is my sole contribution, if any, Mr. Chairman, to your discussion.

Senator HICKENLOOPER. Mr. Smith, pursuing this matter I raised a moment ago a little further, my thought about the categories into which this field falls and the representation on the Commission probably is prompted, at least now, by the fact that I think we have had examples of where so-called broad-gage men have been appointed to office but have then wholly failed or refused to take the advice of the technical or trained people in the field in which they are supposed to administer, and the people who are trained or who have the background for the solution of problems, have, in some instances, been completely disregarded, and the so-called broad-gage people have followed another tack that diverges from that advice. There is no authority there to do what these people feel is right or proper under the circumstances.

That is not always true, I realize, but I think that examples could be produced of that, although they are immaterial here. It is for that reason that I feel that there must be some assurance that the technical knowledge of these people in their special fields can be brought into some position of authority or some position of control in the disposition of this thing, and it is to protect against people who are not specialists, listening to evidence or listening to recommendations and then liter-

ally brushing them aside because of their own particular attitudes, that I make that suggestion.

Mr. SMITH. Well, I would think anybody who literally brushed aside technical information in this field would certainly be a very irresponsible person, and I would hope that you would get, at least out of the membership of this Commission, a good many safeguards against that.

Senator HICKENLOOPER. Let me call your attention to something that has already happened. I don't know what the fact is about this, I am not attempting to state the fact, I mean, but there was some considerable apprehension just 2 or 3 weeks ago that many of the very carefully guarded secrets of this thing were going to be divulged before any agreements were had internationally. Now, I say that that feeling was prevalent in many places here. It would seem to me that that, had it happened, might have been literally brushing aside a very vital part of this great field.

Senator MILIKIN. Well, that would not be brushing aside any technical testimony; that would be brushing aside the United States of America. You can vaccinate a judge with technical information but you can't always make it take, and sometimes he is very wise in disregarding technical information.

Senator HICKENLOOPER. Well, I always think he is a little incompetent when he holds against me, anyway. [Laughter.]

The CHAIRMAN. Do you have anything further to add, Mr. Smith?

Mr. SMITH. I think not.

The CHAIRMAN. Thank you very much. Would you be willing, Mr. Smith, to submit by way of amendments, that which you have put in your statement, on the administrative phases of this matter?

Mr. SMITH. I would be glad to do so.

The CHAIRMAN. We would appreciate it very much if you would.

Mr. DAVIS. Mr. Davis has come here to testify on the subject we are interested in; and I guess you can go right ahead, Mr. Davis.

STATEMENT OF WILLIAM H. DAVIS, FORMER DIRECTOR OF THE OFFICE OF ECONOMIC STABILIZATION, AND FORMER CHAIRMAN OF THE WAR LABOR BOARD

Mr. DAVIS. Thank you, Mr. Chairman and Senators.

I come here with some temerity, almost. I suppose that the committee wants to hear from me perhaps because of what administrative experience I have had in the Government, which included to some extent a sort of multiple-person board, and also, I think, because of my familiarity with the patent system and the fact that I am now serving as chairman of a committee appointed by the President to advise him, through the Secretary of Commerce, as to the policy of the Government with respect to the patent laws. And those questions do come into this discussion because the McMahon bill does make provisions with respect to patents in this field of atomic energy.

From the general study that I have made of the situation and the proposed bills, I have felt that there were a few basic things that are quite necessary.

The first is that the National Government should promptly gain control of the production and of the use of all material and all proc-

esses readily capable of or directly connected with the release of atomic energy by chain reaction.

Second, that the development of atomic energy for the peaceful pursuits of mankind, and for military purposes, subject to all international agreements to which the United States adheres, and subject to the exigencies of active military operations, should be directed and controlled by the Federal Government through a single permanent commission whose members, in my judgment, should be wholly devoted to that single duty and no other.

Third, that scientific and technical information about the production of atomic energy should be fostered, accumulated, and recorded by our Government, and made universally available just as soon as adequately safeguarded exchange of such information can be internationally agreed on.

Senator AUSTIN. May I interrupt for a minute?

Mr. DAVIS. Surely.

Senator AUSTIN. I put in the record this morning a quotation from Mackenzie King, Prime Minister of Canada, taken out of his statement in the Parliament of the Dominion of Canada, House of Commons, on December 17, 1945, at a time when that great body was about to act upon the agreement which he, on behalf of Canada, had entered into with the United States and Great Britain. I ask you if this statement by him corresponds with what you have just stated as a postulate in your third recommendation:

However, we stated our readiness to share, on a reciprocal basis, with others of the united nations, detailed information concerning the practical industrial application of atomic energy, just as soon as effective and enforceable safeguards against its use for destructive purposes could be devised.

Mr. DAVIS. Senator Austin, that expresses exactly my views. It seems to me so plain, knowing what we do know now about the lethal powers of this energy, and having our attention unfortunately almost exclusively diverted to that aspect of it, it seems to me clear that you can't run a government, I don't think you can run a family, 2 or 3 years from now, unless the whole world believes, the peoples of the world believe, that they know all that anybody knows about this material. It is the unknown that terrifies, and there is terror in this thing. So that you just couldn't run a government unless you were satisfied that you knew and had available all the knowledge that is anywhere available.

It is like the bubonic plague. Now, we are not afraid of communicating with Chicago for fear that we will spread the bubonic plague to New York or Washington, because we are accustomed to feel complete assurance that if the bubonic plague was in Chicago we would know about it. And when you bring things into that common knowledge of mankind the terror of them disappears. If there is any secret about this thing, and if that secrecy is not dispelled, you just can't live. And above all things you are not going to be able to stop the present concentration upon the destructive aspects of it to the certain neglect of the tremendous constructive values of this new source of energy.

Senator HICKENLOOPER. Does your conception of this go to the point of disclosing everything we know about the destructive composition of this thing, that is the destruction of a bomb?

Mr. DAVIS. Oh, yes; and I don't think the world can live with this thing until everybody in it is ready to tell all they know about the subject. Of course I agree with the quotation that Senator Austin read. In fact I put into my own statement the same idea, that you must have an assurance of safeguards. But that those safeguards should stop short at any point of technical information—whether it is practical industrial know-how or basic scientific theory—seems to me impossible. It must extend to a complete disclosure of everything that is known about it.

The fourth item that seemed to me essential was that in the meantime, under the control of the proposed Commission, all knowledge on the subject should be made as freely available for peaceful pursuits as in any wise is consistent with national safety, because there is no doubt that at the moment the emphasis is on the destructive value.

Gentlemen, these scientists, on the 2d day of December 1942, succeeded in setting up this chain reaction at Chicago. They all knew what it meant; every scientist there knew the tremendous significance of that achievement. They didn't tell anybody, not at all. It was put under the most tremendous injunction of secrecy, and the material was produced and sent down to Dr. Oppenheimer and the others in New Mexico to make bombs out of. I often wonder, and I like to visualize, and I would like the committee to visualize, what would have been the result if that discovery had been made on the 2d day of December 1932. We weren't interested in bombs in 1932, we were interested in energy for peaceful purposes. We were at the bottom of a depression. If those fellows had made that discovery on the 2d of December 1932, it would have been in the newspapers the next morning, it would have thrown an entirely different color on the whole psychology of the country. The depression would have been over, I think, because of the hope and promise that is inherent in this thing, and nobody would have ever thought about bombs. They would have eventually, of course, but it would have been entirely different.

Now, we must capture that same attitude of mind about it. I think, if I may be so bold, that if this committee could have scientists calculate and come here and tell the committee what could be done with the amount of energy that was released at Hiroshima and Nagasaki or even down in New Mexico in that first experiment, just calculate that amount of energy and figure up what you could do with it for useful purposes, that would be very enlightening. Some such evidence, it seems to me, ought to be before the committee, at least before the country. If you want the Colorado River to flow over the Sierra Nevada Mountains, all right, we have got plenty of energy to do that in any one of these explosions, I should judge, although I never measured it. But certainly we have now available to us an almost inconceivable, a truly inconceivable, amount of energy, and enough energy to do anything we please with the face of the earth, when we please to do it, and I think that the sooner attention is directed to that aspect of it, the better.

Now finally, my fifth suggestion is that the essential control of the means of production of atomic energy should be so administered as to interfere as little as possible with the fullest and freest utilization of atomic energy for peaceful purposes. Military uses should, of course, be and remain wholly under Government control.

I am emphasizing there that the control of production and distribution of the materials from which atomic energy can be released I think it absolutely essential to be in the hands of the Government, and I think it should be done in such a way as to avoid, as far as possible, any interference with the development of the uses for peaceful purposes of the atomic energy.

Senator MILLIKIN. We have had a lot of testimony, Mr. Davis, that the use of the energy for peaceful purposes takes you three-fourths of the way along to the use of the energy for war purposes. Does that not suggest that at least until the world is postured for peace, that we have got to exercise the same degree of control over its peaceful development as over its war development?

Mr. DAVIS. I think so, Senator, but I make the distinction there—and I am glad you asked the question because it will help me make the distinction which I have in mind—between the production of the energy and the materials from which atomic energy is released by chain reaction; I make the distinction between that production and the development of the use of the energy after it is released.

Now, I believe, as the McMahon bill proposes—you can't go too far to suit me—in absolute governmental control of every speck of material and every speck of invention and discovery in the field of the production of atomic energy, and control of the licensing of the material for use. I think that should be absolutely controlled by the Government, at least for the present, until we know where we are. But I have in mind that the McMahon bill—in fact all the bills, I think—reflect the idea that that being so, the license to use this material should be as free as possible and without, certainly, discrimination, and without monopoly and so forth. That is expressed. But I am emphasizing here—and I will come back to it when I come to the patent section—that it takes some thinking to do that.

You may unconsciously or through ignorance put in hampering provisions which are unnecessary to the control of production.

Now, I was asked to go over the three bills—S. 1717, introduced by Senator McMahon; S. 1463, introduced by Senator Johnson; and S. 1557, introduced by Senator Ball—and I have done so. I think the mere statement of what I regard as the essentials is enough to indicate that I would find the McMahon bill much more to my liking than any of the others.

Senator McMahon, I don't know just how I should approach this subject. I have some matters really almost of draftsmanship, that I could touch on, and then on the patent section I would like to express my thoughts rather fully. If I may, I will just run over S. 1717 page by page and indicate the draftsmanship changes, for whatever they may be worth, and I assure the committee that this is without any desire to butt in where my advice is not wanted.

On page 4 of the McMahon bill, in line 19, in the sentence under (b) which reads—

the theory and production of atomic energy, including processes and devices related to such production—

it seemed to me that the word "materials" should be inserted so that it would read—

including processes, materials, and devices related to such production—

because, as you know, at least two of the important discoveries were of materials useful in the production of atomic energy.

Now, in the next line, line 20, and throughout the bill, we find the word "fissionable," and as a matter of semantics that seems to me a shocking word, but I don't know how interested the committee is in that.

The CHAIRMAN. What would you suggest?

Mr. DAVIS. I will make this suggestion, Senator, prefacing it by saying this, that I am not making the suggestion merely as a matter of semantics. I think as a matter of definition it is important. I realize that the bill, and very wisely I think, defines fissionable material in an almost arbitrary way, that is in the sense that the Commission is to make its own dictionary. The words are used in the bill to define that material which the Commission has decided that it ought to control, for the purposes of the act. That is what it practically amounts to. You see almost any material may be fissionable. As I understand it, they are working now on carbon and silicon, two elements which make up the overwhelming part of this terrestrial planet, and they don't know how to fission them so as to produce atomic energy. Did I hear Senator Hickenlooper say that he hopes they never will find out? If so, I would be inclined to join with him. But still they may be fissionable in that broader sense.

I took occasion to look at Webster's Dictionary and I find no such word as "fissionable" in the dictionary. The word is derived from a Latin irregular verb, and the word "fissure" is the English verb, as well as noun. There is a word "fissile" which is a good dictionary word, and is defined as meaning "capable of being split, cleft, or divided in the direction of the grain, like wood, or along natural planes of cleavage, like crystals." And there is, down at the bottom of the page under unapproved words, so to speak, the words "fissibility" or "fissible."

But the key to the thing, gentlemen, is that what you are shooting at is not all material which releases atomic energy, because after all, radium, which is the preeminent material in its natural state which radiates energy, does not need to be controlled. What you are shooting at, it seems to me, is material which releases atomic energy by chain reaction, that is a conflagration, like a fire. It starts and feeds on itself. That is the thing that characterizes this new discovery.

The CHAIRMAN. Do you know, Mr. Davis, that for a couple of weeks we had nothing but doctors before us, and not honorary at that, and they kept using that word, and I thought it must be in the dictionary.

Mr. DAVIS. Well, if you knew much about scientists, Senator, you would know that they are the worst makers of words in the world. The last person to let write a dictionary is a scientist.

Senator HICKENLOOPER. Perhaps they are creating a new word. Doesn't "jitterbug" now appear in the dictionary?

Mr. DAVIS. Oh, this word will appear in the dictionaries all right. It has been used enough. It is the business of a dictionary writer to put a word in the dictionary if it is in the language.

Senator HICKENLOOPER. At this point, isn't there another field of atomic investigation at least that the scientists have talked about for a long time, the possibility of creating some reaction by combination as well as fission?

Mr. DAVIS. I don't know about that but I should think there would be; they are interested in other explosive fields, of course.

Senator HICKENLOOPER. I don't know whether they think it feasible or not but I think they have been investigating that source as well as fission, or whatever this other word is.

Mr. DAVIS. That is an idea that I didn't think of, in which case you wouldn't use the word "fissionable" at all.

Senator HICKENLOOPER. It occurs to me that it is worth inquiry as to whether or not reference should be made to material that will undergo fission alone, because there may be other combinations and other methods to which that word would not apply.

Mr. DAVIS. There certainly might. I was thinking of what we have in plutonium and uranium-235, which is that upon bombardment with neutrons they release more neutrons than it takes to start them bombarding, and that is the conflagration.

Senator AUSTIN. The trouble there is that you haven't got an exclusive definition by such a word or by such conduct because in fact it is not always bombardment that is necessary to release this energy; it may be by absorption.

Mr. DAVIS. Well, my suggestion—not to dwell upon it too much—for what it is worth, is that the best thing, or the best two words, rather, that I could think of to replace "fissionable," would be "reactive fissile" material, and then define "reactive fissile material" as the bill now does, to include plutonium, uranium-235, and such other materials as the Commission may, from time to time, determine to be capable of releasing, or directly connected with the release of, atomic energy through chain reaction. That is my suggestion and it doesn't cover what Senator Hickenlooper had in mind.

I may say in passing, Mr. Chairman, that it seems to me that if the definition—and this is pretty finicky, you can forget it if you want to—that if the definition were of the words "fissionable material" in the singular, or "reactive fissile material," and then throughout the bill pains were taken to always use it in the singular, you would avoid quite a number of confusions in the bill. In the bill as it is presently written, sometimes you say "fissionable material" and at other times "fissionable materials," and I think if you used the singular it might help.

On page 7 of the bill, in line 10, where it provides that—

the Commission shall arrange for the exclusive operation of facilities employed in the manufacture of fissionable materials by employees of the Commission—

it would seem to me wise to change the word "manufacture" to "production" because then you will have the benefit of the definition of "production of fissionable materials" which is found in section 4 (a).

Senator AUSTIN. Mr. Chairman, may I ask whether it was intended to have some different phase of process represented by the word "manufacture"? You have used the words "production of fissionable materials" in line 5, page 7, and, when you use the words "in the manufacture of fissionable materials" in line 10, do you mean to represent that subsequent transaction which puts the material, the product, into use? It is a question of what you mean.

The CHAIRMAN. Well, Senator, I think that Mr. Davis is correct. I don't think that the word "manufacture" is necessary to convey my meaning.

Senator AUSTIN. You don't?

The CHAIRMAN. No.

Senator HICKENLOOPER. It would seem to me, Mr. Davis—I was just talking to Dr. Condon about it—that as the word “fission” has a limited definition, and while I haven’t the exact wording at the moment, that some definition such as this might be helpful:

any material which is capable of an explosion for the production of power through the alteration of the structure of the atom.

That would take in your atomic theory, it wouldn’t limit it to fission or any other method, and Dr. Condon suggested that I might mention “capable of maintaining a self-creating force.” But really what we are after here is the power or explosion or something else created from the alteration of the structure of the atom, and there are several methods as to that.

Mr. DAVIS. That is right.

In the Johnson bill, on page 12, on line 17, you will find a definition of the material or substance as—

substances determined by the Commission to be readily capable of or directly connected with the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy.

Now, I take it that that definition, which contains such words as you have in mind, was probably modified by Senator McMahon—I am guessing at this—in the definition in section 5 of his bill, because it was too broad; it includes radium, for instance. And the definition in the McMahon bill was “capable of releasing substantial quantities of energy,” which I take to be an effort to get away from radium. Perhaps the two, however, could be combined. As I say, all we know about now, or all I know that we know about, is the chain reaction, the self-perpetuating release of energy.

The CHAIRMAN. Don’t you think that that is a good definition of “fissionable materials,” waiving for the moment your objection to the use of the word “fissionable”?

Mr. DAVIS. Yes.

The CHAIRMAN. Don’t you think that that is a definition that would work satisfactorily?

Mr. DAVIS. What definition?

The CHAIRMAN. The definition of “fissionable materials” under section 5. I just want to get clear your view on that. You have no quarrel with the definition of “fissionable materials,” I take it?

Mr. DAVIS. No; I haven’t any really, Senator, if I am correct in thinking that what you were shooting at was to let the Commission determine what goes in this dictionary—

The CHAIRMAN (interposing). I think you have got to, because it may be a constantly changing situation.

Mr. DAVIS. I do too, and very much so. When it comes to the patent end of it, you use that expression in the patent section and people who make inventions and own patent rights must not be under any doubt as to what is a fissionable material, they must be able to say, “Well, the Commission has said this is so,” and until the Commission says it is, their patent rights are not affected by the bill. I think that is tremendously important. As I say, my objection to the word was perhaps a little finicky, that it is not very good English and does contain this other content of what you are really driving at.

Now, on page 15, line 21, the last word of that line, “therein,” I couldn’t understand. I thought it had gotten in by mistake. As far as I can see it has no predicate.

The CHAIRMAN. I think it is a misprint.

Mr. DAVIS. Then on page 17 where you are dealing with the dissemination of information, which I think is so important, you say:

The term "basic scientific information" shall include, in addition to theoretical knowledge of nuclear and other physics, chemistry, biology, and therapy, all results capable of accomplishment, as distinguished from the processes or techniques of accomplishing them.

Now, it really seems to me that the words "information as to" should be put in there before the words "all results" in line 4. You say:

all results capable of accomplishment, as distinguished from the processes or techniques of accomplishing them.

The CHAIRMAN. Where do you want to make the insertion?

Mr. DAVIS. At the beginning of line 4 insert the words "information as to," before the words "all results."

That brings me, Mr. Chairman, to the patent section—

The CHAIRMAN (interposing). What do you think of this section on dissemination of information? That is one of the most difficult, and must be one of the most carefully studied of the provisions of the bill, and in my consideration of it it gave me the most trouble, because you have, of course, two distinct objectives: One, to give out just as much knowledge and information as you can, consistent with national security and safety. That is what I tried to do in this section. Have you really studied this section?

Mr. DAVIS. I gave this much thought to it, for whatever it is worth, Senator. You see in some of the other bills there was a much greater attempt to rely on the difference between basic scientific knowledge and practical know-how. My experience is that they run into one another in indescribable confusion, and it would be very difficult to separate them.

The CHAIRMAN. The Smythe report illustrates that.

Mr. DAVIS. Yes, and we have it in the patent business all the time, because you can't patent a discovery in basic physics, but only its useful application. And it is very difficult. But here you are trying to say, as I read it—and I read it a number of times—you are trying to go as far as possible now in saying now what may be freely disseminated.

The CHAIRMAN. That was the intent.

Mr. DAVIS. And you say "basic scientific information" and information as to the results capable of accomplishment by this basic scientific information, but not the means of accomplishing it.

The CHAIRMAN. Well, the Smythe report after all reported the end result of accomplishment by different processes which it described, not in detail as to exactly how it was done, but the fact that it had been done. Now that was the philosophy behind giving out the Smythe report, don't you think so?

Mr. DAVIS. I do, indeed, and I think the Smythe report did a great deal of good, and that we are much better off to have that much released than to have had all that kept secret. I don't think it did any harm. Of course if we could now step to a point where we had this Commission set up and where we had our international agreement as to exchange of information, then this section would no longer be necessary.

The CHAIRMAN. Well, you know that the bill carries a proposal to suspend any section that should be in conflict with later developed international agreements.

Mr. DAVIS. Yes; that is right. As I read this section I thought, well, the Commission is going to have to exercise some discretion there. I tried to imagine, Suppose they discover how to release atomic energy from carbon, not by chain reaction but by some other phenomenon? Under this section the Commission would be in duty bound, I take it, to disseminate the information that they had discovered how to release atomic energy from carbon.

Senator HICKENLOOPER. At that point, Mr. Davis, and Mr. Chairman, as I read section 3 and section 9, it seems to me that those two sections taken together make mandatory the divulgence of all information, including information as to atomic bombs as weapons, and make mandatory the research in that field, the way the language of the bill reads here.

Mr. DAVIS. You mean basic scientific information as to the making of bombs?

Senator HICKENLOOPER. It says: "Basic scientific information in the fields specified in section 3 may be freely disseminated." And then it states what the term "basic scientific information" shall include.

Section 3 starts out:

The Commission is directed to exercise its powers in such manner as to insure the continued conduct of research and developmental activities in the fields specified below by private or public institutions or persons and to assist in the acquisition of an ever-expanding fund of theoretical and practical knowledge in such fields.

Now here is the important thing:

To this end the Commission is authorized and directed to make contracts, agreements, arrangements, grants-in-aid, and loans—

it is a mandate, the Commission is "directed"—

(1) for the conduct of research and developmental activities relating to (a) nuclear processes; (b) the theory and production of atomic energy, including processes and devices related to such production; (c) utilization of fissionable and radioactive materials for medical or health purposes; (d) utilization of fissionable and radioactive materials for all other purposes, including industrial uses.

Now, that word "all," I take it, means all, that there is no limitation.

Then in section 9 it says that this basic information "may be freely disseminated," having set up a mandate that the Commission shall thoroughly explore the use of atomic energy in these materials for all purposes.

Mr. DAVIS. Now, I take section 9 to exclude the processes or techniques of accomplishing these results. The way I feel about it—I don't know how good my advice about it is, Senators—but as I read it I felt—

Senator HICKENLOOPER. I would be interested if you would read it at your leisure, if you would examine it with that idea in mind.

Mr. DAVIS. As to how far section 3 is carried into section 9?

Senator HICKENLOOPER. Yes. My impression is that section 3 is carried in completely, because it says, "basic scientific information in the fields specified in section 3 may be freely disseminated." Then it defines "basic scientific information" as not only research but—

Mr. DAVIS (interposing). I take it that the intended meaning of section 9, or when I read it I took it to amount to this—

Senator HICKENLOOPER (interposing). It does exclude techniques.

Mr. DAVIS (continuing). To mean that in the fields specified in section 3, basic scientific information acquired under the provisions of section 3—basic scientific information as distinguished from this know-how—may be freely disseminated.

The CHAIRMAN. Senator Hickenlooper, is your objection that if, for instance, some great superbomb was to be developed that you would, under the bill, have to report the fact that it was in existence, but would not have to say how it had been done?

Senator HICKENLOOPER. No, I don't think you would have to report it. This says, however, that the Commission is directed to make contracts in all these fields, and explore all of the fields of atomic production, and then it says that that information "may be freely disseminated," and that goes right up to the point of the technique. The technique is excluded in this particular section. But you also find another section in this bill defining "foreign governments" as "persons," and the Commission is directed to issue, upon demand, to all "persons," under certain restrictions and limitations, this fissionable material.

The CHAIRMAN. Wait a minute, Senator. You will also find in the bill a provision against the export or import of any fissionable materials. Now I think that—

Senator HICKENLOOPER (interposing). I think that is under the Commission—

The CHAIRMAN (interposing). No foreign government could export any fissionable materials under this bill. I think it might be well to tighten that up.

Senator HICKENLOOPER. I am merely calling attention to the rather radical conflict of language in a couple of places which I think will cause some confusion.

The CHAIRMAN. We want to correct such things; that is what we are here for.

Senator HICKENLOOPER. I think that section 3, in connection with section 9, would bear some rather careful analysis as to what it does say, and I value your opinion on that, Mr. Davis, very highly.

Mr. DAVIS. Thank you, Senator, I don't know as that would be worth half as much as your own.

Senator HICKENLOOPER. That is very nice of you, but I would still like very much to have your opinion.

Mr. DAVIS. I know what you have in mind, I am sure, and I will be glad to think it over. I might throw in, parenthetically, that I can't imagine anything that would be better for the world than if the Army should now announce that the fissionable material which we now have embodied in bombs has a capacity of releasing an amount of energy which would be "sufficient to do the following things." It would probably be sufficient, as I say, to make the Colorado River run over the Sierra Nevada Mountains, and perhaps remove the Sierra Nevada Mountains, for all I know, if anybody wanted to. I think they have got enough energy in bombs today to irrigate every square mile of arid land in America.

Senator HICKENLOOPER. It would have a very fine effect also, if this should be true—I don't know whether it is or not—if they also announced, when the time came, that we have enough bombs to blow anybody off the map. That might speed up some agreements and negotiations.

Senator AUSTIN. We might call on Paul Bunyan and his blue ox.

Mr. DAVIS. This has Paul backed off the map, Senator.

Now, to come to the patent section, Mr. Chairman and gentlemen, I have prepared a proposed substitute. This is a subject on which I have some special knowledge. That begins on page 18.

Paragraph, or rather section 10 (a), proposes really the exercise of eminent domain with respect to any inventions or discoveries that lie in the field of the production of fissionable material. It proposes—and I think soundly so—that any such invention or discovery becomes, ab initio, the property of the United States, and the inventor or discoverer will be compensated by this Patent Royalty Board.

The CHAIRMAN. Let me ask you at this point, this question. Because of your particular interest in the patent field have you looked into the patent situation in the Manhattan project; have you any information on that?

Mr. DAVIS. No direct information, Senator. I know only a little about it through Mr. Kenyon and Mr. Lister. Kenyon was the head of the War Department's patent work, and Lister was out there at the Manhattan project, but I haven't discussed it in detail with them.

The CHAIRMAN. They are the gentlemen that would know about how many patents arose in this project, that is, the occasion for the patents? Will you make a note of those two names and let's have them for the committee?

Mr. DAVIS. Yes; can I put that in the record right now?

The CHAIRMAN. Surely.

Mr. DAVIS. The first one is Mr. W. Houston Kenyon, Jr., whose address is 165 Broadway, New York City. Mr. Kenyon was the patent adviser to the Secretary of War during the war, and is now the head of the staff which is working under this committee of which I am the chairman, on a revision of the patent laws.

Mr. Lister's name is Gordon K. Lister, and his address is 60 East Forty-second Street, New York City. He is a young patent lawyer, and I don't know the extent of his knowledge of this particular thing but I know he was out there on the Manhattan project. In fact I have a letter from him about this bill. I attended a meeting of the patent bar in New York a week ago and they knew that I had been asked to testify about this bill, so some of them offered some objections.

Now, as to section 10 (a), as I say, I am in accord with the basic idea that the Government should have the ownership of all inventions or discoveries in the production of fissionable material. The section, as it is written, starts out:

Whenever any person invents a device or method for the production, refining, or other processing of fissionable material.

There were two suggestions I had on that which I embodied in the proposed redraft. The first of them is that the words "a device or method" are not sufficiently comprehensive because you may be interested in materials, as I said before, and I see no reason why the language of the patent statute would not be better here so that there would be no question about it. It is somewhat artificial language, but it has been explained and interpreted by the courts, and it would read as follows:

Whenever any person invents or discovers any new and useful art, machine, manufacture, or composition of matter for the production of fissionable material—using those words—

for the production of fissionable material—

to carry in the definition of section 4 (a).

The CHAIRMAN. Those words have been construed by the courts.

Mr. DAVIS. Yes.

The CHAIRMAN. I see no reason why we shouldn't adopt that suggestion.

Mr. DAVIS. Then in line 24 it is provided that the Commissioner of Patents "shall issue a patent in the name of the Commission." I propose to change that to "shall issue a patent to the Commission." It seems a slight change, but the patent statute provides that patents shall be issued in the name of the United States of America to the inventor or his assignee. So that it is really more proper to say that the patent will issue "to the Commission."

Then I did suggest in this redraft that instead of referring to this Patent Royalty Board as such, that you should use the expression, perhaps, Patent Compensation Board, for this reason: That I foresee that especially in these basic inventions, in the field of production, that a royalty compensation—in fact you foresaw that in the draft here—would not be an appropriate one, and that a lump-sum payment would be more appropriate; that somebody might invent or discover a very important improvement in the production of fissionable material and it might be the policy of the Commission not to use that at all at that time. So the Government would be saying, "I am going to take this from you and not use it," and you couldn't compensate him then by a royalty. I would like to get away from that. I would like to see it perfectly clear in the bill that this Board which fixes compensation is not limited to royalty payments. In fact the bill says that—

The Patent Royalty Board shall determine what constitutes just compensation in each such case and whether such compensation is to be paid in periodic payments rather than in a lump sum.

Senator HICKENLOOPER. Mr. Davis, I would like to ask you about this, on that particular provision. This sets up a board. That is, the Commission itself takes this patent by this process, eminent domain or whatever you want to call it—it is not that exactly—and then the Commission itself sets up a compensation board.

Mr. DAVIS. Yes.

Senator HICKENLOOPER. It is just as if I wanted to sell you a horse, and I turn the title of the horse, or to the horse, over to you, and then say, "How much will you give me for the horse?" I am against a procedure where the group that makes the rules sits in judgment on the compensation to be paid. It seems to me that if the Commission is going to take the invention of an individual under a theory of compensation, that is, if we go on the theory of compensation, we have two ways to go, either the Government will just preempt it with no compensation, or fair compensation will be paid.

The CHAIRMAN. We couldn't take it without compensation and stay within the Constitution.

Senator HICKENLOOPER. Well, the bill hasn't gone on that theory, it has gone on the theory of compensation. Therefore, it would seem to me that if a patent is issued to the Commission, then the Commission should present this matter, along with the man who invented it, to a court of claims, or to some other body removed from the parties in interest.

Mr. DAVIS. Senator, I am halfway between the two on that, and I thought a great deal about it. If I may develop what I did think about it—

Senator HICKENLOOPER (interposing). That is why I raised the question, I would like to get your opinion on that.

Mr. DAVIS. The Commission is certainly going to need a permanent institution, set up for the purpose of measuring the value of these inventions, and this Board not only has the functions, in the bill, of fixing compensation for rights taken by eminent domain, but also for fixing a reasonable royalty in the other field of the use of atomic material where there will be occasion to grant licenses through the action of the Commission, and to compensate for them.

Now, you will certainly need there a body of men who devote themselves to that job, because there is a great interrelation of values as you can imagine, in such a field. They become knowing of what values are in that field. I think the initial determination should be made by such an administrative body. I don't think that the final determination should be. My suggestion was to be that you go back to page 11, under "General Provisions" beginning at the bottom of page 10 and running over to page 11, where it is provided that—

In the exercise of such rights of eminent domain and condemnation, proceedings may be instituted under the act of August 1, 1888, or any other applicable Federal statute.

Now, the Johnson bill went a little further than that—

Senator HICKENLOOPER (interposing). But when you exercise eminent domain the authority, as a rule, exercising eminent domain, does not have the final say on the compensation. An owner, if dissatisfied, has a remedy in adequate review.

Mr. DAVIS. Well, precisely, and if I may finish here, because I didn't quite finish, I will bring that out. In the Johnson bill it is proposed, in section 8, page 16, under the heading "Compensation for Private Property Acquired," that—

The United States shall make just compensation for personal property acquired, taken, or requisitioned pursuant to section 6 (d) or section 7. The Commission shall determine such compensation. If the compensation so determined be unsatisfactory to the person entitled thereto, such person shall be paid 50 percent of the amount so determined, and shall be entitled to sue the United States to recover such further sum as added to said 50 percent will make up such amount as will be just compensation.

Now, some such arrangement of preliminary determination by the Commission, with review by the courts under the act of 1888, it seems to me should apply here, not only to all personal property condemned but including the patent rights, which are personal property.

Senator HICKENLOOPER. I agree with that.

The CHAIRMAN. That 50-percent provision is the same provision that was contained in the War Contracts Disputes Act. Fifty percent of any disputed contract was paid and the rest was litigated.

Mr. DAVIS. Well, whether 50 percent is the right division or not I hadn't thought much about it. I do think, though, that there should be an initial fixing of the compensation by the Commission, through this special board, but that that should be subject to review in the courts. I suppose it would be anyway.

The CHAIRMAN. Yes; it would be.

Mr. DAVIS. That is my suggestion on that.

Senator AUSTIN. Have you taken care of that in your substitute?

Mr. DAVIS. No; I have not; it doesn't come directly into that portion.

The CHAIRMAN. Might I interrupt, Mr. Davis, and request Mr. Newman to follow that portion of Mr. Davis' testimony and let us have an amendment in accordance with that provision of the Johnson bill?

Mr. NEWMAN. Yes, sir.

Mr. DAVIS. Now to get to the next step which I think is of tremendous importance to everybody concerned, and I would like to try to express this as clearly as I can because it is rather specialized knowledge. That has to do with the provisions of subsection (b) of section 10, under "Patents." The proposal there is that "Any patent now or hereafter issued"—I have got to interrupt myself, Mr. Chairman, and go back to section 10 (a) first, I am sorry, because I neglected to point out—and I have taken care of it in the proposed redraft—that the last sentence of section 10 (a) which provides, "Any person to whom any such patent has heretofore been issued shall forthwith transfer" and so forth, omits to cover inventions that have already been made before the passage of the act, patent applications that are now on file. In my redraft I have enlarged it to say—

Any person who has heretofore made any such invention or discovery, or who has heretofore filed an application for any such patent, or to whom any such patent has heretofore been issued, shall forthwith transfer all right, title, and interest in and to such invention, discovery, patent application, or patent—

and so forth. That is just completing the coverage.

Now back to subsection (b). The purpose there was to say that now we turn to this field of use of atomic energy, and having, I think, two thoughts in mind: One is the possible lethal use of atomic energy which must be guarded against, and the other is the great desirability of promoting the widest possible use of atomic energy in peaceful pursuits—

The CHAIRMAN (interposing). Do you mind if I interrupt you for just one moment?

Mr. DAVIS. Not at all.

The CHAIRMAN. Under 10 (a) you have said that you wanted to insert a provision that took care of a patent that had already been issued?

Mr. DAVIS. The thing that was left out was inventions that have been made and have not issued yet as patents, Senator. Your first provision covers any inventions hereafter made. The last sentence covers any patents heretofore issued. The thing that was omitted was any inventions heretofore made and any patent applications now pending.

The CHAIRMAN. I am sorry to have interrupted you; I misunderstood you.

Mr. DAVIS. Now, in subsection (b) the proposal, then, is to say that with respect to all patents taken out by private citizens, which relate to the utilization of atomic energy, the language being—

covering any process or device utilizing or peculiarly necessary to the utilization of fissionable materials, or peculiarly necessary to the conduct of research or developmental activities—

that as to all those patents they become subject to compulsory license on terms and conditions as to royalty, to be fixed by this Royalty Board. I think that that is a great mistake, and I can illustrate it by making two inventions for you.

First I will assume—this is not my invention—but suppose I invent a little device the size of a water bucket that has got pipes in it, and you can connect it to the faucet in your house and it has a receptacle and you drop a little pill of uranium-235 or plutonium into this receptacle and you have got a house hot-water heater that will run a week or a month or whatever it is—and these things are sold over the counter in the department store or hardware store. I see no reason in the world why the inventor of such a device as that should be treated any differently from the inventor of something that uses the energy of the sun, or electrical energy, for a useful device of that kind. I will develop that a little further later on.

Now let's go to the other extreme. Suppose some of these big laboratories, or I or you, discover tomorrow that by throwing some kind of an electromagnetic field, we will say, around an active pile of plutonium, that they could not only absorb the neutrons that now have to be absorbed in these huge metallic shields, thereby doing away with all that mess, but that in so absorbing the neutrons they became immediately converted into electrical current, electrical energy, that could be transmitted. So you could set a pile on this table and throw your electric field around it and have a power plant sufficient to light a city. Well, with so basic a thing as that I can see how the Commission might feel, and the country might feel, that it should not be left in the monopolistic control of a single company.

So what I suggest in my redraft, Senators—and I do it with the greatest earnestness—is that you leave it to the Commission to say with respect to this type of patent right—

The CHAIRMAN (interposing). You mean the pill in the pail?

Mr. DAVIS. Yes, or any invention or discovery relating to the utilization of atomic energy, that it be left discretionary with the Commission to go out into that field and say, "In this case you must issue license," using that discretion from time to time as the policy of the act would dictate. What I propose in my redraft is that when the Commission finds that it is appropriate to the policy of the act, and suitable to accompany the license to use which it is to issue under section 7, then have the power to say to the patent owner, "You must issue a license for use on terms to be fixed by this Commission, and not do it in a blanket way."

Now, let me tell you why, Senators, and this goes to the heart of a very important subject. There are three activating effects of the patent system. I, of course, may be suspected of prejudice in that field, I have devoted my life to it, but I certainly know from experience that what I say is true.

There are these three different motivating things. The first one is that you reward the inventor, thereby inducing him to disclose his

discovery instead of keeping it secret. Now mind you, the nature of the discovery is that it comes to the mind of an individual—it may not come for a long while to the mind of anybody else—but if this individual wants to keep it secret he can. And the primary function of the patent system is to induce him to disclose it. Now, the last thing we want in this atomic energy thing is to have people feeling that they have been done out of the benefits of the patent system and therefore be inclined to try to keep the secret.

Of course the inventor is induced to disclose it by two very fundamental human motives. One of them is the honor, the dignity—he likes to be recognized as the inventor, and that has a tremendous effect, I know from experience. The second is that he needs to live like the rest of us, and he gets money that way.

Now, I will state the other two functions of the system before I come back to the effect of this bill.

The second is to protect risk capital. After all, it takes a lot of money nowadays, and in this field maybe tremendous amounts of money. It cost \$2,000,000,000 to complete this little job of getting the thing on the market, so to speak. But if a group of investors, a corporation or an individual, puts in this risk capital in developing a naked idea to a commercial product or process, and then if his competitor can come along the next day and copy his commercial process or product, he not only hasn't been rewarded but he is definitely in the red on the transaction because he has to carry this investment and amortize it, and the other fellow has none. So that protection of risk capital is the second function.

Now, the third effect of the patent system which every patent lawyer has had many illustrations of in his experience, is not so well understood, and I refer to it as the "enforced diversity of innovation"—and I will put it this way.

Suppose you had an area of land and you know that there is "gold in them thar hills," and you wanted to explore them as rapidly and thoroughly as possible. The best way to do it would be to take, say, as many explorers as you had, say 100 men, skilled in the business, who knew their way, and say to them, "Now, you fellows know your business; you go ahead on your own hook, each in his own direction, and I will lay upon you only one injunction, and that is that you must not follow in anybody else's footsteps; wherever you see footsteps turn aside and go somewhere else"—because the natural tendency of mankind is partly "sheepish," there is no doubt about that, that they like to follow other people's footsteps.

The effect of the patent system in what we might call the lower levels of invention, is to force diversity. A is a manufacturer of can openers; B is a competitor. B comes along with a new type of can opener. He gets a patent on it. A can't copy it, but he still has to stay in the can-opener business, so he gets busy and gets himself up some new type of can opener, and it is usually a little better than B's.

Now, that is a humble example of what I have seen occur throughout American industry for the last 45 years, over and over again, and in the great industries. I could give you numerous instances. For instance, in the separation of copper from its ores, and in the refining of copper, or in the chemical field where the fact that A is shut off by a patent from one new line leads him to develop another.

That is what I refer to as the "enforced diversity of innovation," which is a fundamental effect of the patent system.

Now, let's look at this proposal of the present section 10 (b) in the light of those three things, and subsection (a), too. Now, in (a), where you are dealing with the basic production of this material, you propose to reward the inventor and you propose, really, that the Government should put in the risk capital. Now, let me put it this way, Senators, never open up a patent right to compulsory licensing unless you are ready to have the Government supply the risk capital, because nobody else will supply it if you once take away that monopoly right. But in this basic material you want to control the production of it, and the Government will, as it has done, supply the risk capital. Now, you lose the diversity of innovation when you take everything into the hands of the Government. It is probably replaced, in this field of basic research and tremendous interest, by another motive of mankind, the creative instinct which I often say is such that you don't need to encourage an inventor to invent, any more than you need to encourage a man to love; it is a basic human instinct. You have to support him——

The CHAIRMAN (interposing). In other words, Columbia would get a grant-in-aid and so would Chicago, and the competition is between the two universities, for instance?

Mr. DAVIS. Sure. These boys get in there and they are motivated by the love of creation, so much so that I, in the scientific research bill, was opposed to the idea of giving any reward at all in the laboratories of nonprofit institutions because it just gets these boys worrying about money when, if you leave them alone, they are really rather devoted, I think—Dr. Condon may agree with me or not; I don't know—to their research.

But at any rate, when you step into the second field, the field of use, if you set up, as this bill proposes, automatically this compulsory license, you destroy the protection to risk capital and you destroy the compulsory diversification of effort. And I think it would be quite unwise and unnecessary to do it, because, in preference to that, you should leave it, I think, to the Commission to have really the power of modified eminent domain, to go in there and say "In this case we find that this monopoly is standing in the way of the basic purpose of the act, specifically today, now, standing in the way, and we therefore decide to throw out of the window this risk capital advantage and the diversity of innovation advantage, for the sake of the higher good." But I don't think you can do that in general.

Now, I will just add this much to that, that you also have, and reflected in the language of the bill, a field of invention and that is in the devices that have already been invented, tremendous advances in devices. The advances were made because there was plenty of money around, and this really tremendous purpose had to be accomplished, and they made improvements in filters and pumps and endless things that probably would not have come about in 20 years in the ordinary processes of advancement.

Well, if those things are necessary or essential to the production of atomic energy, or even to its utilization, then the Commission should have discretion to take them. But there is no reason why the inventor of those things should have to give a license to his competitor to make those pumps for general purposes, and all of

them have uses outside of the field of atomic energy which I don't think the Commission should have any right to interfere with.

Senator AUSTIN. Have you the phrase or paragraph before you that you suggest as a substitute?

Mr. DAVIS. Yes; I have some copies of it here.

Senator HICKENLOOPER. I wonder if we can have that printed, Mr. Chairman.

The CHAIRMAN. Yes; we shall, Senator, and it will appear in the record at this point.

(The proposed substitute section 10 is as follows:)

PATENTS

SEC. 10. (a) Whenever any person invents or discovers any new and useful art, machine, manufacture or composition of matter for the production of fissile material: (I) he may file a patent application to cover such invention or discovery, sending a copy thereof to the Commission; (II) if the Commissioner of Patents determines that the invention or discovery is patentable, he shall issue a patent to the Commission; and (III) the Commission shall make just compensation to such person. The Commission shall appoint a Patent Compensation Board consisting of one or more employees and at least one member of the Commission, and the Commissioner of Patents. The Patent Compensation Board shall determine what constitutes just compensation in each such case and whether such compensation is to be paid in periodic payments rather than in a lump sum. Any person who has heretofore made any such invention or discovery, or who has heretofore filed an application for any such patent, or to whom any such patent has heretofore been issued shall forthwith transfer all right, title, and interest in and to such invention, discovery, patent application or patent to the Commission and shall receive therefor just compensation as provided above.

(b) (1) The Commission shall have power, on its own motion or upon application of any interested party, and upon first finding that such grant would be in furtherance of the policy declared in section 1 and is required in connection with the issuance of any license under section 7 of this Act, to grant (by right of eminent domain) to any person a license under any patent heretofore or hereafter issued of such scope, and containing such terms for the protection of the public interest, as the Commission deems necessary to effectuate the purposes of this Act and containing such reasonable royalty and related provisions for the benefit of the patent owner as the Patent Compensation Board shall determine.

(2) In determining such reasonable compensation, the Patent Compensation Board shall take into consideration any defense, general or special, that might be pleaded by a defendant in an action for infringement, the extent to which, if any, such patented invention or discovery was developed through federally financed research, the degree of utility, novelty, and importance of the invention or discovery, the cost to the patentee of developing such invention or discovery and a reasonable rate of return on such research investment by the patentee.

(3) If complaint be made to any court, Federal, State or Territorial, alleging that a defendant has, in course of the production or utilization of fissile material or by-product material, made, used or vended the invention of any patent heretofore or hereafter granted, and seeking relief for infringement thereof according to law or equity, the said court shall not have jurisdiction or power to stay, restrain or otherwise enjoin (i) any acts so complained of which are within the scope of any license previously granted by the Commission as provided in section 10 (b) (1) hereof; nor (ii), if not so licensed, any acts so complained of until sixty (60) days from and after service of the complaint unless the Commission has previously refused to license the same. If, during said sixty (60) day period, the defendant shall apply to the Commission for a license as hereinabove provided and shall diligently prosecute such application, the court shall not thereafter have jurisdiction or power to stay, restrain or otherwise enjoin the acts so complained of unless and until the Commission has determined to refuse a license or, the Commission having granted a license, the defendant makes, uses or vends the said invention in a manner not within the scope of said license or, having done so in a manner within the scope of said license, fails to abide by those terms thereof which are for the benefit of the plaintiff. Nothing herein contained shall be deemed to lessen or curtail the existing jurisdiction and authority of any court

to enter judgment for damages or costs or to increase such damages, for infringement of any patent, but the provisions as to reasonable compensation contained in any license granted by the Commission, and a written recommendation of the Patent Compensation Board as to the reasonable compensation it would have established in the particular case had application for a license been duly made, shall be admissible in evidence upon the issue of damages.

Mr. DAVIS. Now, there is one question that I myself raise at the bottom of page 1 of this draft. I have put in parentheses the words "by right of eminent domain," so that the sentence reads:

The Commission shall have power * * * to grant (by right of eminent domain) to any person a license—

and so forth. I marked that that way for the very reason that I wanted to discuss at that point the question that we have discussed, of review of the Commission's compensation acts, and whether it is necessary to put in "by right of eminent domain" I would like to leave to the lawyers of the committee, or the committee itself, I don't know. The words are not used in the earlier part of the bill and probably needn't be used here.

The CHAIRMAN. They usually "take" under the right of eminent domain. I have never heard of "granting" under it.

Mr. DAVIS. That is right. The wording of the general provisions on page 10 is "take, requisition, or condemn."

Senator HICKENLOOPER. Eminent domain is generally considered to be an inherent authority of government. I am like the chairman, I never heard of it being used in this particular way before.

Mr. DAVIS. The way it gets connected with the word "grant" is that the Commission now shall have power to take from the inventor and grant to others.

The CHAIRMAN. Having taken, and taken under a legal power, that of eminent domain, they would have it legally, to do as they would with it. I don't think it is necessary.

Mr. DAVIS. I don't either.

Now, there is one other point I make here. In the bill as drawn, in section 10 (b) (2) on page 19, it says, "Any person to whom any such patent has been issued, or any person desiring to use any device or process," and so forth, may apply for a license and apply to the Board to fix an appropriate license fee. I foresee a great deal of trouble, unnecessary trouble, for the Board, if you say that any patentee who has a patent in this tremendous field can go to the Board, because you will find a lot of gadget makers who will be coming to this Commission and saying, "I would like to have you now fix an appropriate fee for the grant of a license under my patent," and he would be doing it just to get publicity, recognition. I don't think the Commission or the Board should undertake to fix a license fee until there is some reasonable prospect, at any rate, that the Commission is going to order the issuance of a license, or until there is an application at least from somebody who wants a license. What I have done in my redraft is this. In my section 10 (b) (1) I say: "The Commission shall have power, on its own motion or upon application of any interested party," and so forth. That is partly side-stepping the issue by leaving it to the discretion really of the Commission to say whether this fellow is an interested party or not.

Senator HICKENLOOPER. One more step there. It might be well, and would still leave open negotiation between individuals and take

the patent compensation board off the spot, if the inventor of the device that hadn't been turned over to the Government, or was considered to be under the supervision of this Commission, if he made a bona fide deal with some fellow that wanted to use it at a certain fee, and then submitted it to the Commission as to whether that would be approved.

Mr. DAVIS. That might be helpful. There is another helpful thing that might be done, following the lead of the present Commissioner of Patents, who has now set up a register in the Patent Office in which people are beginning to register a very large number of patents available for license. I believe the Radio Corporation has recorded all their patents there. Now the Commission might well maintain such a list too. Maybe it is unnecessary to duplicate it, but people could come and say, "I hereby offer to license my invention in this field to anyone who wants a license, on terms to be fixed by this Board," and maintain a register of such patents.

Senator AUSTIN. I would go one step farther than your suggestion and make that "any person having a justiciable interest."

Mr. DAVIS. Well, maybe so, Senator Austin. You have my point?

Senator AUSTIN. Yes.

Mr. DAVIS. I would be very glad, Mr. Chairman, if the staff wants to talk with me about this section, and finds any bugs in it, or doesn't know what I am shooting at, or anything like that, rather than take the time of the full committee, to go over it with the staff.

The CHAIRMAN. If you could, Mr. Davis, get together with the staff and see if the views can be reconciled, that would be very helpful, although I recognize that there is a basic difference of opinion.

Mr. DAVIS. Yes.

Senator HICKENLOOPER. You have a very different situation there. I mean what you have been talking about now is about a patent that I might secure and retain, not about a patent that would be taken under eminent domain or turned over to the Commission under this bill.

Mr. DAVIS. That is right.

Senator HICKENLOOPER. And yet it would have such an effect or an interest in this atomic energy field that it would still be subject to the control—that is, the end result would be subject to the control—of the Commission.

Mr. DAVIS. Yes.

Senator HICKENLOOPER. That would be the only way the Commission would have anything to say about what I licensed Senator Austin if I controlled the patent?

Mr. DAVIS. That is right. Suppose you had invented a pump for liquids or gases, as they did in this development. Now you want to go into the manufacture of that and you license somebody to manufacture that pump for pumping beer in a brewery. The Commission wouldn't have any interest in that and there is no reason in the world why your patent rights should be interfered with in that field at all. It is only if they want to use it in the production or use of atomic energy.

And I will say this to you: There is an idea abroad, gentlemen—if I could impress this on this committee as I have tried to do on other committees of the Senate—there is a very natural idea that runs like

this: "We want to have this thing freely and widely used to the maximum extent. A patent is a monopoly and therefore an impediment to extensive use. Therefore, let's break down the impediment and let everybody use it." It is a very natural idea but if it were a sound idea the whole patent system would be unsound, and it is not just a theoretical matter, it is a practical matter of actual experience. People will say to you, "Look at what a wonderful country the United States is"—we all like to say that—"and what a wonderful job we have done in invention and promotion of industrial things, gadgets, if you please—"

Senator HICKENLOOPER (interposing). I take it Lorenzo Jones has contributed to that.

Mr. DAVIS. Yes. But I don't know what we would have done without the patent system. I do know from practical experience, over and over again, that to get risk capital I had to have the patent, I never could have gotten it without the patent; and that over and over again a man has been forced into a new line because he was shut off in some path by a patent. Those are real values, and it is those values that make it unsound to think that by doing away with the patent in a field you are going to increase the public use in that field. It is quite the contrary. The most effective method of getting at invention, which is a naked idea—it is like a child at birth, it has to be brought up, fed, developed, and kept for an average of, probably 7 years might be a good average, before you get the thing on the market, it has got to be taken care of all that time—and if you open it to compulsory license, even on a reasonable royalty basis, you just leave it out on the doorstep, you know, in the cold. That is what I have tried to work into this proposal.

The CHAIRMAN. This objection occurs to me and I would like to get your observation on it: I can see the strength of your point as far as concerns inventions hereafter made. In other words, let's assume that a new type of pump is invented next year and it has two applications, one in the production of atomic energy, and another in pumping beer in the brewery. Now, I can see a very good reason for at least the beer-pumping function being protected by a patent. How about, though, the situation that might confront us if, for example, the Kellex Co. had invented, as I am sure they have, certain pumps, certain apparatus, which was necessary while it was working under the Government contract, and they now find that it has a beer-pumping purpose. What is your observation on whether or not they should be protected by the patent for the beer-pumping purpose, having invented it under Government contract to do this job and having been reimbursed?

Mr. DAVIS. Well, that is a very difficult question to answer because it depends on the contractual relationships, express or implied, at the time the invention was made. In connection with the Kilgore bill I was asked to confer with those people, and I have taken the position that any invention or discovery for which the United States paid with its money, they paid for the research, should belong to the United States. Secondly, that when an invention or discovery belongs to the United States, it becomes senseless to talk about a patent at all because the patent right is merely an emanation of the power of government as an umbrella over the private citizen who owns the patent, and when the invention vests in the Government, that emana-

tion must be absorbed in the body politic and the practical aspect of it is, the pragmatic aspect is, that you can't administer and you can't politically visualize the Government granting a monopolistic right to its citizens discriminately.

The CHAIRMAN. In this redraft have you provided any way to take care of the contingency which you have suggested?

Mr. DAVIS. Only to this extent, Senator: The bill as it was originally drawn omitted to provide for this compulsory license with respect to devices peculiarly useful in the production of atomic energy, or of fissionable materials, and that has been corrected in here. So that the Commission in any case would be able to say, "Well, you must give the Kellogg crowd, or somebody else, a license to manufacture some of these things for use in the production of atomic energy." That is only a part of it. Your problem is one about which Mr. Kenyon would know much more than I, because during the war every contract of research they made involved this problem, and every agency of Government had a different policy as near as I can find out. The Navy did one thing, the Army did another, and so on. In general the Army—and this is a generalization with a good many exceptions to it—but as near as I can generalize the Army would make a contract which assured to the Government in perpetuity the right to use the invention for governmental purposes, without cost, but left to the originator, like the Kellogg people, the right for private use. I think you will find the bulk of them like that.

But I was talking with Dr. Bush about a case in which they made a contract in some medicinal field, as I recall, for special research, and the results of the research were, by contract, assigned to Dr. Bush, as Director, or to the Government, but under a deed of trust, really. That is, they agreed to assign them to the Government for specified purposes. You will find instances like that.

Now, the Kilgore bill provides, as it is now drawn, that any invention paid for by a Government appropriation for research will belong to the Government, with certain exceptions, and those exceptions amount to this—that the procurement agency can make a special contract where the contractor is putting in his own money, or where the research is in a field in which the contractor has already put in a lot of money. That is left to the discretion of the agency, the agencies being enjoined, however, to observe the general policy of the Government that anything paid for by the Government, by Government money, should belong to it. That is the present form of the proposed Kilgore bill.

Senator AUSTIN. May I ask you if there is any difference in your mind between the relationship of the Government as a contractor to the inventor, and that of the private enterprise to the inventor? Doesn't it all turn upon what the inventor's contract was?

Mr. DAVIS. Yes, it does, Senator, but the law, as you probably know, on that subject, is very trying. The law has always said that a man employed by you to make an invention, which is a little indefinite to start with, but employed for the purpose of developing a certain field, if he makes an invention in that field, then it doesn't belong to you but all you have is a shop right in it, and that really lies back of what the Army did during the war so largely.

In the last war I was in a position, in passing on Government forms—I got in pretty late like everything in the last war, and didn't

begin to regulate anything until the middle of 1918—but I found patent sections that just unbelievably differed. I found, for instance, in many of the departments of the Army, that the contracting officer required the contractor to hold the Government harmless against patent infringement suits. In other departments of the Army the practice was exactly reversed, and the Government guaranteed to hold the contractor harmless.

Then, as you know, they passed an act putting the thing in the Court of Claims, so that you can't sue a Government contractor on a patent now except in the Court of Claims. But it is a very complicated, unnecessarily obscure law, and I think I would answer Senator McMahon's question by saying that this section that I drew up does not deal with that, but if the Kilgore bill does not in itself cover this field, then it seems to me that a similar provision as to Government research, expenditures and patents, should perhaps be brought into this bill. Indeed it is hinted at in this bill, as you know, where you say that in fixing the compensation, the royalty board shall take into account the extent to which Government money has been involved.

The CHAIRMAN. Mr. Davis, going back to your pill-in-the-pail-of-water idea, for the purposes of illustration, I want to see if I understand you correctly, and if I do, a couple of the implications of it. We will assume that John Jones comes along and is successful in dropping the pill in the pail of water and he produces a small gadget which conceivably might take the place of all local power installations in homes and factories and shops. For a period of 17 years he would have America in his back pocket, wouldn't he?

Mr. DAVIS. Yes; that is what I tried to picture on a somewhat larger scale in my electrical field idea. That is a situation where, if it were announced today that the General Electric Co.'s laboratories had discovered something like that, it would blow the roof off the stock market, because every public-service corporation in the country wouldn't know where they were coming out.

Senator HICKENLOOPER. Isn't that pretty well taken care of in this bill, though? In other words, under this bill the Commission would have charge of anything that has the use of atomic energy involved.

Mr. DAVIS. That is right, Senator. Under the bill the General Electric Co., having made that invention, couldn't use it until they got a license from the Commission to get the material. That is the first step.

The CHAIRMAN. And the Commission couldn't grant the license until it had made a study of the social implications and the political implications of the invention and reported them to Congress.

Mr. DAVIS. Yes.

Senator HICKENLOOPER. Traditionally that would probably take a very long time.

The CHAIRMAN. Well, assuming that that would be the result of the General Electric Co. dropping the pill in the pail of water, it might very well take a long time, because otherwise, if you were to spring it on our economy overnight, not only the stock market would go "blooey" but everything else.

Senator AUSTIN. What have you done here, Mr. Davis?

Mr. DAVIS. What I have done here is to say that the Commission, at the time it considers whether to issue a license for use of atomic

material and to allocate the material to the General Electric Co. or whoever it is, shall also have the opportunity to consider whether they should impose upon the patent rights in that case this right to extend licenses to others.

The CHAIRMAN. Now, in this particular case of your pill in the pail of water, if you were running the Commission what would you do?

Mr. DAVIS. Well, my pail of water, Senator, was not something that I thought of as replacing present installations, power installations. The other one was, the power plant. But my pail of water was just something like you would sell to homes that didn't have adequate hot-water systems, just as you now have a little burner that you put on the edge of the bathtub, or what-not. I was trying to imagine something that was not necessary to anybody's happiness, but for which there would be a reasonably good market, and in that case I would say, "Well, let him have his patent," if it was only a patent on the gadget.

The CHAIRMAN. In other words, as you have it written out you leave it within the jurisdiction of the Commission as to whether or not it is important enough for it to be widely disseminated, taking the risk of the loss of—what did you call it, Mr. Davis?

Mr. DAVIS. Enforced diversity of innovation—that is rather a mouthful.

The CHAIRMAN. Leaving that decision to the Commission?

Mr. DAVIS. Yes.

The CHAIRMAN. I take it that you are going to work with the staff on this?

Mr. DAVIS. Yes, sir.

The CHAIRMAN. Thank you very much, Mr. Davis.

The committee will recess until 10 o'clock tomorrow morning.

(Whereupon, at 1:10 p. m., the committee recessed until Wednesday morning, January 23, 1946, at 10 a. m.)

ATOMIC ENERGY ACT OF 1946

WEDNESDAY, JANUARY 23, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to call, at 10 a. m., in room 424-B, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Austin, Byrd, Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

Mr. Secretary, we invited you here this morning to testify on S. 1717, and any comments that you care to make will be welcomed regarding the domestic legislation which is pending before the committee.

Would you proceed in your own way?

STATEMENT OF HON. JAMES FORRESTAL, SECRETARY OF THE NAVY

Secretary FORRESTAL. I am very glad to respond to your invitation to testify before the Special Committee on Atomic Energy of the Senate, limiting, however, what I have to say to the military considerations that grow out of the bill.

I don't believe I am qualified to express views on the other implications of the discovery of atomic energy.

I have considered the provisions of Senate bill 1717 as it relates to the Navy. I concur in the over-all purpose of the bill, but respectfully suggest that certain changes may properly be made.

In its present form, the Navy thinks the bill is not satisfactory in the following respects:

Prestige of the Commission is established by the caliber of its membership. We think that members serving, to quote the language of the bill, "at the pleasure of the President," would carry a connotation of impermanence which would not be desirable and would also limit the dependence of the membership.

The CHAIRMAN. That is the way you serve yourself.

Secretary FORRESTAL. Well, sir; maybe I haven't got prestige.

The CHAIRMAN. I think you have got a lot of it.

Secretary FORRESTAL. We think the outstanding scientific and industrial leaders might be unwilling to serve on these terms. We think that the lack of an executive officer or administrator could profitably be corrected.

We think that while the organization of the so-called Manhattan district into functional groups is logical, that those groups could profitably be coordinated by a single—I don't like the word "coordinator" in that sense.

The CHAIRMAN. A general manager?

Secretary FORRESTAL. Yes; an executive, in other words, who will bring together the functions, the actual working of your functional committees or groups. In fact, we think the fact that there is no mandatory liaison or exchange provided between the State, War, and Navy Departments is a gap. It seems to me, as far as I am concerned personally, that this is so related, just as our military power is inextricably related to diplomatic policy; that certainly this whole subject is one that is tied very closely to the question of military policy and our national policy in the field of foreign affairs.

We think that the fact that the Commission has no specific responsibility for the national defense, while at the same time it is charged with the development of atomic weapons, is not logical. We think that responsibility and the authority for development must go together.

Fissionable materials are required, by section 5, subparagraph (a) (4) of the bill to be distributed to any applicant equipped to observe safety standards and who does so observe them regardless of national interest.

Section 9 (b) (2) of the bill gives the Commission the sole right to determine what information is of value to the national defense. The Commission has no responsibility in matters relating to national defense, and we think that that right and authority are therefore not properly vested in that body.

Senator BYRD. What section is that?

Secretary FORRESTAL. Section 9 (b) (2) of the bill.

The CHAIRMAN. That is on page 17, Senator Byrd.

Secretary FORRESTAL. The positive recommendations we have are as follows:

That there be included as an object, and a provision made for the organization along the lines that were so successful in the Manhattan district during the war;

That a mixed Commission be established of ex officio and full-time members as follows: Vice President of the United States as chairman, the Secretary of State, Secretary of War, and Secretary of the Navy, all acting ex officio;

That four full-time members be appointed for specified terms—6 years in our judgment—by the President.

The CHAIRMAN. Pardon me. You have the Vice President, the Secretary of War, the Secretary of Navy?

Secretary FORRESTAL. And the Secretary of State.

That four full-time members be appointed by the President, with the advice and approval of the Senate, and subject to recall only by impeachment, and that they be eligible for reappointment with a salary substantial enough to enable the man to take such a position to be attracted by it, something in the order of what was provided for the Justice of the Supreme Court.

We believe that the prestige of the Commission would be insured by the fact that members of the Government were included in it, men who are also responsible for the national security and for our

international relationships. The full-time members would provide continuous surveillance of actual administration.

We think, in addition, that that Commission should have an executive director or secretary, or call them what you will, or administrator similarly appointed by the President with the approval of the Senate, to receive a substantial salary and to be charged with the execution—to be specific about it, the preparation of agenda, with distribution of the information to the membership, and with the responsibility of doing the dustpan job at the conclusion of meetings, to see that the decisions made are carried out.

I might add that I think that is essential throughout our entire Government.

The CHAIRMAN. That is the general manager?

Secretary FORRESTAL. Yes; that is correct. There should be provision for continuous transmission of experimental results through Government and industrial agencies which have legitimate claim on that kind of information. The Commission should have the authority to establish safeguards, the authority and duty to establish safeguards against the use of fissionable material in a manner that endangers health. That, of course, is obvious. He should have the responsibility of seeing to it that experiments take place in a properly protected area, or sufficiently remote so that there can be no undue danger of damage to the population.

From 1946 to 1950, in that period, unless the use of atomic weapons is either abolished or controlled by international agreement of a very firm and definitive character, we think that military application of the weapon should be a joint responsibility of the Commission and of the War and Navy Departments, again on the thesis that the responsibility for the national security lies with the military departments, and that this subject cannot be divorced from the general question of national security.

The CHAIRMAN. Now, Mr. Secretary, let me try to understand just what you mean by that. You stated that during the period from 1946 to 1950—I wish you would restate it, because I am getting a little fogged up there.

Secretary FORRESTAL. I might read the entire paragraph. I think what I read subsequently might possibly clarify that statement.

We think that from 1946 to 1950, unless the use of atomic weapons is abolished by international agreement, that the military application of those weapons should be the joint responsibility of the Commission and of the War and Navy Departments. During that period the Commission and the Joint Chiefs of Staff should determine the broad lines along which atomic weapon development is to proceed. In the implementation of those decisions, the Commission should have cognizance of the atomic war-head design and development. By that I mean that part of the weapon which particularly is concerned with the atomic energy application. It is, you might say, like the war head of a torpedo. It should be that particular area of development and design which should be under the charge of the Commission, while the War and Navy Departments should have the duty of the design, the development and the combat use of the vehicle, and the weapon as a whole.

In 1950 that provision should be reexamined in the light of international agreements and the current strategic and technical requirements.

Admiral Blandy, I think, might expand in somewhat more precise language what I mean by that allocation of responsibility.

Senator JOHNSON. Mr. Chairman, will we have an opportunity to interrogate the Secretary?

The CHAIRMAN. I am sure we will.

Senator JOHNSON. He is not leaving?

The CHAIRMAN. No. The admiral will go ahead here, and then we will go back to the Secretary; or would you prefer, Senator, to talk with the Secretary before we start? I am sure either way it is agreeable with the Secretary.

Senator JOHNSON. However it may fit in. I have no preference, but I do have a question or two that I would like to address to the Secretary.

I notice that he says if the atomic bomb shall be abolished by the United Nations. I want to ask him if he thinks it is possible for the atomic bomb to be abolished by anybody unless they are also able to abolish war and all other weapons. The atomic bomb is only one weapon, and I should also like to ask him if he thinks there will ever be another world war in which atomic bombs will not be used, basing that on the fact that the atomic bomb is the most efficient and the least expensive of all war weapons.

Secretary FORRESTAL. It is obvious you cannot abolish either dynamite or gunpowder, and if you have war they will be used. My own view is that it is quite likely that this weapon would be used. In other words, I doubt very much—unless you can cure the fundamental evil of war—whether you can sort of delimit an area for the kind of weapons you will use in war.

Senator JOHNSON. That is also my opinion, and I think it is very harmful to hold out the hope to the people that by some hocus-pocus or resolution, or something of that kind, the atomic bomb can be simply wiped out and forgotten and marked off.

Secretary FORRESTAL. I certainly wouldn't want to give that impression, Senator, either to you or anybody else. I think your point is well taken, but I am speaking for a military department, and I think it would be a disservice to the military establishments to have the impression created that we think there is no hope of ever stopping war. I think there is.

Senator JOHNSON. I think there is a hope for stopping war; at least I hope there is a hope, because of the atomic bomb, among other things.

Secretary FORRESTAL. All we are trying to do here, Senator, is to say that since this country has suffered in the past from the over-optimism about the possibilities of stopping war, all we are trying to say is that you should have protection against the very thing you have in mind. That is what we are really after, not to reach a wishful state of mind where we think that our desires will control human action.

Senator JOHNSON. I am very glad to have that point in your testimony clarified, Mr. Secretary.

That is all, Mr. Chairman.

The CHAIRMAN. I have a few questions, but I think I will wait until after the admiral concludes his statement, unless Senator Byrd or Senator Hart has any questions.

**STATEMENT OF VICE ADM. W. H. P. BLANDY, DEPUTY CHIEF
OF NAVAL OPERATIONS FOR SPECIAL WEAPONS**

Admiral BLANDY. I believe the best way to express what I think about the Commission having the sole responsibility for development of the entire weapon, in case any weapons beyond the atomic bomb should be developed and used, would be to draw a parallel with the torpedo. I don't believe we would want somebody who merely had to do with explosives at the present time to be responsible for and have full authority over the design and construction and production of the entire torpedo, when the Navy had to use that torpedo and had no authority over its design.

There is general agreement, I believe, among military and naval people concerned that there must be a centralized control of the production of fissionable materials so far as the Government is concerned, and the research and development in connection therewith.

When it comes to the applications, the military applications of atomic energy, I believe that the War and Navy Departments should have a greater share in that phase of the matter.

The CHAIRMAN. How would you set it up, Admiral?

Admiral BLANDY. In the first place, a great deal will be accomplished by having the Secretaries of War and Navy as members of the Commission, and then I would have the same type of liaison with the Commission on the part of the War and Navy Departments as was had with the Office of Scientific Research and Development. That worked very well.

In the case of the Navy Department, my own experience was that of Chief of the Bureau of Ordnance during the first part of the war. I had officers definitely told off as liaison officers with sections of the Office of Scientific Research and Development, and they belonged almost as much to the OSRD as to my Bureau. They worked intimately with the scientists who were doing the research and development end of the work.

The CHAIRMAN. Of course there is nothing in the bill as it is now written to prevent the closest liaison between the Army, Navy, and the Commission.

Admiral BLANDY. There is nothing to prevent it, but nothing to require it, either.

The CHAIRMAN. Was it a requirement by law in the Office of Research and Development?

Admiral BLANDY. No, sir; but, on the other hand, they were not given the sole responsibility of developing weapons. That responsibility still lay with the War and Navy Departments. The OSRD was to help, and that is what I think should be the case here, with the proposed Atomic Energy Commission.

But the War and Navy Departments, I believe—I probably should leave out the War Department, because I am speaking only for the Navy Department—should have the final word on the approval of a weapon, as to whether or not it is adequate for its purpose, because

after all they do have the over-all duty of providing for the national defense from initial conception to final use in battle.

The CHAIRMAN. Now, as I understand it, Mr. Secretary, you advocated an eight-man commission: Vice President, Secretary of War, Secretary of the Navy, and Secretary of State, and four full-time members.

STATEMENT OF SECRETARY FORRESTAL—Resumed

Secretary FORRESTAL. Yes.

The CHAIRMAN. To be for a definite term and, without confirmation. That would make a commission of eight, I take it.

Secretary FORRESTAL. Yes.

The CHAIRMAN. Well, as I gathered, your objections to the bill can be summarized as follows:

- (a) That the Commission should be broadened;
- (b) It should be given a full term;
- (c) The membership should be made up partly of Cabinet officers and partly of other full-time appointees.

Of course, the Secretary of War, the Secretary of the Navy, and the Secretary of State would be limited in their period of time to the tenure of the President who appoints them.

Secretary FORRESTAL. Or to his pleasure.

The CHAIRMAN. But you say that the four full-time members would have continuity, and you advocate that. You also advocate the appointment of a general manager, for want of a better term. I think I agree with you, personally, on that.

You also would like to have a specific mandatory liaison between the State, War, and Navy Departments and the Commission working under the bill.

Now, as I get it, those are your objections. Outside of that, you approve of it, do you not?

Secretary FORRESTAL. Well, as I say, I have limited my testimony to the military aspects of the bill. I did not think it was my province, nor do I have the background of knowledge that I think one should have to go into the broader aspects of it, as regards the use of the atomic energy for industrial purposes.

Senator JOHNSON. Mr. Chairman, I would like to ask the Secretary what the philosophy back of making the Vice President a member of this board is?

Secretary FORRESTAL. Simply to identify it somewhat more closely with Government and to raise, if you will, the prestige. I think the Vice President's office still has prestige.

The CHAIRMAN. They have a vacancy now.

Senator JOHNSON. Prestige is all right enough, but you are changing the function of it. The office has no function except to act as a spare tire in case of an emergency, and now you are bringing the Vice President into the most important function, as I see it, of government.

Secretary FORRESTAL. Isn't that a good thing, possibly to increase the scope of the activity of the office of Vice President? After all, he becomes President.

Senator JOHNSON. Well, I doubt that we should by law try to change an office that is set up by the Constitution. That is entirely another question, however.

I just wondered why you bring him into this picture.

Secretary FORRESTAL. Well, we have no pride of authorship about the suggestion. What we are trying to do is be sure that this Commission does not get set up on an academic and remote basis where it is operating without relation to the other parts of the Government. The membership of this Commission could be the occupants of other Federal offices, who could be suitably suggested, I dare say; but certainly the War and Navy Departments definitely should be on. As to the Vice President, I don't have a deep conviction about it. It is a suggestion rather than a deep conviction. The other three are more than a suggestion. I think very strongly they should be on.

Senator JOHNSON. I think there would be very good reason for putting a Public Health representative on there to see that nothing was done that would injure the public health.

Secretary FORRESTAL. I wouldn't quarrel with that, but I would not want to see a commission which could say to the War and Navy Departments, "This is as far as you can go in the development or use of these weapons."

Senator JOHNSON. Your point is, and I think it is very well taken, that it is hard at the moment to separate the peacetime uses of atomic energy from its wartime potentialities?

Secretary FORRESTAL. That is right.

Senator JOHNSON. I think that point is well taken.

Senator HART. Mr. Chairman.

The CHAIRMAN. Senator Hart.

Senator HART. Mr. Secretary, you of course are cognizant of the bill with Senator Johnson's name on it, where the feature, as far as organization and composition of the Commission is concerned, lies in part-time men. The philosophy behind that, as I understand it, is that only in that way can we get certain of the best brains and judgment of the country to work on this problem, because they will not leave their other fields of employment.

My question is, do you think that it would be advisable and practicable to include in this Commission a certain number—probably a minority—of men on a part-time basis along the lines of the whole Commission as it would be constituted by the Johnson bill?

Secretary FORRESTAL. I think that is practicable. I always think in terms of individuals, and I think that your point is well taken. Undoubtedly it would be questionable whether you could get Dr. Vannevar Bush to give full time to this, and yet it would be highly desirable to have men like him and Dr. Conant as part-time consultants or full members of the Commission.

I think there has to be some nexus of permanence that gives this the character, if the implications of this are as serious as the scientists tell us.

Senator HART. I don't think it is out of your field, Mr. Secretary, to ask you also if you think the employment of men of those capabilities and experiences in an advisory capacity as members of an advisory board would be good enough?

Secretary FORRESTAL. It would be very desirable.

Senator HART. Would it be good enough?

Secretary FORRESTAL. I would doubt it. I am impressed all through Government by the constant interruptions, not in policy but

in the mechanics of government. This, after all, is going to be a pretty important part, whether you like it or not, of government. I think there has to be some continuity of organization that will provide, if you will, the factual background for the men who make policies, because I doubt if any man who gives his part-time attention to this can follow it with the closeness that I think it will probably have to be followed.

Senator HART. Do I understand you to say, Mr. Secretary, that you think the inclusion of the men on that basis, meeting a few times a year with the Commission, with expenses and a fee of \$50 a year, would not be an advisable or practicable means of organizing the Commission, in part?

Secretary FORRESTAL. I doubt if it is possible to lay out a chart now that will tell you how you are going to engage the attention and interest of such people. They may have interest, but whether they have time to give to this problem in the detail it will have to receive, is questionable. I doubt whether you could get either Dr. Conant or Dr. Bush. I doubt whether the limitations that are imposed automatically upon them by the nature of their present jobs would give them a great deal of time or allow a great deal of time to be devoted to this project. I think it practicable to have them; I don't see how you would escape having them. They are two of the few people in the country that can speak with informed background.

I think no matter what form your Commission takes, or what body is organized to deal with it, you will have to have recourse to the advice and help of those people.

Now, the tenure or character of their employment and how you work it out, I would be reluctant to try to be precise about. I don't think I have thought deeply enough about it.

Senator HART. That is, you would rather not give your opinion right now as to whether those men employed in advisory boards versus actual members of the committee would be better?

Secretary FORRESTAL. I am inclined to think that I would say you would have to have both.

Senator HART. I have nothing further on that line, Mr. Chairman, except that I wouldn't like the Secretary to be misunderstood. He has mentioned Dr. Bush and Dr. Conant, but of course there have been employed under the Manhattan district leading industrialists, also.

Secretary FORRESTAL. That is another element which I am glad you mentioned, because it is obvious that the complex which produced the atomic weapons that the Army and Navy used is a complex of abstract research and applied research and industrial know-how.

The CHAIRMAN. Mr. Secretary, what we are really doing here is trying to set up what may be a new department of the Government: You wouldn't suggest that the Navy be run with any absentee, part-time, come-lately advisers—"I'll see you a month from Tuesday" stuff. You would want them on the job, and you are on the job; this is your only job and you gave up your private business because you thought you needed to do it to run the Navy; isn't that true?

Secretary FORRESTAL. Yes; that is correct, sir.

The CHAIRMAN. Now, in that capacity as Secretary of the Navy, and overseeing the organization, you reach out and pull in such scientific advice as you need?

Secretary FORRESTAL. Scientific and other; business and educational.

The CHAIRMAN. And that has been what has made the Navy the success that it was in this war. Therefore, I assume that if we set up a commission to run the domestic problem of atomic energy, it would be operated in a good deal the same fashion and the same style, generally speaking. We would reach out for the best advice we could get on the problems they would be charged with. They would do it better, don't you think, if they were on the job and were full-time members?

Secretary FORRESTAL. That is my view. It is my view, provided you have the representation, as I said earlier, of those agencies of Government that have responsibility for our diplomacy and our defense. I would want to qualify it. I would agree with your statement with that qualification.

The CHAIRMAN. This argument that you cannot get men of the proper caliber to take a job of responsibility doesn't strike a very sympathetic chord with me.

Secretary FORRESTAL. Most able men, Senator, have many demands on their time. I have certainly found, as I think you have, that the men you want are always in demand in many fields.

The CHAIRMAN. That is true of the secondary positions, but not with the top positions. There is still, I think, enough honor left in top positions in our Government to get good men. Otherwise we would be in a bad way with the next Supreme Court vacancy; we just couldn't fill it.

Senator BYRD. Mr. Chairman.

The CHAIRMAN. Senator Byrd.

Senator BYRD. Secretary, I was called out for a few minutes. Did you deal with section 6 on page 12, the military application of atomic power? Does that section meet with your approval?

Secretary FORRESTAL. Well, it has, provided that the nature or constitution of the Commission includes the people in Government who are responsible for the use of weapons and the national security.

Senator BYRD. They will be in the minority, won't they, even by the suggestion that you made in changing the Commission? In other words, is the Army and Navy willing to turn this over to what we might term "a civilian commission" to decide whether or not the atomic bomb shall be manufactured or used?

Secretary FORRESTAL. It is not.

Senator BYRD. Even with your suggestion, doesn't this bill do that?

Secretary FORRESTAL. Well, we were trying to suggest modifications.

Senator BYRD. You only suggest how many military members.

Secretary FORRESTAL. Four, the Vice President and Secretaries of War, State, and Navy.

Senator BYRD. The Vice President isn't a military man, and we have no Vice President now, anyway, and cannot have one for 3 years.

Secretary FORRESTAL. As I said, our suggestions were directed mainly to getting into this Commission members of the responsible Government departments.

Senator BYRD. Don't you think one of the vital questions involved in this legislation is to what extent the military will be subordinated to any civilian commission in the manufacture and use of atomic bombs?

Secretary FORRESTAL. Well, we certainly have great reservations on that.

Senator BYRD. This section takes it completely out of the hands of the Army and Navy, as I read it, and leaves it to the Commission.

Secretary FORRESTAL. Our suggested modification maybe does not meet your point. It certainly is an improvement.

Senator BYRD. You suggest three military men; the Secretary of the Navy, Army, and who else?

Secretary FORRESTAL. The State, because this has a diplomatic implication.

Senator BYRD. Three out of five. That still does not answer the question whether this power of decision should rest or should be taken away from the Army and the Navy who are primarily responsible.

Secretary FORRESTAL. Possibly I am counting on the fact that the authority and prestige of the people who speak for those responsible departments of government could not be ignored.

Senator BYRD. Well, is the text of this satisfactory to you with these other changes that you mention in regard to the appointment of the Commission? That goes pretty far, as I read it.

Secretary FORRESTAL. I have sufficient confidence that if this were broadened to include those individuals, I would be; after all, we are trying to make suggestions to a bill to bring it into conformity with the protection we think is necessary. I wouldn't want to appear here just in a state of flat negation. We are trying to make suggestions which we think will modify it sufficiently to give protection.

Senator BYRD. To my mind, that is a very vital question that must be decided.

Secretary FORRESTAL. I agree with you, Senator; there is no question about it.

Senator MILLIKIN. May I ask, Mr. Secretary, would the Navy object to keeping this under the exclusive control of the military for a further temporary period?

Secretary FORRESTAL. Of course not. It wouldn't.

Senator JOHNSON. Mr. Secretary, I notice that you have an equally divided situation here through your recommendations, an eight-man board. What is the reason for an eight-man board instead of an odd-number board where you would have a majority vote? Perhaps I haven't understood your proposal, but that is the way I understand it.

Secretary FORRESTAL. All we are addressing ourselves to is the desirability of getting military and other governmental representation on this Commission. As to its numerical composition, I wouldn't stand on eight, seven, or nine, but I do feel most strongly, as I say, that the military departments of the Government should have a voice in this Commission.

Now, as to the character of that voice, its extent, it is for your committee to determine; but I submit that it would be, in the present state of the development of this weapon, unthinkable that the users of that weapon shall not be represented.

Senator JOHNSON. Well, in view of all the testimony of scientists, mostly, of course, your position is absolutely correct. Up to the present moment there has been no plan advanced here, even by the scientists, where the military aspects of atomic energy can be separated from

its peacetime uses, except the very vague hope that maybe something can be worked out to change human behavior, and all that sort of thing, and make it safe to close their eyes to its military uses, and launch a domestic and peacetime use.

Secretary FORRESTAL. Along the same line of your thoughts, it is obvious that we have laws against murder, but people still have revolvers, and sometimes use them.

Senator MILLIKIN. Mr. Secretary, would you advise that in our own consideration of what to do about this thing we give very careful consideration to the state of world affairs to determine in our own minds whether we have reached a point where the important nations can cooperate with each other peacefully?

Secretary FORRESTAL. Well, that is fundamental, Senator.

Senator MILLIKIN. I had hoped that you would say that.

Secretary FORRESTAL. Well, I speak for a military department, and I would not want to give the public the impression that we think only in terms of the use of military force as the only means of securing peace for the world. I agree with your implied statement.

Senator MILLIKIN. I put my questions very carefully so as not to embarrass you in that particular.

Secretary FORRESTAL. My hopes are the same as yours and everybody around this table; but we cannot, as I say, wish ourselves into Paradise.

Senator AUSTIN. Mr. Chairman, I have just one question.

The CHAIRMAN. Senator Austin.

Senator AUSTIN. Mr. Secretary, don't you think that this committee ought to keep a little something in reserve here so that if the Congress should set up a military department in which there would be a munitions board, that the control of the military aspect of this energy could be fitted into that munitions board?

Secretary FORRESTAL. For the reasons that Senator Hart advanced, the industrial aspects of this development, I think your thought is an excellent one.

Senator AUSTIN. That is all.

The CHAIRMAN. Mr. Secretary, and Admiral Blandy, too, if you wish to answer this, on page 12 under the "Military applications of atomic power," do you approve of section (c) of the proposed bill, which provides that the President must give his consent and direction each quarter for the amount not only of fissionable materials that may be produced, but the amount of atomic bombs, bomb parts, and other applications of atomic power?

Secretary FORRESTAL. I would like to respond to that first, Senator, and then I would like Admiral Blandy to comment.

I think it is dangerous to assign responsibility of that character to the President, which must necessarily be exercised vicariously. I mean by that that it seems to me it would be quite difficult for him to act under that clause intelligently except on the advice of some other agency. Now, shall that agency be this Commission, or the War and Navy Departments?

If it is this Commission, that strengthens my statement that that Commission should have representation from the security departments of the Government.

The CHAIRMAN. No, Mr. Secretary. I presume the President, being directed to exercise an independent pact, would make that

decision from advice that he might receive from a dozen different sources. My point is that the decision to make atomic bombs and bomb parts is not a decision which any person is going to exercise vicariously. It is going to be one of the most, if not the most, important decision that he as President makes. I wanted to find out what you thought of putting the responsibility on the President of the United States as to just how much we are going to do in the way of making destructive devices.

Secretary FORRESTAL. I think it puts a burden on them which is too great for them to discharge. I go back to one President who once discharged, I think, his Chief of Staff over war plans, and within a very short time afterward we had to have war plans in the most explicit form. That was some years ago, so it is not recent history.

I just wouldn't want to take a violent position for or against, but now that you call my attention to it, I must confess I have misgivings on it.

I would like Admiral Blandy to expand on that.

Admiral BLANDY. I don't think that is a very workable provision from the standpoint of smooth operation. It is a sort of staccato piece of music to have this recurrent consent every quarter. I don't think you could have much of a continuing policy on development in that way, but I do recognize that if the President is to have this veto power, he could exercise it at any time—for instance, in response to a ratification of an international agreement either abolishing atomic weapons or limiting them.

Senator HART. Admiral Blandy, do you not think that it would be necessary to divide that problem into two categories, one, the production of fissionable material, which as we all know is a continuing process and not something that can be turned on and off at a moment's notice, whereas the actual construction of a bomb possibly could be turned on and off as we like. We cannot do that with the fissionable material itself, can we?

Admiral BLANDY. No, sir. As I say, it would be very unsatisfactory both for a development program and a production program to have this stop-and-go sign reversing every quarter.

Senator HART. Can you not separate in this problem the construction of the bomb itself from the production of fissionable material, which is a different kind of a process?

Admiral BLANDY. If I understand you correctly, Senator, you mean that this might not apply to the construction of the bomb, but only what we might call the atomic part of the bomb?

Senator HART. Well, we can turn the spigot on and off in the bomb assembly lines.

Admiral BLANDY. You can do it, but it isn't a satisfactory way of manufacturing, of course.

Senator HART. Can you do it at all in the production of fissionable materials at 3-month intervals?

Admiral BLANDY. I am not qualified to answer that, sir. I would rather leave that to someone in the Manhattan district.

Senator MILLIKIN. I think other testimony has indicated it is not practicable.

Admiral BLANDY. I believe so, but I did not want to put myself on record as being an expert in the production of fissionable materials.

Senator BYRD. It was also testified, as I recall it, that if you manufactured the plutonium, or whatever was necessary to operate a great power plant, that that could be converted into a bomb in 3 months' time. You could take that same mass of material and convert it into a bomb. That was 70 or 80 percent of the actual completion of the bomb.

That is correct, isn't it, that the same material can be used?

Admiral BLANDY. I understand so, yes.

Senator BYRD. If you operated a power plant on a large scale, for instance.

Senator HICKENLOOPER. Mr. Chairman, may I ask Admiral Blandy a question?

I will put this question a little more concretely, Admiral. I would like to ask your opinion on this.

Would it be more practical and feasible if the bill provided, for instance, that either the President or some other proper agency would designate the amount of fissionable materials or the activity of this Commission for production for a whole year at a time, giving notice, say, 6 months prior to the beginning of the production period?

In other words, lengthening the time of notice and then giving a much greater period for production than snubbing it right down to a quarter, each 3 months.

Admiral BLANDY. I think that would be a much more practicable scheme.

Senator HICKENLOOPER. It is my understanding, from testimony here, that it is completely unworkable to have quotas, at least if they are varying quotas prescribed each 3 months, that the whole operation and production program is just not suited to that kind of operation. I don't know, but we have had some testimony along that line. I merely wanted to get your personal opinion on the matter, if you care to give it.

Admiral BLANDY. I think that would be, as I said, a much more practicable scheme. As a matter of fact, through appropriations, the Congress could exercise a good deal of authority in the actual production, also. That is handled on an annual basis—at least it is in the War and Navy Departments.

Senator MILLIKIN. The Congress traditionally exercises complete control over the supply and maintenance of our ordnance.

Admiral BLANDY. Yes, sir.

Senator MILLIKIN. Yes, and we do it under the Constitution. There is no reason that has been developed why the Congress cannot determine whether we are going to make bombs or not make bombs in the same way it determines whether you are going to build a battleship or not build a battleship.

Admiral BLANDY. If it were placed on an annual basis, I believe that would be the preferable method, to leave it to the Congress.

Senator MILLIKIN. It certainly would be unprecedented to give the President authority to determine a battleship program. It never has been given. There may be some limitations or some delegations of a certain amount of discretion in the matter, but the Congress lays out the military program, at least in its broad outlines.

Senator HICKENLOOPER. Mr. Chairman, it is my understanding that in 1934 the Congress authorized the building of the Navy up

to treaty strength, 5-5-3 strength, and put the procedure and method in the hands of the President; but that was a specific proposition.

Senator MILLIKIN. That was direct authority to the Navy to accomplish a certain objective by a certain time. That is precisely what I am talking about. By the same token we could, if we wanted to, prescribe the same sort of directive and the same sort of limitations on the atomic bomb.

Admiral BLANDY. I think it would be preferable.

Secretary FORRESTAL. I will say, Mr. Chairman—if I might boil my view down to this—that with a thing that is charged with such tremendous fantastic implications as this atomic energy, it is too important a subject to be left only to the military; but I think it is equally fantastic to conceive that it be left solely to an agency in which the military had no voice.

Senator HICKENLOOPER. Mr. Chairman, I am sorry I was late, but I would like to ask the Secretary a question which I believe he touched on in his statement.

Yesterday I suggested that at the present time, at least, it was my view that any commission that is set up should have representations in authoritative positions of several categories. I might not limit them to any particular ones, but to me science should be represented by a capable man. The technical end of production, such as engineering, should be represented. Certainly, I believe, someone who knows something about foreign situations should be represented. I think the public should be represented, and above all, at least in this temporary bill, most everyone admits that our legislation now is bound to be temporary because we don't know what the future holds; I think that for at least that time until we are assured that the bomb will be outlawed among nations, that those charged with the national defense—which means the armed forces—should have an equal representation among others.

There might be one or two other categories.

Secretary FORRESTAL. You have expressed, Senator, much better than I have, what I have been trying to suggest.

Senator HICKENLOOPER. I thought I saw a statement on that here, but I didn't have time to go over it.

Secretary FORRESTAL. We suggest that the State, War, and Navy be members of this commission.

Senator HICKENLOOPER. My suggestion of yesterday didn't quite go to designating the State, War, and Navy, but at least that those two fields of national responsibility be represented equally on this commission.

Secretary FORRESTAL. Well, our feeling is precisely as you have expressed it.

Senator HICKENLOOPER. Thank you.

Senator BYRD. Mr. Secretary, at the top of page 12—

The Commission is authorized and directed to—(1) conduct experiments and do research and developmental work in the military application of atomic power * * *

Is it your understanding that that would be done by the military authorities, or would be done by some agency that this commission would set up?

Secretary FORRESTAL. I would think it would have to be done under the guidance and direction of the military authorities using, as they had to use during this last war, all the elements of technical abstracts.

Senator BYRD. It seems to me a mistake to leave any loophole here whereby another vast organization can be set up to do this experiment and research work.

Secretary FORRESTAL. We wouldn't want an agency to develop submarines for the Navy. I should think the Navy must have the right to select its weapons.

Senator BYRD. And subsection (b):

The Commission shall not conduct any research or developmental work in the military application of atomic power if such research or developmental work is contrary to any international agreement of the United States.

Do you construe that to mean that agreement would be such an agreement as would have to be confirmed by the Senate?

Secretary FORRESTAL. I should think that language would have to be examined and written very carefully.

Senator BYRD. I certainly think that should be clarified. An agreement with regard to the use of the atomic bomb is one of the most vital questions.

Secretary FORRESTAL. There again, who makes the determination as to whether it is contrary to international agreement? Where does that power reside?

Senator BYRD. I think it should be written in there, "Such agreement confirmed by the Senate." There are a lot of international agreements, a great many that don't come before the Senate.

Secretary FORRESTAL. To reinforce your thought on it, I do not know that there was ever a specific agreement about the way in which submarines were to be used, but there was certainly an agreement that was not kept in two wars.

Senator BYRD. I, for one, would not be willing to set vast power which may mean the future destruction of this country in any department of the Government. I think there ought to be such an agreement that would be, in its language, confirmed by the Senate. Is that your opinion about it?

Secretary FORRESTAL. I think it is a very well taken point. I would like to think on it.

Senator BYRD. We ought to have such safeguards as we can around such an agreement.

Secretary FORRESTAL. I will say this: You must not limit the development until the world has got the pattern we are hoping it will achieve. You must not limit or put hampering strings around the military responsible people for the development of weapons.

Senator BYRD. Does the chairman regard the words "international agreement" to mean such an agreement as would be confirmed by the Senate, or some agreement made by one of the agencies of the Government?

The CHAIRMAN. I would think, and have taken the position all along in my thinking on this and in the former bill, the first bill ever introduced on this subject, that it would have to be agreed upon by the Congress of the United States.

Senator BYRD. You mean both branches?

The CHAIRMAN. Both branches.

Senator BYRD. And not be in the nature of a treaty, then?

The CHAIRMAN. I don't see the necessity for it, personally. I, however, am one of those who believe I would like to have inter-

national agreements ratified by a majority vote of both Houses rather than a two-thirds vote of the Senate.

Senator BYRD. I imagine you would make this to clarify that in one way or another?

The CHAIRMAN. Yes; I would be glad to clarify it.

As far as I am concerned, it could read, "Any international agreement of the United States which has been approved by the Congress of the United States."

Senator JOHNSON. Mr. Chairman, if the Secretary will permit me, I should like to go back to the difficulty of dividing the wartime uses from the peacetime uses of uranium or atomic power. The scientists told us that when you used uranium for power, you were 75 percent on the way to its use as a bomb. In other words, when we use coal for power, the ashes are practically worthless; but when we use uranium for power, the residue is the very thing that we need to create bombs. That makes all the difference in the world, and so the two are tied together so closely that we ought to recognize that fact in any legislation which we propose, which we handle.

Secretary FORRESTAL. There is no question about that.

Senator JOHNSON. 75 percent means the assembling of the uranium, the mining of it, the assembling of it, the processing of it right up to the point where all it requires is the chemical action, and then you have your bomb.

Secretary FORRESTAL. I don't know what you mean, Senator, that at this time it is inseparable. Certainly it hasn't reached any stage yet where you can separate it.

Senator JOHNSON. That is correct. We all hope there will be some way of separating them, although nothing appears any place to base that hope on at the moment.

Secretary FORRESTAL. My own very sketchy knowledge on the subject certainly conforms to your impression.

Senator JOHNSON. I think that is such a fundamental point that I hope the chairman and the committee will pardon me for bringing it up so often here.

Secretary FORRESTAL. That is why I said that the complex that makes the bomb is the composite of abstract research and implied research and the industrial complex that produces it, and it is not divisible at the moment.

Senator HART. Has the Secretary finished his statement?

Secretary FORRESTAL. I have, sir.

Senator HART. Mr. Chairman, I would like to ask him something in a different and somewhat less important field.

A moot question in anything that we do concerns the spread or the nonspread of information on atomic energy and secrets vital to the country, and their various solutions.

The bill which my colleague introduced mentioned on page 5, in the first paragraph, the—

dissemination of scientific or technical information, except to the extent already required by the Espionage Act.

I am certain, Mr. Secretary, the Navy Department has had experience with the workings of the Espionage Act, and my question is whether or not you think that that act is sufficient, as of now, for your purposes?

Secretary FORRESTAL. I would doubt it. I would want to refresh my reading of the Espionage Act, but I think it is too elastic to give protection under that wording.

Senator HART. Can you go any further in that, Mr. Secretary, as regards experiences of the last war?

Secretary FORRESTAL. You mean the war just finished?

Senator HART. Yes.

Secretary FORRESTAL. Well, we know that there has been dissemination, all right; that has occurred. But I think I would like to respond to that in writing, Senator, because it is a question I should not answer lightly.

The CHAIRMAN. I think, Mr. Secretary, it might be well when you do that, if you don't think the Espionage Act as it is now written will cover the subject, to suggest what amendment to the Espionage Act would cover the subject, because we have got to have, it seems to me, some definite tying post, some place to start from, some base.

Senator AUSTIN. Mr. Chairman, let me recall to your memory that this Espionage Act has been before the Congress many times during the past few years, and very good causes for amendment of it have been presented.

I have not been a member of the Judiciary Committee for about a year, but before that for many years I had to do with that problem as a subcommittee man of the Committee on the Judiciary. I should think it would be a very troublesome thing to attach to this bill the burden of amendment of the Espionage Act, basing my opinion on that experience. I would advise against it, and think, rather, that the suggestion of the Secretary of the Navy should be some specific exceptions rather than amendments to the Espionage Act.

Secretary FORRESTAL. I am inclined to agree with you, Senator. I wouldn't feel qualified to rewrite or suggest the rewriting of the Espionage Act, in the light of this legislation. I wouldn't want to have that assignment.

Senator AUSTIN. It would be very difficult.

The CHAIRMAN. Of course, under the bill, Mr. Secretary, the Commission has the power to write regulations imposing further restrictions on dissemination in addition to those provided for, or that might be provided for, by the Espionage Act. The only restriction on that is that the President must approve those regulations and restrictions.

Secretary FORRESTAL. I must confess that I am a prejudiced witness because I have in mind the difficulties we had in operating prior to the beginning of this war in dealing with Japanese observation. I am all for the minimum amount of espionage in this country. We pay a high price for a thing I think we should preserve, but it lends force to your observation. Senator Hart, I know, believes more than I that we could not enforce any of the normal precautionary measures that you would take for the security of our fleet in the Pacific.

The CHAIRMAN. I want to call your attention to subparagraph (5) on page 18, which provides:

(5) whenever it will facilitate the carrying-out of the purposes of the Act, adopt by regulation administrative interpretations of the Espionage Act except that any such interpretation shall, before adoption, receive the express approval of the President.

Of course, it is for a lawyer to determine how much that permissive authority would extend as against the Espionage Act itself. I wouldn't know. The Navy and Army have worked during the war on the powers to make regulations, and there are plenty of people in the hoosegow now because of your regulations.

Secretary FORRESTAL. During the war, Senator—not before the war.

Senator HICKENLOOPER. Mr. Chairman, I might observe from my reading of that it would seem to me that that section is not desirable, because you are putting into the hands of the Commission the interpretation of a criminal statute and making that interpretation in turn a criminal statute. It would seem to me that that is the province of the court. The Espionage Act is a criminal statute, and this says that the Commission can interpret the Espionage Act, and that then becomes the final statute.

The CHAIRMAN. The difficulty in the Espionage Act is the classification of material that is subject to it, and by regulation you could classify the material with which, if there was any interference, immediately a violation of the act could be had.

Senator HICKENLOOPER. That is true, but this is a very broad provision indeed. It says:

(5) whenever it will facilitate the carrying out of the purposes of the Act, adopt by regulation administrative interpretations of the Espionage Act except that any such interpretation shall, before adoption, receive the express approval of the President.

That to me, at least, is revolting against a fundamental of criminal procedure and our concept of criminal law.

The CHAIRMAN. That is what the Army and Navy have done under the war power, and that is how they maintained their secrecy requirements that the exigencies of wartime have demanded. That is how they operated, and that is how they are operating now.

Senator HICKENLOOPER. Morally, I might approve of their action; as a fundamental American policy of jurisprudence, I would condemn it in peacetime.

The mere fact that they have done it during wartime as a matter of necessity, as I say, might in the emergency meet with approval, yet I think we are on dangerous ground in writing that into a permanent statute, a permanent peacetime policy of the American legal structure.

Secretary FORRESTAL. I think, Mr. Chairman, that, after all, laws and their enforcement do react to the climate of opinion during which they are enforced, and the atmosphere of opinion during the war was very far remote from what it is normally in the American public minds, thank God, in peacetime.

Senator HICKENLOOPER. I might say this as further explanation of what I mean: The Attorney General has been given the right to examine—and we assume that he examines carefully—various statutes for interpretation. Without exception, so far as I know, when he interprets the statute he gives an exhaustive opinion of that statute and what it means. That, however, is in turn subject to review and determination by our courts.

This is an administrative interpretation of a criminal statute that is not subject to the review and determination of any court system.

The CHAIRMAN. Oh, yes.

Senator HICKENLOOPER. Just the President.

The CHAIRMAN. Oh, no. After all, you have got to charge him with this, and then he is going to come to court. That is for the courts to determine.

Senator AUSTIN. Mr. Chairman, if we should have such a set-up as I gather the Secretary of the Navy has advocated here, which is a sort of council of common defense, that includes State, War, and Navy, what would be the difficulty of describing the things proscribed in some such way as this?—reading at line 8, page 5:

but shall not contain any provisions or conditions which prevent the dissemination of scientific or technical information, except that proscribed by the Council of Common Defense.

Then it wouldn't be in a box of trying to interpret the Espionage Act, and would not be left to the limitations of the Espionage Act, and you would be in a position to adapt yourself to the changing scene. That is, what might be dangerous at one time would not be dangerous at another time.

Secretary FORRESTAL. In other words, you would make a positive affirmation of what you could give out, rather than saying what you couldn't?

Senator AUSTIN. Yes; it seems to me so. However, that is just a thought to work with.

The CHAIRMAN. Of course, the whole effort, Senator, I think you agree, should be to get out as much scientific information as we can without hurting the country's security, and I personally do not like to put within the hands of the military the sole determination.

Senator AUSTIN. It wouldn't be if you follow the thought of the Secretary of the Navy, namely, you have got the combination of State, War, and Navy in his picture here.

The CHAIRMAN. Oh, you mean the board?

Senator AUSTIN. Yes; exactly.

The CHAIRMAN. Not the Board of National Defense as you call it, but you mean the Commission as made up?

Senator AUSTIN. I am not undertaking to crystallize this into a definite term. I made an illustration of a council of common defense, that is all.

The CHAIRMAN. It has other applications than the thing we are talking about?

Senator AUSTIN. Yes.

The CHAIRMAN. Are there any further questions of the Secretary?

If not, Mr. Secretary, thank you very much for coming. I don't know whether we are going to see you tomorrow morning or not, but I understand that we have room 312, which is the Finance Committee room, for our meeting tomorrow morning, and I understand that Admiral Blandy is going to testify about the tests that will be made.

Secretary FORRESTAL. That is correct, sir. Thank you, Mr. Chairman and members of the committee.

The CHAIRMAN. Admiral, do you have any more to add?

Admiral BLANDY. I have nothing further to add.

The CHAIRMAN. I think the committee is through with you for the time being. We will be glad to see you tomorrow.

Admiral BLANDY. Thank you, sir.

The CHAIRMAN. Mr. Secretary Ickes.

Mr. Secretary, you have a prepared statement, and I believe each member of the committee has been given one. You can proceed, sir.

**STATEMENT OF HON. HAROLD L. ICKES, SECRETARY OF THE
INTERIOR**

Secretary ICKES. Mr. Chairman and gentlemen, I am very glad to pay my tribute to the important public service that this committee is rendering. It is easy to become hysterical over the real dangers that are inherent in our conquest of the atom. A few months ago it looked as if the urge to do something, no matter what, might saddle us with short-sighted legislation drafted under emotional stress. At that point this committee wisely insisted that just because this problem had such breath-taking dimensions, it required the most thorough and painstaking analysis that the legislative organs of our democracy could give it. As the result of that wisdom, we are able today to consider a bill which is carefully designed to safeguard the progress and the freedom of science while maintaining the integrity and supremacy of civilian government.

These objectives of S. 1717 are close to my heart. I am entirely in accord with their major implications.

I quite agree that our national safety and our industrial progress depend upon our doing the biggest job of scientific research that has ever been done in the world; that we cannot leave that research to private initiative and industry; that the Federal Government, with all of the aid that it can get from the colleges and private laboratories, must shoulder the main burden of that task, while leaving free and untrammelled the road of private scientific research; that the Government must be empowered to maintain full access to all private scientific developments in this field, to own all patents and materials, and to control all military and industrial applications of atomic energy in such a way as to protect the public safety; that at the same time the Government must give increased attention to the social and economic possibilities, as well as to the physical and medical implications of atomic fission; that any control agency set up in this field should be responsible to the President of the United States and not to an irresponsible supergovernment; and that whatever is done by such a control agency must be open to the broadest scrutiny and congressional supervision based upon the regular and detailed reporting of agency activities. A democracy cannot afford to keep secrets from itself.

If I disagree on some of the detailed aspects of this proposed legislation I know that you will take such disagreement as a part of the democratic process to which the efforts of this committee are directed and out of which can come something better than any one of us alone could have devised.

Scientific progress and scientific freedom are indivisible. That, I take it, is the underlying theme of S. 1717. We cannot advance the cause of science and civilization by making research a crime. Under this bill it would not be necessary for a student of physics to secure permission from an Army officer if he wished to discuss with his colleagues, let us say, the effects of nuclear bombardment on the neptunium atom. That cannot be said of some other bills which have been introduced in this field.

We have often been told that the price of liberty is eternal vigilance. We have not been told often enough what the returns on that investment amount to. I think that it is only timely to observe that we in the United States today have the highest standard of living in the

world and our people today enjoy the greatest measure of security possessed by any people in the world, largely because of the freedom with which scientists, explorers, engineers, and technicians of many races, creeds, and national origins have been able to meet on our soil, to think unpopular thoughts, to try out unorthodox ideas, to explore with imagination and develop with ingenuity our natural and human resources. From the days when the refugee du Ponts first settled here, at the invitation of Thomas Jefferson, to the arrival of those great refugee scientists who played so preeminent a role in the conquest of the atom, Einstein and Fermi and their many distinguished collaborators, we have been not only safeguarding liberty but enjoying its rich fruits. I hope that the day will never come when the thinking of scientists is so hedged about with petty restrictions that, as happened in Germany and Italy, foreign scientists will not want to come here and our own scientists will not want to stay here. And so I am grateful to this committee for its efforts to maintain the freedom and the progress of American science.

Let me add that I think that the distinction is wisely drawn in S. 1717 between the realm of discussion and experimentation, where freedom is the only safe rule, and the realm of applied technology, where, in a matter that involves the national safety and welfare so vitally, social control is essential. The control that S. 1717 would impose upon the commercial production of fissionable materials and their utilization in industrial channels seems to me to be entirely justified. If the push of a button can destroy a city, no nation can afford to leave the button in private hands. That would amount to an abdication of sovereignty.

I said a moment ago that this bill is designed to maintain the integrity and supremacy of civilian government. That seems to me to be a matter of very great importance. The scientists who have worked on atomic fission tell us that there is no specific military defense against atomic bombs, and that within 2 to 5 years other nations will probably be in a position to make them. I am impressed with that prediction because I recall that in November 1941, shortly before Pearl Harbor, when most of the scientific and technological problems of atomic bomb manufacture and even of plutonium production and U-235 enrichment were still unsolved, some of these same scientists predicted that the first atomic bombs would be produced between November 1944 and November 1945. They were right. So I assume that they may be equally right now, when they predict that other countries will have such bombs in less than 5 years.

We have, then, only a little time in which to negotiate with other nations for a security which cannot be achieved by a monopoly of knowledge or by specific military defenses, a security which must be based upon the international sharing of knowledge and adequate international inspection and policing. That kind of agreement can better be achieved if the control of atomic energy is in civilian rather than military hands. I do not blame the military for suspecting and preparing for the worst from all other nations. That is its job. But you cannot successfully negotiate an international agreement unless you start with the assumption that it will be advantageous to all of the parties concerned.

If you look at this problem of atomic energy only through military binoculars all that you can see is the threat of future wreckage, to

which the only answer is more wreckage. Even the destruction of enemy cities at the outbreak of a war would not provide an adequate defense. Presumably enemy storage and transmitting areas may be located in uninhabited sections of desert or ice or water, deep underground and relatively immune from attack. If we want security for our homes and our children—not just the uncertain satisfaction of hoping that in an atomic war we might kill sooner more of the enemy than they could of us, we are going to have to gain that security by working out arrangements of mutual advantage with other nations. Nor will that job be facilitated if we make atomic energy control a function of the military.

I suppose that there was a time when electricity was almost as terrifying as atomic energy is today, and I am pretty sure that if we had proceeded to treat electricity as a military secret we would have succeeded only in retarding our development as a nation. We need to have civilian control of atomic energy in the interest of the development of our Nation and of industrial and medical progress, as well as in the cause of world peace and true national security.

According to an old Chinese proverb, the first result of a war is that the adversaries exchange vices. I hope that the first result of our victory is not going to be an imitation of the Japanese system in which the military controlled industry, government, and science. As I see it, that arrangement had disastrous results for Japanese industry, government, and science, as well as for the Japanese military. Some of the bills that have been introduced on the subject of atomic energy would take us a long way along the road to Tokyo.

So much for the general objectives of S. 1717, with which I am in complete sympathy. On the proposed machinery for achieving those objectives, I have some doubts and suggestions to present to this committee.

In the first place, I think that the idea of setting up an independent board, unconnected with existing departments of the Government, to handle the problem of atomic energy is unsound. Atomic fission is too big a matter to be set off in a field by itself with a fence around it and separated from the problems with which the regular departments of the Government have to deal. Atomic energy is part of the larger problem of energy, and its development vitally affects what we are to do with our oil, coal, and water power. Atomic energy puts new values upon our public lands and our mineral resources. It profoundly affects our industrial potential, our standards of living, our international relations. If the departments of our Government are to leave all of these implications of atomic energy to an independent board of atomic experts, the established departments of Government—including the Departments of State, War, Navy, and Interior—through which the Nation has from its beginning accomplished its important business, will be shunted aside and our major national responsibility committed to a new and untried board. This board would undoubtedly be or become expert on atomic energy but I believe that it would take years, if not decades, for the board and its staff to acquire a feeling for the duties and responsibilities of government.

In the years that I have spent in Washington, I have seen a good many problems arise that looked on their face as if they were brand new. The natural impulse in such a situation is always to set up a

new kind of organization to deal with the assumed new problem. But in the end it generally has developed that the problem was not quite so new as was supposed, and that established agencies of Government had been working in the same field. In such a situation it has become necessary to set up a coordinating agency to coordinate the new agency with the old agencies and perhaps a few liaison officers to coordinate the coordinators, and then maybe a few top-level "super-dupers" to get the whole thing straightened out.

Now, the development of atomic fission is a great scientific advance which is bound to change the fabric of our daily lives. But it is neither the first nor the last such advance. In the space of our national existence the jump from manpower and animal power to steam power and electricity, in the fields of production, communication, and transportation, was wholly revolutionary, yet we did not find it necessary to set up a special Federal department of steam or electricity or to alter the essential form of our Government to meet the problems thus created. After all, the form of our Government was set to meet and conquer new problems arising from all directions, many of them unforeseeable. The matter of opening the country to railroads and telegraph lines in the last century, a task never envisioned by the founding fathers, was largely handled by the Department of the Interior. Other essential problems created by the conquest of steam and electricity were handled by various of the departments of the Federal Government.

It is easy to forget that the progress of the sciences and the useful arts was one of the objectives to which our form of government was expressly dedicated by the founding fathers. I shall not take the time of this committee to rehearse the many great scientific and engineering advances that have been sponsored and aided by the Federal Government. I content myself with saying that if the existing governmental departments that are properly concerned with international relations, military defense, natural resources, power, and technology, are not qualified to carry on with the problems of an atomic age, they ought to be abolished; otherwise they ought to participate, within their appropriate fields, in the control of atomic energy. I therefore believe it important to orderly government that there be a single administrator responsible to a committee of Cabinet officers, appointed by the President, carrying out those responsibilities set by S. 1717 that do not fall within the jurisdiction of any single existing department.

If, however, in the judgment of your committee, it be essential that the public interests have other representation, I would then urge that consideration be given to the establishment of a board of nine members, including five or six heads of departments and four or three independent members. I have already made such a suggestion to the Kilgore committee in connection with the proposed national science research foundation bills, and your committee may wish to consider the application of that recommendation to your own special problem. I note that one of the bills before your committee, S. 1557, provides for a membership of five Cabinet officers, the Secretaries of State, War, Navy, Interior, and Commerce, and of four members at large employed on a per diem basis. That seems to me to be a mistake. If there are public members, they should be full-time public members without outside personal business interests. The United States is entitled to undivided loyalty.

I think, too, that whatever the membership of the control agency may be, it is essential that the board's executive authority be centralized in a single administrator. Multihheaded boards are fine for discussion, and they may be well suited for judicial or quasi-judicial jobs that require no initiative on the governmental side. But they just won't do the work where you have a task that requires drive, initiative, and direction emanating from a central authority while coordinating the efforts of a great staff. A control agency cannot possibly coordinate its staff if it is moving in two or three different directions itself at the same time.

Other suggestions that I have to offer with reference to the provisions of S. 1717 go to matters of detail. There are several points at which the bill seems to me to need clarification or strengthening, if it is to achieve the objectives to which it is directed.

For one thing, I am troubled by the provisions of section 5 which make it a crime for me or for anyone else to own any fissionable material. I do not know whether there is any fissionable material in my farm in Maryland. The geologists tell me that uranium exists in small quantities in practically all parts of the earth and that about one part in 140 of natural uranium is U-235, which is fissionable. The lawyers tell me that my property goes down to the center of the earth. It isn't very easy for me to figure out whether that many cubic yards of earth contain any fissionable material, especially when you take account of the fact that I would not recognize fissionable material if I stumbled over it in the street. At any rate, I do not think that I should be fined and imprisoned just because I may innocently and unknowingly be an owner of fissionable material.

The CHAIRMAN. I think you are right about that, Mr. Secretary. Secretary ICKES. Thank you.

I suppose that the provisions of the bill outlawing private ownership of such material are intended to refer to packages of stuff refined in laboratories and properly labeled. And I have no objection to the provisions of section 5 so far as they apply to that, but I do think that the language of S. 1717 is unduly broad and somewhat terrifying.

Another point at which I think the language of this draft may be overdrastic is raised by section 7 (b) which seems to require the Atomic Energy Commission to give out fissionable materials and to license the use of such materials to just about any and every applicant. I think that is all to the good, where materials are wanted for scientific purposes. But where such materials are wanted for purposes of private profit, I am not prepared to say that anybody who steps up to the counter should be entitled to a pound of fresh plutonium. Quite apart from the military and international aspects, on which others can speak with more authority, I think that such a provision might have unfortunate consequences from the standpoint of our domestic economy. At any rate, if I were a Senator I would want to know more than I do know about the cost of plutonium production and the economics of its utilization before I promised to hand it out to all comers.

If I am correct in believing that commercial use of fissionable materials is not an immediate possibility, I think that there might be some advantage in leaving for future congressional consideration the terms that should govern the disposition of fissionable materials. After all, we can't solve at once all of the problems that atomic

fission puts before us. Whatever legislation is enacted this year must be considered interim legislation, to be amended when our knowledge of the subject is greater than it is today. This matter of the disposition of the sources of atomic energy might very well be left for some other time when we are better informed than we are today on the economic ramifications of the problem. True, that would leave our legislation incomplete. But completeness may be a false goal in interim legislation. I think, for instance, that it would be a serious mistake to postpone the consideration of domestic legislation such as is before your committee until the completion of pending international negotiations. There are some phases of this problem on which prompt legislative action is necessary.

One such phase, I may say, which is in no way covered by S. 1717, is legislation amending the laws relating to the disposal of the public lands so as to reserve to the United States all fissionable materials. This would obviate the necessity for the Government's buying back such material at a later time. I may say parenthetically that a suggestion for legislation of this kind has been prepared by my staff and will shortly be submitted to the Congress for its consideration, and I hope it will have speedy congressional attention because of the urgency of this special aspect of the atomic energy problem.

Another phase of the problem that seems to me to require further consideration is the question of byproduct power, such as is given forth incidentally in the production of plutonium. Thus far such byproduct power has been used only for such unworthy purposes as raising the temperature of the Columbia River. I am not anxious to raise the temperature of any river, and I am not satisfied with the provisions of section 7 (c) dealing with the disposition of byproduct power. I think that whatever power is produced incidentally in the production of fissionable materials should be disposed of under the same standards that now govern the Federal disposition of power produced incidentally in various water-control projects, such as those constructed by the Bureau of Reclamation and the Corps of Engineers. That is to say, there should be a definite preference given to public agencies and nonprofit cooperatives in the disposition of power produced at public expense.

Necessary transmission outlets must be authorized in order to effectuate this preference, and the Congress should reiterate its sound traditional policy of fostering the widespread use of power in the interest of the ultimate consumer and of avoiding its monopoly by limited groups. Language such as that adopted in section 5 of the Flood Control Act of 1944 would accomplish this end. Public expenditures in this field should not become a disguised subsidy to a few utility companies.

One final point on which the language of S. 1717 seems to me to need some modification is in connection with the provisions for condemnation in section 5 (d) (1) of the bill (at pages 10 and 11). This section as it stands is open to question. Some of my legal advisers tell me that there are certain forms of property which are ordinarily not subject to condemnation unless expressly specified in the condemnation act. I think, therefore, that section 5 (d) (1) should be amended so as to cover expressly all forms of real and personal property, however held, including patents, as well as properties already

devoted to other public uses by States, municipalities, territories, Indian tribes, or other legal entities.

Senator AUSTIN. May I ask you a question?

Secretary ICKES. Yes.

Senator AUSTIN. You say all forms of real and personal property. Do you mean whether they contain any of the elements?

Secretary ICKES. No, relating to fissionable materials.

Senator AUSTIN. That is what I wanted to find out.

Secretary ICKES. More important than any of the foregoing suggestions as to the terms of S. 1717 are those which may be directed to what the bill as a whole fails to provide.

In the first place I do not find anywhere within this bill any prohibition against the peddling of confidential material by employees of the Commission. As I have already suggested, I think that one of the good points of S. 1717 is that it leaves independent scientists entirely free to experiment and discuss as they see fit. That is all to the good. But somewhere in the Government there must be power to control the way in which the products of Government research and experimentation are to be made available to the public and to other nations. This is a matter that cannot be left to the decision of individual employees. I think, therefore, that the bill might very well prohibit the unauthorized disclosure of confidential material by employees of the Commission or by persons or agencies working for the Commission on a contract basis.

There is a second point upon which the powers vested in the Commission seem to me inadequate to accomplish the purposes of the proposed legislation. The members of the committee are fully aware of the extent to which our conquest of the atom was made possible by the work of scientists who did not have the foresight to be born in the United States. Einstein, Fermi, Bohr, Oliphant, and Szilard came from Germany, Italy, Denmark, England, and Hungary, and a host of other great scientists came to us from these and other countries. Their help was asked and eagerly accepted, in wartime, without much reference to the red tape and technicalities of our exclusionary immigration laws and regulations or the citizenship requirements of our civil-service laws. It may be that on future occasions when we need help from abroad we will not have a war emergency to justify detours around the morass of immigration laws and regulations. I suggest, therefore, that the proposed Atomic Energy Commission ought to have the power to employ noncitizens wherever necessary, whether they reside here or in any other part of the world, without regard to existing citizenship requirements for Federal employment.

Senator AUSTIN. That would probably be subject to such international arrangements as we get into?

Secretary ICKES. It would have to be that.

The Commission ought to have the further power to bring into this country any persons whose services may be required, together with the dependent members of their families, without regard to race, or national origin, or any other of the grounds upon which we now exclude would-be immigrants.

Under the present immigration laws we decide whether a man can come into this country by looking, primarily, not to what he might bring us for the future, but to his national origin. Under our gerrymandered quota laws we take the position that a German immigrant

is twice as valuable as a Pole. We assume that he is 4 times as precious as a Hungarian, 30 times more worth while than a Rumanian, and 100 times worthier than a Filipino. We have, therefore, since 1924, made it very difficult for scientists and technicians to come to this country if they had the bad fortune to be born on the wrong side of the boundary line. Unless we are willing to sacrifice our national future, as the Germans did, to a racial myth, we ought to include in S. 1717 some provision by which the Atomic Energy Commission may be relieved, in its own work, of the incubus of citizenship and immigration restrictions and set free to hire the best talents in the world, wherever they may be found, to carry out its great task.

There is a related point that raises somewhat similar considerations. We have been repeatedly told that scientific talent is one of the precious elements in our national economy that ought not to be wasted. Yet one of the distressing features of our war mobilization was the extent to which we put talented physicists, chemists, economists, and other technical experts to work peeling potatoes in the Army and doing various other chores, some even less edifying than that of KP. I recall one incident of a college graduate known to me personally. He was born in this country of Chinese parents, and he volunteered for service in the Army. He spoke Cantonese and several other languages. He was put to work cleaning latrines. In my own Department it made me heartsick to see talented map draftsmen, engineers, and geologists, who were doing vital war jobs, taken out of important war work and put into uniform to perform tasks that others could do better, or at least as well. If such situations should be repeated in the future they might very well constitute a serious impediment to the scientific work of civilian departments and agencies. I suggest, therefore, that the Atomic Energy Commission ought to have the power in appropriate cases to co-opt employees of other agencies, including the military, with the consent of the persons affected, and to put such men to work on the profoundly important activities that would come within the jurisdiction of the Atomic Energy Commission.

There is another point on which I think that the specified powers of this Commission are inadequate to the efficient accomplishment of the tasks for which it is made responsible. Under section 1 (b) of S. 1717, a major responsibility of the Commission is the dissemination of information to industry and to the public concerning atomic energy. Now, the dissemination of information by a Government agency is an activity that has traditionally been regarded in certain quarters with grave suspicion. Accordingly, we have a considerable number of laws which make it difficult or impossible for any Government agency to disseminate information in an effective and economical way. Take, for instance, the law which prohibits the sale of more than one copy of any public document to a single customer unless the customer is a Member of Congress (act of January 12, 1895, sec. 61, 28 Stat. 610, 44 U. S. C. sec. 71); or take the law which prohibits the use in Government publications of any illustration "unless it relates entirely to the transaction of public business" (act of March 3, 1905, sec. 1, 33 Stat. 1213, 44 U. S. C. sec. 118); or consider the general legislative prohibition against Government publications "not having to do with the ordinary public transactions of the executive departments" (act of March 3, 1905, sec. 1, 33 Stat. 1249, 44 U. S. C. sec. 219 (a)), or the law that requires all Government printing to be

submitted to the Government Printing Office (act of January 12, 1895, sec. 87, 28 Stat. 601, 622; 44 U. S. C., sec. 111).

These are but a few of the many statutes which encumber the path of a Government agency that tries to disseminate information.

During the war it was possible to find detours around many of these statutes. For instance, The Official Report on the Development of the Atomic Bomb Under the Auspices of the United States Government, written by Professor Smyth, at the request of Major General Groves, appeared shortly after the dropping of the first atomic bomb. That, I suppose, is because it was published by the Princeton University Press and not by the Government Printing Office. What the Comptroller General is going to say about that, I don't know, but in any event the report is out, and for some months it has been high on the list of nonfiction best sellers.

The CHAIRMAN. I can back you up on that, because we have yet to get copies of hearings that were held 5 weeks ago, completed copies, from the Government Printing Office.

Secretary ICKES. It is illustrated and a book dealer is permitted to buy more than one copy—even if he isn't a Congressman. My suggestion, then, is that specific language be included in S. 1717 which would free the Atomic Energy Commission from all restraints imposed by existing law on the dissemination of information by Government agencies.

Indeed I might go further and suggest that there are a number of other outworn laws which might very well be dispensed with if we want an Atomic Energy Commission that will operate with reasonable efficiency. Take, for instance, the law which prevents Government employees from attending scientific conferences, unless express provision in that behalf was made in the appropriation bill drafted a year or two before (act of June 26, 1912, sec. 8, 37 Stat. 184, 5 U. S. C. sec. 83). As I read the Smyth report, the process of developing the atomic bomb consisted very largely of conferences, at which fragmentary ideas of different people were brought together, and these conferences were generally arranged at a week's or a month's notice. It was wartime, and I suppose that the Comptroller General was not even told about these conferences. Or consider section 102 of title 5 of the United States Code, which declares that no Government department shall spend more than \$100 in any year for the purchase of needed periodical publications. I suppose that some Government official bought too many magazines or newspapers in 1842, when that law was passed, but must all Government agencies suffer forever for that indiscretion?

The woods are full of statutes like that, and, so far as I can tell, the general theory of these statutes, as construed by that watchdog of the Treasury, the Comptroller General, is that the use of airplanes, motor-propelled vehicles, typewriters, bottled water, and anything else not used by George Washington's Cabinet is, *prima facie*, illegal unless expressly mentioned in the latest departmental appropriation acts. You can readily appreciate, gentlemen, that an Atomic Energy Commission might not find its work facilitated by these statutes. I think it would be a good idea to exempt such a commission from all laws governing public purchases, contracts, and expenditures, whenever the Commission determines that compliance with such laws would be incompatible with the public interest.

I have emphasized what I conceive to be mistakes of commission and omission. These are for the most part relatively minor. I cannot conclude without saying that, in my opinion, the accomplishment of the basic objectives which you have set out in S. 1717 is essential to the maintenance of our democracy and to our future well-being and security as a nation.

Senator HART. Mr. Secretary, referring to the early part of your statement, there is one thing I would like to understand.

Do you personally believe that we should now disclose all of the secrets which remain to us in connection with the atomic bomb?

Secretary ICKES. Should disclose them?

Senator HART. Yes; to everyone.

Secretary ICKES. Well, I wouldn't say to everyone. If it means should we disclose them to the nations that fought with us to win the war, I would say "Yes."

Senator HART. That is, you would disclose every last remaining secret which we now have?

Secretary ICKES. I would.

Senator HART. In your statement, at the bottom of page 5, you say: Nor will that job be facilitated if we make atomic energy control a function of the military.

Secretary ICKES. That is right..

Senator HART. Who has proposed that we do?

Secretary ICKES. Well, I have seen various suggestions to that effect. I may be misinformed, but even if it isn't proposed, I would like to put in the negative anyhow, Senator.

Senator HART. There is no such proposal before this committee.

Secretary ICKES. Then that is all to the good.

Senator HART. I have nothing further.

Secretary ICKES. Perhaps I cried before I was hurt, but I don't want to be hurt.

The CHAIRMAN. Any further questions of the Secretary?

Senator HICKENLOOPER. Clearing up the Secretary's statement a moment ago that he would disclose the secrets of atomic energy, is that all the secrets we have including the making of the bomb to the nations that fought on our side during the war, and would that be prior to the arrival of any agreements for the outlawing of the weapon?

Secretary ICKES. That is a matter of international negotiation that I am not competent, and certainly not disposed, to discuss. That is a matter of international agreement.

Senator HICKENLOOPER. I was merely attempting to get straight in my mind as to when you would make this disclosure. Frankly, I feel that there are some disclosures which should not be made until we get satisfactory agreements.

Secretary ICKES. I might agree with you, Senator.

Senator HICKENLOOPER. I wouldn't want to go out now and just bare our bosom to the world.

Secretary ICKES. I am the last man in Washington to attempt to invade the jurisdiction of the State Department. A Member of Congress may do so, but I may not.

Senator HICKENLOOPER. On page 9 of your statement I have a little difficulty in reconciling the recommendation of the Secretaries of State,

War, Navy, Interior, and Commerce as members, where you refer to the provision in one of the bills—

Secretary ICKES (interposing). I don't recommend that provision.

Senator HICKENLOOPER (continuing) —that those officers, together with four members at large, be employed. Then you criticize the employment of the per diem members on the basis that they would not be devoting their full time and energy to the commission.

To me, that doesn't quite square with the fact that the Secretaries of State, War, Navy, and Interior apparently are approved on that Commission, but they certainly have other duties besides the atomic energy, and would be devoting only a small percent of their time.

Secretary ICKES. But they have no duties outside of duties to the Government, which I think is a very valid distinction; and your per diem members, if they should be appointed, would have only that specified duty to the Government intermingled with personal and private business duties of their own.

The CHAIRMAN. Mr. Secretary, in this statement that you made here today, you stress the necessity for civilian control, which you believe is exemplified in S. 1717.

Now, the War Department prepared a bill which was the subject of hearings over in the House. It was introduced by Mr. May on request, and Senator Johnson was acting as Chairman of the Military Affairs hearing by request. That bill required that there be part-time directors, and provided for full-time general managers, with a specific exemption from the statute which requires that no military men may at the same time hold civilian jobs. In other words, it was claimed by some—and I want to find out if you agree with that thought—that the purpose was to have absentee directors and full-time military operators.

Now, that bill is before the committee at this time. Is that the bill that you had reference to, or the suggestion that you had reference to, for military emphasis rather than civilian emphasis in the control of this matter?

Secretary ICKES. Yes; I would oppose that provision in any bill. I think we would be taking a long step away from the road of civilian control of our Government that we have traveled since the Constitution was adopted.

The CHAIRMAN. Thank you very much, Mr. Secretary, for being here.

The committee will meet at 10 tomorrow morning, on the Navy test. (Thereupon, at 12:05 p. m. the committee adjourned until 10 a. m., Thursday, January 24, 1945.¹)

¹ For Admiral Blandy's statement on January 24, see pt. 4 of the hearings on atomic energy. The hearing on that day was not part of the series of hearings on S. 1717.

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ATOMIC ENERGY ACT OF 1946

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

SECOND SESSION

ON

S. 1717

A BILL FOR THE DEVELOPMENT AND CONTROL
OF ATOMIC ENERGY

PART 2

JANUARY 25, 28, 29, 30, 31, AND FEBRUARY 1, 1946

Printed for the use of the Special Committee on Atomic Energy



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ATOMIC ENERGY ACT OF 1946

FRIDAY, JANUARY 25, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met at 10 a. m., pursuant to adjournment, in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Austin, Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will please come to order.

It is my understanding that Dr. Hutchins, Dr. Gustavson, Dr. Redfield, and Professor Levi of Chicago are going to give us an hour's presentation—that was the agreement that was made with them—of their point of view on domestic legislation.

I understand that they would prefer not to be interrupted by questions until they have finished, if that is agreeable to the committee.

Maybe an hour is too much. As I understand it, you gentlemen will take about 40 minutes, the members of the staff tell me. So, gentlemen, you may proceed.

STATEMENT OF DR. ROBERT M. HUTCHINS, CHANCELOER OF THE UNIVERSITY OF CHICAGO

Dr. HUTCHINS. Mr. Chairman and members of the committee, my associates whom I present today are Robert Redfield, professor of anthropology and dean of the division of the social sciences; R. G. Gustavson, professor of chemistry and vice president and dean of faculties; and Edward H. Levi, professor of law, for 5 years special assistant to the Attorney General.

The university with which we are connected was a major center of the research leading to the atomic bomb. The university has organized three new institutes to continue atomic research on a large scale. All of us have been for some time concerned with the problems before this committee. In my own case I have been involved in these problems since the beginning of the research on the atomic bomb, even before the inception of the Manhattan project.

The issue before the committee is the most important before the Congress. It is far more important than the Pearl Harbor investigation, important as that is; for this committee is concerned with the future of civilization and not merely with incidents, however lurid, in the past.

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The issue before this committee is more important than the labor disputes that are now going on, important as they are. Nobody supposes that these disputes can wreck the United States, no matter how much they may retard its progress. The policy adopted by this committee may determine the fate of our country, and even of the world.

Compared with the issue before this committee, such questions as balancing the Budget, adopting peacetime conscription, or even the rate of demobilization of the armed forces pale into insignificance.

We know that civilization cannot outlive an atomic war. We know that the decisions of this committee will go far toward deciding whether we are to have an atomic war. It is not too much to say, therefore, that the deliberations of this committee may determine whether or not civilization shall survive.

Any legislation in the field of atomic energy must be based on the assumption that war will in some way or other be averted. We cannot assume that there is going to be a war and then try to frame domestic legislation on that assumption. The assumption that there is going to be a war would lead to the conclusion that we had better start the war this morning, because only this morning can we be sure of having supremacy in atomic bombs.

No plans for atomic energy, and no plans for anything else, for that matter, can be made on the supposition that we are going to have war. Any war we have will be so destructive that no plans can be carried out. We must plan in the conviction that we can defeat war and develop atomic energy in a world at peace.

It is therefore apparent that in this field there can be no solely domestic legislation. Any legislation must subordinate domestic use to international agreements. We must assume that such agreements can be reached and that they will be kept. Any legislation must be such as to reassure other nations as to the peaceful intentions of the United States. For this country to announce by way of domestic legislation, for example, that it regards atomic energy as a weapon would justify the fears of other countries and lead them to suppose that the United States intends to dominate the world by force. Any domestic legislation about atomic energy must fit into the general plans which this country adopts to promote peace.

These considerations lead to the conclusion that any legislation in the field of atomic energy must contemplate an unusual degree of governmental control. The Government must know all about all developments at all times, because of the international ramifications of any development at any time. This discovery is the most important since the discovery of fire. Its social, economic, military, and political consequences cannot now be foreseen. We know that we cannot play with fire, even after 5,000 years of experimentation with it. This discovery is infinitely more dangerous than fire. The people of the United States must plan to develop this discovery for the benefit of the world; they must plan to protect the world against it. This matter is too serious to be left to the casual activities of individual enterprisers.

Consideration of the international aspects of the problem also leads to the conclusion that this discovery should be developed under the auspices of civilian rather than military representatives of the Government. The surest and clearest way to prove to the world that we

regard atomic power as a weapon is to place control of it in the hands of the armed forces.

Here I do not enter upon the fitness of the armed forces to promote scientific research or to deal with scientific workers or to develop the peacetime uses, such as the medical uses, of atomic energy. I wish to emphasize the general alarm that would spread through the world if we proclaimed that the military were in charge of atomic energy in the United States.

Although we have to accept an unusual kind of governmental interference in developing atomic energy, the limitations imposed by such interference need not be seriously restrictive, not nearly so restrictive as those imposed by the Army during the war. The secrecy requirements of the Manhattan engineer district were excessive even in wartime and were, I believe, detrimental to the project.

A country like ours will profit by the freest exchange of scientific information, for we have the technical skill and the resources to make the most of any ideas that appear anywhere in the world. Even from the standpoint of future military security, therefore, secrecy requirements should be reduced to the minimum. Certainly all basic scientific information should be free.

There are already on the statute books enough laws to prevent the treasonable revelation of military secrets.

We must agree, however, that this discovery is so important and so dangerous that the people through their elected representatives must supervise its development. This discovery cannot be allowed to get out of hand. Since we have here an unprecedented force, we must reconcile ourselves to unprecedented methods of dealing with it.

Mr. Redfield, Mr. Chairman.

**STATEMENT OF DR. ROBERT REDFIELD, DEAN, SOCIAL SCIENCES
DIVISION, UNIVERSITY OF CHICAGO**

Dr. REDFIELD. Mr. Chairman and members of the committee, in legislating about atomic energy the paramount consideration is peace. Whatever else a bill may accomplish, it must provide conditions that make war less probable. One test it must meet before it is measured by any other: Does it increase the chances of enduring peace?

The effectiveness of the bill in connection with production of energy and with development and research is to be tested within the framework of the bill as a measure for the peace of the world, and subordinate to this first consideration. This is because today we face an absolute necessity to prevent another war.

For the first time in history the necessity to prevent another war is absolute because we can no longer look forward to both war and the preservation of our civilization. Before atomic energy a nation could plan to advance human progress with or without a great war. Then one could say, let us try to avert a war, but if war cannot be averted, let us fight the war and also go forward with the work of civilization.

We have just fought a great war, and in spite of the immense cost of victory we feel that victory was worth the cost.

That war was the last such major war. Now a great war will not leave even the victorious nation with enough to enable it to go forward with the work of civilization.

The committee has heard convincing testimony as to the immense increase in destructiveness made possible by the new weapons. A major war with atomic weapons would destroy both combatants as leaders of civilization. It is this fact which makes the prevention of another war the paramount consideration in the control of atomic energy.

The bill that will command our support is not a bill which makes for both war and peace, for peace maybe, but if not, then war. It is a bill which makes for peace.

In legislating about atomic energy, domestic and international issues are inseparable. Any bill that can be drawn will affect the chances of war or peace. What this Nation does with regard to atomic energy will be looked to by every nation in the world as a guide post to the future. If it appears that this Nation plans for war, other nations will plan for war. If it appears that this Nation puts peace first, beyond other considerations, then other nations will be disposed to join us in making that peace.

Any bill in this Congress about atomic energy is a major act in international affairs. It may be a decisive act in the choices that lead to war or to peace.

Peace is made through confidence between peoples and through agreement between nations. It is threatened by secrecy, endangered by suspicion, and put in grave peril in a race of armaments. Therefore, that bill about atomic energy makes for peace which promotes candor and confidence and which checks a race of armaments.

What are the features of a bill about atomic energy that will have these effects?

In the first place, such a bill will treat atomic energy as an instrument for the advancement of human welfare. It will encourage in every way development and research for medical and industrial uses. On the other hand, it will provide means whereby the use of atomic energy in the manufacture of bombs may be quickly brought to a halt. To encourage the peaceful uses of atomic energy it will provide for the utmost freedom in the exchange of scientific knowledge. It will offer scientists in all parts of the world opportunity to join with scientists of the country in the extension of knowledge in this field with the least possible secrecy regulation. It will take control of atomic energy from military authorities and put such control, and the bombs themselves, into the hands of civilian authorities.

In the second place, a good bill will provide for such governmental control of both development and production as will demonstrate the readiness of this country to enter into international agreements for the reduction of armaments and the control of war and which will make it possible for this country quickly to meet such agreements. It will do this by providing governmental control over the source materials of atomic energy, and over the manufacture of all products at all closely connected with atomic weapons.

It will provide a system of inspection of plants, facilities, and laboratories which will maintain this control and will show determination to explore the possibilities of world-wide inspection as a part of atomic energy control through international agreements.

It will maintain these controls for the further reason that there must be no suspicion that private interests are concerned in the manufacture of atomic weapons. The bill must be a statement to

the people of the world that this country is determined that atomic bombs shall never be used again.

To realize this determination may require a degree of interference with industrial development of atomic energy beyond that which has been called for in connection with previous discoveries. No private interest deserves consideration if it stands in the way of a peaceful utilization of the new energy. If, to bar military uses, it is necessary to modify the special patterns of commercial development or regulation of development that have prevailed in metals, electricity, fuels, and plastics, we must modify them. For atomic energy is a new beginning, or it is an ending, and to make it a new beginning we dare not be bound by the past.

To realize the determination that atomic energy shall be only a benefit it is further necessary that the bill provide the people with understanding of the consequences of its use. Its social, economic and political implications are so vast and far-reaching that we cannot allow the impact of the changes it will bring to fall upon society as they may happen to fall. This is a change in technology that can destroy civilization or make it over, and therefore the effects of its development on industry, on prices, on leisure and its uses, on government and community life, must be studied as they occur and even before they occur. Social science recognizes in this physical event the initiator of changes in human living perhaps greater than have occurred before, and swifter.

We must have, therefore, the foresight which social science adds to the guesses of common sense, and therefore the bill must provide for study and report of the implications of atomic energy for society. Of these implications the most immediate are those political consequences which make for an ultimately destructive war, or for peace. To prevent war and to promote peace the bill must, in first instance, be shaped.

Dr. HUTCHINS. Mr. Gustavson, Mr. Chairman.

Senator MILLIKIN. Dr. Gustavson is from my own university. He is a man highly esteemed in Colorado. We all loved him very much and hated to see him leave, but are glad to see him in such appropriate surroundings.

The CHAIRMAN. It becomes incumbent upon me to say that the first time I saw Dr. Hutchins he was dean of the Yale Law School and had me on the carpet. He, as you can see, wasn't much older than I was at the time. I submitted gracefully to his kind attention.

Senator HICKENLOOPER. I believe the only credit we can take is that we join Illinois across the Mississippi River.

Senator JOHNSON. Senator, I want to congratulate Illinois on getting Dr. Gustavson. I recall that when I was Governor of Colorado I tried very hard to have Dr. Gustavson made the president of the agricultural college at Fort Collins, and I concur in everything that my colleague, Senator Millikin, said about him. We have suffered a very great loss in losing Dr. Gustavson, and our loss is Illinois' gain.

Dr. GUSTAVSON. You are very kind, Senator Johnson.

The CHAIRMAN. I don't know what you are going to say, but I certainly am deeply interested now.

Dr. GUSTAVSON. The proper thing for me to do is bow out, I think.

STATEMENT OF DR. REUBEN G. GUSTAVSON, VICE PRESIDENT
AND DEAN OF THE FACULTIES, UNIVERSITY OF CHICAGO

Dr. GUSTAVSON. It is difficult to throw off the psychology of war when thinking about atomic energy. If we succeed in developing an international organization which will decrease to a very great extent the possibility of a war with atomic bombs, then it is indeed possible to contemplate marvelous developments in the fields of science and industry as a result of the discoveries in the field of nuclear physics and nuclear chemistry. If we fail to establish such an organization internationally and an atomic bomb armament race is the result, then it is hard for me to believe that the kind of life it will be possible to live, namely, one of constant fear, is worth being concerned about.

Naturally we first think of atomic energy in terms of useful power. Atomic power is a reality. Energy can be liberated in the form of heat at any temperature we desire. It is now possible to liberate this energy under conditions that can be carefully controlled. It is possible to regulate the rate at which energy is liberated by nuclear reactions just as accurately, indeed, as it is possible to control the temperature of this room.

Science had to develop methods for the liberation of atomic energy under controlled conditions before an atomic bomb could be produced. This controlled release of atomic energy was first accomplished in December 1942.

We ask ourselves, "What are the possibilities for the development of power that will compete in price with coal, oil, or natural gas?" The question is difficult to answer. A few calculations may be of interest. One pound of uranium will produce something like 11,000,000 kilowatt-hours of energy. If we should be able to prepare concentrates of uranium-235 for \$9,000 a pound, then that would mean, as far as fuel is concerned, that energy could be produced at the rate of one-tenth of a cent per kilowatt-hour.

How does this compare with coal? Suppose we assume that coal costs \$5 per ton and that we are dealing with a coal which contains about 14,000 British thermal units per pound. Then we find that, as far as fuel is concerned, electrical energy, not taking into consideration the equipment necessary, would cost about six-hundredths of a cent per kilowatt-hour.

These figures are of interest because they indicate that these calculations, which are only rough approximations, mean that commercial atomic energy is a possibility. As far as the physical factors are concerned, if materials were made available, a dynamo could be generating electricity from atomic energy in 6 months. When we remember that we have only started to learn how to separate the uranium atoms which have a weight of 235 from those which have a weight of 238, that, in fact, the whole field of producing energy from nuclear reactions is in its infancy, even a conservative would be inclined to say that the probabilities are strong that atomic energy will be a commercial success.

Progress will undoubtedly take place as we work in this field as far as efficiency of the processes are made better. This means, of course, that the possibility of driving submarines, ocean-going vessels, and possibly even trains with atomic power is real. Smokeless cities may be a reality.

But even though we should never be able to use atomic energy economically, there are still many great advances in human welfare that are possible through these discoveries.

In the first place, we now have neutrons, some of which are moving very rapidly, so-called fast neutrons, other neutrons which are moving relatively slowly, available for study. We can use these neutron rays in much the same way as we use X-rays. And, in fact, a number of experiments which have been carried out using X-rays will undoubtedly be repeated using neutron rays.

We know that certain types of cancer yield to X-rays. Will there be other types of cancer that will yield to neutron rays? Research alone is the answer.

We know that you can bring about certain mutations in plants with X-rays. What will we be able to do with neutron rays? Research, again, is the answer.

We know that we can bombard the common stable elements such as iron, phosphorus, and sulfur with neutron rays and render them radioactive. It is possible, for example, to convert the element manganese into a form of iron which has the properties of radium by bombarding that manganese with neutrons.

This man-made radioactive iron can be followed by means of delicate instruments which will detect the radiations that are thrown off by the radioactive iron. Using material of that kind, for example, we can follow the rate at which blood corpuscles are destroyed in the body. That is, we can put this radioactive iron into a form in which it can be assimilated and put into the blood corpuscles, and then you can follow the blood corpuscle because it contains a tagged form of iron. We can study the value of different kinds of preservatives on red blood corpuscles. In fact, this was done in work carried out by the Army and Navy during the war.

We can use these same radioactive elements, which are called tracers, to follow chemical reactions. We can use them to follow chemical reactions not only in the laboratory but even on a very large scale, and if I had the time available for example, I could point out how you could even study the reactions of a blast furnace with these tracer materials. Just as we can take pictures of bony structures within living organisms by means of X-rays, so we can take probably pictures of atoms in molecules by using neutron rays.

So we have an opportunity today to learn what the atomic architecture of various kinds of substances really is by actually photographing them after a fashion with neutron rays. These techniques will undoubtedly be of tremendous significance in industries such as the organic chemical industry, the medicinal industry, the synthetic rubber industry, et cetera.

While the fundamental discoveries in producing atomic energy, about which we have been talking, came out of the world of physics, we must not think by any means that this represents a finished story. We have broken atoms up into a nucleus and electrons. We have broken this nucleus up into particles which we speak of as protons and neutrons.

We have evidence from studies that have been made with cosmic rays that there are particles larger than the electron and yet smaller than the neutron. One such particle is called the mesotron. Is it possible to break the neutron up into these smaller structures? If we

are able to break up the neutron into mesotrons, for example, will such reactions take place with a liberation of energy, just as the breaking up of the nucleus takes place with a liberation of energy? Research again is the answer to these questions.

So I would say that we have opened up a whole new frontier, a frontier which offers real intellectual excitement for the investigator and which, in all probability, promises a higher standard of living and a better life for the common man. The exploration of this frontier calls for fundamental research. This means that the Federal Government must make grants to universities and other research organizations to get this work done. A great deal of this work in the past has been done in European universities. In the future we must depend upon great American universities, private and public, to do this research. Some of the great research institutions connected with industry will carry their share of the responsibility.

These workers must be free to exchange information not only with workers in our own country but with workers all over the world. In this way a cross-fertilization of minds takes place, and new ideas are born. In this way mistakes are corrected, and incomplete observations are finished.

The Italian investigator, Enrico Fermi, for example, set up the experiment for nuclear fission in 1935. The full significance of the experiment was not realized until 1939, and then the work was finished by a German, Otto Hahn.

Given the means for research and freedom to investigate, new frontiers will be opened up in pure science. Applied science will follow. Two conditions are necessary: Science must have adequate support, and, equally important, science must be free.

Dr. HUTCHINS. Mr. Levi, Mr. Chairman.

STATEMENT OF PROF. EDWARD H. LEVI, UNIVERSITY OF CHICAGO LAW SCHOOL

Professor LEVI. Mr. Chairman and members of the committee, everyone will agree that atomic energy is too important to the future of this country to permit any cartel, domestic or foreign, to control its use or development. If there is any danger of a private monopoly in any of the stages of the development of atomic power, such as control over uranium or plutonium, or over any important process or application, the American people would want to prevent it.

As to many other industrial fields, we may have a split personality, condemning cartels as contrary to free enterprise, and yet tolerating them, because that is what a part of the rest of the world seems to want.

But it seems clear that the American people will not want to tolerate any private cartel controlling the development of atomic power in this country. In fact, the idea of such control seems fantastic.

But the idea is not fantastic, and any legislation in this field must take this possibility into account. After all, there is a cartel controlling radium, and radium is found in ores which also contain uranium. One company already has a dominant position over vanadium, and vanadium is found in ores which also contain uranium.

It may seem unthinkable that a cartel might be permitted to retard the development of a field important to national security. But the

production of synthetic rubber was almost prevented in this country because of the control of patents by I. G. Farben and the various restrictive arrangements it had made. We are told that radioactive byproducts can play an important part in the development of medical research. Again we must be warned by the fact that the field of medicine and drugs is most highly cartelized and controlled. No American company wants to see these things happen in the field of atomic power.

In order to prevent these things from happening in the field of atomic power, legislation must guard against certain common practices or accidental results. For example, it is a common practice for an American company to make an exclusive cross-licensing arrangement with some foreign company under which patents and know-how are exchanged. A basic part of such an arrangement is an understanding between the parties that each party is to have a monopoly in the particular field in its own country.

Whatever we may think of such arrangements, whether they be considered legal or illegal under our present patent system, we cannot permit such agreements to restrict the development of atomic power. In fact when we are trying our utmost to encourage the development and beneficial use of atomic power, it would be anomalous to permit any company, large or small, or even an inventor to own any basic patent with the right to refuse to license anyone else to use the invented process or machine in the field of atomic energy.

In other fields it is perhaps possible that we may permit companies to acquire, accidentally or otherwise, key natural resources, such as bauxite, radium, or vanadium. But we cannot permit such a development for uranium. In other fields we permit companies to keep secret unique processes which they have developed, but in the field of atomic power, there at least should be no trade secrets against the Government.

This means that legislation must give to the Government special powers to prevent any monopolistic ownership of uranium or fissionable materials. It means that, as to atomic energy, our regular patent system must be modified. We can't afford to have blocking or fencing patents in this field. No company would want to assume the responsibility for preventing the widest possible development and application of atomic energy devices.

Legislation must make sure that, unlike the normal foreign business agreement between an American and a foreign company, the general public interest will override any exclusive arrangements. It must provide that our own country's foreign policy will have to control the development by American capital of foreign factories which might produce atomic bombs. And any commission set up by the legislation must have the right of access to all American plants and full information as to the state of the art.

This is the antimonopoly, the anticartel side of the picture. A part of the same picture, however, is that we want to discourage control by monopolies in order to make it possible for all American business to take part in this new development on the widest possible basis.

We want business to engage in research and developmental work in this field. We do not want research to be only governmental or the work of nonprofit institutions. Thus it is important that the Government have the right to give grants in aid and contracts for research

and developmental work to private business enterprises. It is also important that some incentives be provided for private enterprise so that it will be anxious and willing to engage in research and developmental work.

What kind of incentives can legislation in the atomic energy field provide?

We may as well admit the fact that there are some incentives which good legislation in this field cannot provide at the present time. We cannot permit private enterprise in this country to begin the manufacture of fissionable material for the purpose of creating power.

There are two reasons why we cannot permit this. In the first place, the production of fissionable material by private companies for their own purposes and for the commercial sale of power will complicate the international situation enormously. It will make much more difficult the setting up of an inspection system. It would tend also to foreclose the possibilities of an international authority under the UNO which would not only have the right to inspect but the exclusive right to license the manufacture of fissionable materials throughout the world.

In the second place, we do not know enough about the commercial possibilities of atomic power to have intelligent legislation on that subject. And this is a matter which is so important that Congress must decide the issues.

While commercial and developmental work are going on in the industrial field, we will learn more about the industrial possibilities. When we learn more, then the Congress will have the information on which it can determine what the standards for industrial control should be.

And there is another incentive which good legislation cannot give to industry. This is the incentive of the exclusive right to control. In other words, whatever the right to refuse to issue a license under a patent may be worth, no company in the atomic energy field should have this right.

If legislation in this field should deny to private industry for the present the right to manufacture fissionable materials for the production of power and should deny the right to industry to possess patents which it can refuse to license, will there be sufficient incentive so that industry will take part in the development of this new source of power? This is, of course, a crucial question which any legislation in this field must face.

The answer seems to be this: It is unthinkable that American business, given complete freedom to go ahead in research and development in this all-important field, will not do so. Industry can be given the fissionable material for its research and developmental work. The wide exchange of information should facilitate research. Industry can be given rewards for inventions not only through governmental contracts and grants in aid, but by receiving a royalty for the use of the inventions it develops.

Further, during the waiting period it can develop equipment or parts to be sold to the Government. And industry will know that as soon as an international agreement has been reached and the Congress has the social and economic facts before it, additional legislation governing further commercial use will be passed. Industry undoubtedly will wish to take part in such studies as will be necessary before good legislation covering industrial use can be enacted.

I think that if industry is given the choice between intelligent legislation enacted after the social and economic facts concerning the industrial use of atomic power are known in greater detail, or legislation which perforce can provide no standards but which gives all-embracing and uncontrolled authority to a commission, industry will be on the side of intelligent legislation, and it will be willing to wait for such legislation while at the same time engaging in research and developmental work.

It is important that this should be so. This is the only way we can encourage peace in the world and at the same time begin to get the peaceful benefits of atomic power.

Dr. HUTCHINS: Mr. Chairman, in these statements we have emphasized the importance of the issues before the committee. We have insisted that any legislation in regard to atomic energy must subordinate domestic use to international agreements and must be such as to assure other nations of the peaceful intentions of the United States.

We believe that the importance and danger of the discovery justify an unusual measure of governmental control. We think that such control can be so provided as to interfere very little with research and development. We believe that the social, economic, and political effects of atomic energy must be continuously investigated.

We have called attention to the tremendous benefits which will flow from this discovery if war can be prevented and research can be free. Medical care and biological investigation are already being revolutionized. The use of atomic energy for heat, power, and light presents no scientific or engineering problems; the only question is that of the economics of distribution.

We have pointed out that research in these fields is in its infancy and that the Government should conduct research and support research on a liberal scale. The applications of a discovery as important as that of fire cannot now be foreseen; but they will undoubtedly mean a higher standard of living for the world.

We think that legislation must provide that no cartel, domestic or foreign, can interfere with these developments. This means, among other things, that we must be prepared to modify our patent laws in this field.

We believe that no satisfactory bill can be drawn now to regulate industry in this field; and we favor a period of study, the formulation of a program, and the clarification of the international issues before industrial development begins. We turn now to the question whether the bill before the committee meets the requirements which we have been attempting to state.

This bill, Mr. Chairman, S. 1717, known as the McMahon bill, raises the issues we have been discussing. The first of those issues is the international problem.

Redfield, what do you think about the McMahon bill as to the international issue?

Dr. REDFIELD: While the bill does not declare the paramount importance of the international considerations as clearly or as early in the bill as I should like it to do, the general effect of its provisions, it seems to me, is to make it relatively easy for this country to enter into and fulfill international agreements for control, and there are two paragraphs in the bill in which the international agreement and its possibilities are explicitly referred to.

Paragraph 6 (b) provides that no military research shall be carried on if contrary to international agreement, and paragraph 9 (b) provides that knowledge may be disseminated if consistent with international agreement.

Dr. HUTCHINS. Well, there is also, isn't there, Levi, a provision in the McMahon bill requiring the express consent of the President for the manufacture of bomb parts?

Professor LEVI. There is that, and I think it is also important to mention that the basic idea of the bill that basic scientific information should be freely available is completely in harmony with what we think is necessary in the international system.

Dr. GUSTAVSON. At the same time, of course, it makes provision for the control of distribution of technical material depending upon what the national security is, and also makes provision for this very wide exchange of material of a basic nature. It is important to know that the bill distinguishes that.

Professor LEVI. It also prohibits private arrangements between American and foreign companies which might get in the way of international agreement if you can get one, and it does provide an inspection system which ought to help facilitate the international agreement.

Dr. HUTCHINS. This inspection system that is provided in the bill facilitates international agreements in two ways. In the first place, it provides that the Government shall be at all times informed as to what is going on in this field, and, in the second place, if there is to be an international inspection system, we have under this bill an opportunity to provide a model inspection system in this country.

Dr. REDFIELD. I observed also, Dr. Hutchins, that the bill, with regard to international considerations, would be one which clearly gave authority over this matter to civilians rather than the military.

If I read correctly the relevant provisions of this bill, it does give that assurance.

Professor LEVI. I think that it is terribly important that at the same time the President should control the manufacture of bombs and bomb parts.

Dr. HUTCHINS. I don't think you gentlemen could have read Secretary Forrestal's recommendations to this committee the other day, who seemed to feel that complete military control of this new power would be highly desirable. I thought the quaintest suggestion which Secretary Forrestal was reported to have made was that the Vice President of the United States should automatically become chairman of the proposed commission. I think that is a good suggestion now when we have no Vice President.

Our suggestion on the international aspects of this bill, Mr. Chairman, would, I think, be that it might be strengthened in two ways: First, there might be, as Mr. Redfield proposes, a clearer, earlier, and more explicit statement that the development of atomic energy in this country must be subordinate to our foreign policy. A comparatively minor change might also be advanced, and that is that the by-products might be made available to foreign countries for medical research. There would be no danger in that, and there would be great benefit to the world.

Professor LEVI. Great benefit to us.

Dr. HUTCHINS. And to us. The second issue that we have attempted to discuss is the issue of governmental control. The pro-

visions in the McMahon bill for governmental control are very broad, and yet it would appear no broader than the situation demands.

The Government becomes the exclusive producer and the exclusive owner of all fissionable material, and controls facilities when they can be used at a rate sufficient to produce a bomb. It provides that no one else can produce power until there is a 90-day wait, and no one else can produce fissionable materials unless there is further legislation.

Professor LEVI. They can for research and developmental work.

Dr. HUTCHINS. Do you regard these provisions as excessive, Levi?

Professor LEVI. No I don't. I think they are fairly strict, but I think they are the kind of provisions you have to have if the Government is going to have control over fissionable material, and I think they are drawn up so as to deprive the Commission of undue control.

As I understand it, the distinction between source material and fissionable material in the bill is intended to keep the Government from automatically owning the source material, and to permit it to own only those things it has to own, unless there should be a change, in which case it does have the right of eminent domain and does take over; but there is no automatic ownership.

Dr. REDFIELD. In short, the provisions with reference to Government control seem to provide a nice adjustment between two interests which are not wholly in conflict: the interest to provide such a situation as would make it possible for the United States rapidly and effectively to join any international control, and the interest of our country to favor the development of this new invention for peaceful reasons.

This seems to be a judicious adjustment of these two considerations to one another.

Professor LEVI. Of course, I think we have to recognize that the bill does permit the Government to go into the power business in the sense that it can sell the power it produces incident to the production of fissionable materials.

Dr. REDFIELD. We recognize that is only with regard to this interim period, and presumably it refers to the power which will be produced incident to the development and research.

Professor LEVI. I don't know. The Government is allowed to produce fissionable material, and while it is producing fissionable material, if it does produce power, it can sell it under this bill.

Dr. HUTCHINS. In any event, the industrial legislation is postponed on that subject.

Professor LEVI. That is right.

Dr. HUTCHINS. There is nothing in this bill that seems to suggest that the Government should in perpetuity be the producer and seller of atomic power.

Professor LEVI. That is perfectly correct.

Dr. HUTCHINS. The third question, then, is the question of the McMahon bill in relation to research and development.

What is your view on this subject, Gustavson?

Dr. GUSTAVSON. This is a phase of the bill that scientists have been tremendously interested in, for the simple reason that all of our experience indicates that it is only when you have a free interchange of information that progress in science can be realized.

If you want to know something about the air we breathe, you have got to get acquainted with Lavoisier, the Frenchman, Avogadro, the Italian, and Mr. Black, the Scotchman. You have got to go around

the world, and so it is with practically every piece of fundamental research that has been carried out.

Mistakes are made, observations are incomplete, and it is only when the work of one man is subjected to the critical analysis by another man that these mistakes are corrected, or incomplete observations are completed. This basic freedom in basic research is provided for in the bill.

At the same time, as far as technical development is concerned, or technical matters, the know-how of doing this and that, there is adequate protection for the national welfare as far as the bill is concerned, and a good deal of that legislation, of course, will depend upon what is done in the international field.

I think it is important to recognize, too, that while there would seem to be an emphasis on fundamental research, there is a great deal of industrial research that can go on, even though the industrial applications are held back. For example, in developing the atomic bomb, we saw different kinds of atoms separated by a diffusion process. This is something relatively new in industry, and the fact that that has been successful will undoubtedly mean that people who are making oxygen from the air will probably experiment with the possibility of producing oxygen from the air, using the basic ideas that were used in separating the uranium atoms; or the separation of helium from natural gas falls in the same category.

A tremendous amount of research can go on in industry previous to large-scale industrial uses.

Dr. HUTCHINS. Well, this bill in the first place makes research about as free as it can be in a field as dangerous and important as this, with such limitations as the Espionage Act, with the administrative interpretations of the Espionage Act made by the Commission.

In the second place, the bill does everything it can conceivably be called upon or expected to do in the promotion of research, which calls for grants in aid and calls for Government research, emphasizes medical uses, safety standards, and provides for preferences to research development and medical uses.

There is a point that I am sure one of you gentlemen will want to comment on, and that is that this bill authorizes the Commission to engage in research itself, so the Government here goes into research.

Professor LEVI. Some people think that cuts down private research and will certainly cut down the grants in aid for private research; the Government will want to do the whole thing itself.

Dr. GUSTAVSON. We must remember that we are breaking into a field that is very, very wide. The only comparable situation I can think of is agriculture, where the welfare of the peoples of the world, in fact, is involved, and over the years the Government has engaged in agricultural research through the land-grant colleges; work has been carried on by industry with respect to fertilizers, and so on. There hasn't been any competition that hasn't been good for both parties, and I feel that with atomic energy you have something that is equally broad. It is hard to believe that there will not be more than enough work to go around.

Professor LEVI. I think we should mention that under this bill, of course, the Government has control over fissionable material, and if it should refuse to give the fissionable material out, then it would be controlling the research that other people could do.

Dr. HUTCHINS. We would take the view that the Commission should allocate fissionable materials among research workers in terms of their capacity to adhere to proper standards of health and safety. We would be strongly opposed to any authority in the Commission to allocate materials among investigators in terms of the Commission's estimate of their competence.

Professor LEVI. The way the bill is now written, the Commission has to give it out.

Dr. HUTCHINS. That is the way it should be, isn't it?

Professor LEVI. Not only that, but if it were changed in that regard, I should think the whole spirit of the bill would be changed.

Dr. GUSTAVSON. Of course there is a safeguard there that may not be obvious to the layman, and that is the provision that anyone seeking the use of the fissionable material for research purposes must be able to show that they can adequately protect the health of the people concerned, and also take care of safety precautions.

The field of atomic energy isn't a field in which some boy can go upstairs in his barn and start experimenting. It isn't that kind of a project.

As we know at the University of Chicago, the guarding of the health of employees was a major factor, and so also anyone who engages in this field, if he has the capacity to protect the research workers, to take safety precautions, almost ipso facto is going to be somebody qualified to work in the field.

Dr. HUTCHINS. Let us turn to the social, economic, and political aspects of this bill, Redfield.

Dr. REDFIELD. In these aspects it seems to me the bill is good and its provisions are impressively bold and original as compared with some of the actions of the Federal Government in the field of research in which the necessity of combining investigation of social and economic consequences with the technical and physical matters has been neglected.

It is perhaps not remarkable that during the war the development of atomic energy for military purposes was carried on without the participation of students of society; but in the long run it was unfortunate that it could not be so combined.

There has been some hesitation in considering the general question of Federal support to research, as to whether support for the social sciences should also be included. This bill, however, quite clearly, as I read it, provides that support for research in the social and political and economic implications is to be carried on equally with the investigation of the physical and chemical aspects both by the Government and through grants in aid to other groups.

Furthermore, it is provided that the Commission becomes responsible for a study of what is going to happen to our society when the utilization of this invention really gets under way.

Dr. GUSTAVSON. That is something new, isn't it?

Dr. REDFIELD. That seems to be something completely new. In the past we have let invention fall where it might, and we have had industrial revolutions without being able to do anything about them until they happened. Now we know we may have a superindustrial revolution, and we hope we are going to be wise enough, if this bill is enacted and carried out, to take as much scientific forethought as can be accomplished.

Professor LEVI. I think this bill poses a different problem than the Kilgore or Magnuson bill for general social research, because you do need additional legislation on the industrial use, and you have to get the social and economic facts before you can get good legislation on that.

Dr. HUTCHINS. But the bill provides for studies by the Commission, studies by contracts made by the Commission, studies through grants in aid sponsored by the Commission, so that you have provision for continuous investigation of this subject as the invention develops, and this is unprecedented, unique, and highly desirable.

Now, as to industry, Levi.

Professor LEVI. I think the bill takes a middle-of-the-road, common-sense position as to the industrial problem. It does provide for these preliminary studies, and does provide that the Commission, as soon as it can, must make recommendations to the Congress for further legislation.

It does modify the patent system by not permitting any exclusive control, any refusal of a license; but the effect of the bill is to permit inventors to receive royalties or get paid for their inventions, so that it very clearly tries to preserve that incentive.

It also tries to encourage competition.

Really one of the very few restrictions placed in the bill is the authority given to the Commission to place restrictions on the use of atomic energy devices; the Commission may impose certain conditions in order to encourage competition.

Dr. HUTCHINS. The question is whether adequate incentives are provided for industry.

Professor LEVI. I think as adequate incentives are provided as you can possibly have without saying that we will permit industry at the present time to go ahead and manufacture power and produce fissionable material, which would raise a whole set of social and economic problems in the international scene, which I don't see how you can get legislation on now.

Dr. HUTCHINS. Industry has, of course, a two-billion-dollar backlog of investigation which the Government has carried on during the past 4 or 5 years.

Professor LEVI. And it is getting full use of that, because it has free access to all of that information, all of the patents, and everything. There are no blockings or fencing on patents now.

Dr. HUTCHINS. Mr. Chairman, our conclusion is that the McMahon bill is a good bill. It subordinates the domestic development and use of atomic energy to international agreements, as any good bill must do. It places atomic energy under civilian control. It does not treat atomic energy as a weapon.

Although it provides the necessary measure of governmental control, it at the same time frees research. It calls for both Government research and private research. It provides for research into the social, economic, and political aspects of the problem. It devotes special attention to medicine and biological research. Here we believe the bill could go further, and allow the distribution of byproducts for medical research in other countries. No program for industry can be drawn until the international situation is clearer and the social, economic, and political ramifications of atomic energy have been studied. The McMahon bill recognizes this fact and provides for the necessary study.

What is needed now is the freest possible research and development. The McMahon bill makes all basic scientific knowledge free and provides for the publication, under proper safeguards, of technical knowledge. The whole spirit and policy of the bill is that the most active research and development in this field must be encouraged by every possible means. Hence the bill modifies the patent system and prohibits the development of any monopoly or cartel.

The bill is in the best tradition of democratic legislation. It provides that Congress must be kept informed constantly. It calls for further legislation in the light of greater knowledge. It keeps this great development in the hands of the people, and puts its management in the hands of the civilian representatives of the people. It insists on the widest possible understanding of the problem. It promotes the widest and most rapid development of the discovery.

This is one of the rare moments in history at which it is possible for any man to see in simple dramatic form the issue before the world. We are on the brink of the precipice and one false step may take us over. The issue is no longer the issue of peace or war. The issue is peace or suicide. The people of the United States have recognized that this is the issue. They have declared that they will regard themselves as trustees for this discovery, which is freighted with incalculable good or incalculable evil for the world. The McMahon bill carries out the principle of trusteeship and gives us hope that we may plan with some confidence to obtain for mankind the peaceful benefits of our scientific knowledge and technical skill.

The CHAIRMAN. Now, Doctor, as I understand it, you are open to question?

Dr. HUTCHINS. Yes, sir.

Senator JOHNSON. Mr. Chairman, it seems to me that Professor Levi in his paper put his finger on a very important matter that applies to our job of setting up political controls.

He pointed out, as I understood it from his reading, that we were in no position at the present time to develop a long-range policy, the international situation being what it is and the domestic situation being what it is; that we are in no position to set up a long-range policy.

Perhaps I misunderstood him, but that is what I gathered from his paper. I couldn't agree with his conclusions altogether. If we are not in a position to legislate wisely, to set up the proper controls, then isn't the answer to find some way of setting them up where they can be changed as the changing picture comes into better view, rather than a stab in the dark at this particular time?

What I am driving at is this: Ever since this whole question of controlling atomic energy was dumped in the lap of the Congress, I have been trying to figure out some way of setting up congressional controls, having in view the same objectives that you men have, of providing against private monopoly and all of those things in this new field. But, unfortunately, I haven't been able to figure out in my mind, and no one has been able to help me, how we can set up congressional controls.

It does seem to me that one approach might be a sort of temporary procedure, maybe to last a year, 2 years, or 3 years, and then force it to come back for a further conclusion.

I noticed all through this round-table discussion the term "governmental controls." I would like to reduce that to "congressional

controls," rather than just "governmental controls," and that is the thing that I have been struggling with—and you have not been very helpful to me in your discussion along that line this morning.

Professor LEVI. Mr. Chairman, I don't disagree with that statement. As I understand the statement, it is that congressional control should be preferred over Commission control, and I certainly agree with that. It is also true that any legislation that is passed now, certainly as to the industrial use, must be regarded as temporary or interim legislation. That is the way I regard the McMahon bill.

You could perhaps have an additional statement to that effect in the bill, but the Commission is directed to make recommendations to the Congress as soon as it can as to changes or additional legislation.

Now, you could perhaps put aside the industrial power now entirely, and not have any legislation on it at all; but I think that would be unwise, because you do want industry to take part in the research and developmental work, and you do want to give them some incentives now. Therefore I think it is very important to be able to tell them now, "If you make an invention, you can either sell it to the Government or license it to other people and get a royalty."

I think it is quite important to tell them that now, so you don't have a stalemate until the other facts develop.

Without research and developmental work, I don't think you can get the other facts. As I understand it, that is the direction that this legislation takes. I agree that it is better to have the Congress do it.

Senator JOHNSON. It may take that direction, but it seems to me, if Congress enacts the McMahon bill, outside of receiving reports, it loses complete control. It occurs to me that perhaps there should be a time limit when this bill would completely expire. The trouble is that when Congress enacts a law, and then Congress attempts to amend that law, it runs up against a Presidential veto or the possibility of a Presidential veto and the requirement that you have a two-thirds majority to override that veto.

Changes in laws, amendments to laws, are not quite so easy in practice as they may appear in theory.

This committee had many noted physicists and scientists before it, and they gave us very helpful advice in their testimony; but I don't recall a single one who appeared before us, a single one of these noted men who appeared before us, who did not say in almost these words that unless we can set up international controls over atomic energy, the whole thing ought to be set aside, for two reasons: first, that it is impossible to separate the military uses of atomic energy from peacetime uses, that there is great difficulty in that; and, second, that the peacetime usage is a step toward military usage. You gather your uranium; you process it to a certain extent; you make plutonium out of it in the process of using it for power, and then it is only one small step—which they describe as being 75 percent along the way to a weapon—when you use uranium for peacetime power.

Since you have that great difficulty in front of you, and while steps are being taken—yesterday a very important step was taken—yet it seems to me that we are quite far removed from a satisfactory international disposal of atomic energy as a war weapon right at this moment when we are trying to write this bill.

Professor LEVI. I think anything that would require legislation on the subject again would be within the spirit of our discussion.

Dr. HUTCHINS. Mr. Chairman, isn't it possible to ask just what the McMahon bill does? It seems to me that what the McMahon bill does is to establish first the principle of civilian control. If you don't want civilian control, you don't want this bill.

The second thing the McMahon bill does it to promote research and development in every possible way. If you don't want research and development at this time, then you don't want this bill.

But the McMahon bill specifically does not authorize industrial use, which is 75 percent of the way toward military use. The McMahon bill explicitly postpones that issue, and thus postpones the only issue that is seriously involved with the international situation.

Senator JOHNSON. Well, that is your interpretation of the McMahon bill, and you have a right to that viewpoint. I am not quarreling with that viewpoint, and I am not quarreling with the McMahon bill. I hope that it does all the good things that you say, and still protects us against what might possibly happen to us.

I noticed in your statement a moment ago, Doctor, that you complain about Forrestal's position. I didn't understand Forrestal's position to be out-and-out military control. He did say that at the moment atomic energy is such an efficient weapon of war that the military does have a keen interest in it, that that has been the only use to which it has been put up to the moment, and therefore the military should have some little say-so in the control and handling of this new power.

As a matter of fact—and I don't think anyone can deny that the discovery of atomic energy, or the practical use of it, has completely revolutionized all of the military tactics that we have had in the past, completely changed them—the whole aspect of warfare has been changed by this new discovery. Since that is true, I think we would be very purblind to tell our military agencies, "That door is closed to you."

Dr. HUTCHINS. I should agree with that, Senator.

Senator JOHNSON. I think that is all that Secretary Forrestal was pleading for. That was my understanding.

Dr. HUTCHINS. Then he was misquoted in the press, and I apologize. It was stated in the press in Chicago that, in response to a question, the Secretary stated he would be satisfied with complete military control. If he did not say that, I apologize in behalf of the press and myself.

Senator JOHNSON. I didn't know about that statement.

The CHAIRMAN. No, he didn't; and I had occasion to talk with him again yesterday about it.

I think it is fair to quote him as he talked the day before yesterday and as he talked with me again, as saying that he believes that there should be a civilian—I don't want to say "domination"—control, but there should be more military representation than provided for in the bill as it is now written; and I think that is a better statement. In fact, it is a true statement of his position as he gave it to us.

Senator MILLIKIN. Mr. Chairman, I asked, I think, the question to which Dr. Hutchins refers in a glancing or negative way. That is, I asked him if he would object to a bill that for the time being kept control exclusively in military hands, and I think he said from a military standpoint there would be no objection to that. It was

not a question designed to test the merits or demerits of the Mc-Mahon bill; it was a question which I asked to test his own mind so far as a further temporary control might be involved.

Senator HICKENLOOPER. Dr. Hutchins, I want to call attention to the second paragraph of your first statement, not to criticize but to discuss it with you just a moment, in which you say that this overshadows Pearl Harbor, overshadows strikes, overshadows the internal affairs of the country.

My personal belief is that the stronger and more orderly our social and economical affairs in this country are maintained, therefore the more strength we have to use whatever this atomic energy gives us for world good, and that therefore, hand in hand with the importance of the atomic energy business, must go a sound solution of our domestic problems to give us internal strength ourselves and to prevent disruption.

I didn't know whether your statement was making those relatively unimportant.

Dr. HUTCHINS. No; all these matters are important, as I think the statement indicates. The issue of atomic energy is the issue of survival, really, and if you aren't expecting to survive, there is not much sense in worrying about what you are going to do with your life.

For example, you may expect a person in my position to suppose that the virtue and intelligence of the people are more important than anything else; I think they are; but if those people are about to commit suicide, there is not much use in discussing their virtue or intelligence if they are not going to be there tomorrow. That is all I mean.

Senator MILLIKIN. My thought is that domestic and social virtue internally in this country give us an added strength in order to accomplish things with it.

Dr. HUTCHINS. Absolutely.

Senator MILLIKIN. There is another statement here I would just like you to amplify for a moment, if you care to, a statement on page 2, where you say—

For this country to announce by way of domestic legislation that it regards atomic energy as a weapon would justify the fears of other countries and lead them to suppose that the United States intends to dominate the world by force.

Doesn't it also follow—or does it?—I didn't mean to put my question in a cross-examining manner—that the failure of any other countries of substance or power to agree readily to outlaw and to go along sincerely with the outlawing of atomic energy as a weapon might not also be an indication on their part that we might have something to fear from them, or something at least to suspect of them in the future?

In other words, the responsibility is not all ours.

Dr. HUTCHINS. Certainly, Senator, if any country which is in a position to exploit atomic energy on a large scale turns it over exclusively to the military in that country, or declines to cooperate in international agreements on this subject, there will be justifiable suspicions throughout the world of the intentions of that country.

Senator MILLIKIN. There is one question I would like to ask Mr. Levi.

As a lawyer, Mr. Levi, I take it you have given some considerable thought to this whole field of legislation on this subject. Have you heretofore prepared proposed legislation along this line?

Professor LEVI. Oh, I have read the legislation, and at times I have wished I knew how it could be done better. I have thought about it for a long time.

Senator HICKENLOOPER. I take it that perhaps, either in the preparation of this particular bill, or prior thereto, you were consulted about your ideas on this matter, weren't you?

Professor LEVI. Yes, but what I was trying to say, which I perhaps did not make clear, is that the consultation was by way of criticism of other people's language. I put it that way because there are things in this bill which I am not satisfied with, but I can do no better.

Senator HICKENLOOPER. There are many fine features about this bill. I am not objecting to it, but I am refreshed this morning, for it is the first time in a good many years in legislative history that I have seen a measure as comprehensive as this get such united approval in all of its particulars. I thought perhaps you had been consulted, Mr. Levi, and had given some aid and suggestions in the various categories of the provisions.

Professor LEVI. I will give you an example of what I mean. I think what we have been talking about are the major problems of the bill, as, for example, the patent problem. In discussing that problem we have said that we think the effect is to reward the inventor and to have a kind of compulsory licensing. Of course, that isn't quite what the bill says. The bill gives the title of the patent to the Government. I don't think that is necessary, but I also think it is less important, and I didn't think that was the kind of thing we ought to raise here.

Senator HICKENLOOPER. I am in thorough agreement with the general objectives. I think this has been a fine presentation and a unique method of presentation. I congratulate the Chicago round-table technique, because I think it is highly constructive, and certainly I have obtained a lot out of the discussion.

My own personal feeling is that any commission that is set up to handle this thing must, as has been suggested here, be considered a temporary approach to this problem. I think, 10 years from now, our views may change, but I also have the feeling that until satisfactory international agreements for the preservation of peace which we can rely upon have been reached, I do believe any control of this should take into consideration the military aspects of it until our safety and the safety of the world is established.

At this moment I cannot go along with completely divorcing it from all military implications, and I think military representation should be had until those agreements are reliable and until they have been put into effect. We might well announce now that the moment they are, we will abandon military participation, if it is necessary to do that.

Senator AUSTIN. Mr. Chairman.

The CHAIRMAN. Senator Austin.

Senator AUSTIN. There is one question I would like to ask about your conclusion, Dr. Hutchins.

Is it correct to construe your conclusion to mean that, before effective control of the destructive use of atomic energy is established, we ought to exchange reciprocally with another nation scientific knowledge regarding the constructive use of atomic energy?

Dr. HUTCHINS. Well, Senator, we take it as almost axiomatic in this field that basic scientific knowledge is already very well distributed, that there is nothing that can be gained by any attempt to conceal such knowledge as we already possess.

Second, we take it that the united effort of the world—or perhaps not the united effort, but the scattered efforts throughout the world—to advance basic scientific knowledge will be more valuable to us than limiting it to this country because of the technical skill and the resources of the people of the United States. Therefore, we see nothing to be gained by delaying any longer the distribution of basic technical knowledge and the basic scientific knowledge and exchange of such knowledge.

The bill provides for the control of the distribution of technical knowledge in such a way as to safeguard the interests of the United States. Now, what is needed at this stage is a statement of whether we are going to have civilian or military or mixed control, and a statement that we are going to support or not support the widest possible research and development in this field. That is essentially what the McMahon bill attempts to do.

We do not see any dangers in the military point of view in anything that the McMahon bill advances.

Senator AUSTIN. Then I understand your answer to be yes as to the basic knowledge but no as to the technical knowledge?

Dr. HUTCHINS. No; our answer as to the technical knowledge is the answer given in the McMahon bill, that such technical knowledge may be distributed to the extent that duly authorized representatives of the Government think it is safe to distribute.

Senator AUSTIN. Then is this true, that your answer is yes as to both basic and technical knowledge?

Dr. HUTCHINS. No. We do not favor the unrestricted exchange of technical information. We favor such exchange of technical information as will not endanger the security of the United States.

We rely on the governmental authorities created by the McMahon bill to determine what information may be distributed.

Senator AUSTIN. Then isn't it fair to construe your position to be that you do favor the prior effective control of destructive use of atomic energy, before the exchange of knowledge?

Dr. HUTCHINS. Not before the exchange of basic scientific knowledge, because we see no danger in such exchange. We feel that the representatives of the Government should be authorized to control the exchange of technical knowledge, but perhaps I am exceeding my authority in attempting to speak for my colleagues on this point.

Dr. GUSTAVSON. I think that is important to keep in mind, as I am sure that this committee does, that the atomic bomb as the end product of a great military enterprise was primarily an engineering project. The basic science, the discovery of fission, and a great deal of the basic knowledge connected with it, was all known before the war; the great task which science and industry carried out with the help of military organizations during the war was taking these basic principles and applying them for a definite end. It is important, I think, to remember that Dr. Compton, speaking in Chicago, made the statement that at no time were the engineers slowed down in their efforts to arrive at a point where they could manufacture a bomb by a lack of information that would come to them from research

work, all of which means that the basic knowledge that was available to the whole world was available obviously to any other nation. And they can, if they put the time in on it, gather the same information of a technical character that we gained.

Technical information is very important, and it takes time to get it; but technical information can always be gathered by any group of efficient technical people. Given basic principles and asked to arrive at a definite end, any good engineering concern would usually say, "Yes, that can be done."

Basic information, however, is of a different character. You cannot make any guaranties there, and that information is already available.

The other phase of that is that if we were to maintain secrecy on the basic science involved in this field, and other countries would do the same thing, we would very definitely hinder progress, because it is only as you get this interplay of mind upon mind that you make progress. That is a difficult thing, I think, for the layman to see; but in science it is just a first principle.

For example, Fermi's experiment in Italy on the bombardment of uranium by neutrons. He carries out the experiment, he sees a certain result, he gives it an interpretation. Then, for a matter of 5 years, the whole scientific world was in confusion. In fact, we could say the world was saved by confusion, because work was carried on, attempting to make so-called transuranic elements, and one was reported after the other.

Finally, after about 5 years, an individual in Germany sees the correct interpretation of what happened; and we run that same chance. We do something, we observe incompletely or we make the wrong interpretation. As far as the structure of science is concerned, it depends upon somebody else, maybe in our country or out of our own country, correcting us.

Senator AUSTIN. I think this question will be all I need to ask. I gather that the balance lies between the weight given to security and scientific progress, and you put emphasis on speedy scientific progress, whereas, as a committee of the Congress, it seems to me we have to put weight on security first—No. 1. Is that correct?

Dr. HUTCHINS. That is not the sole prerogative, Mr. Chairman, of a committee of Congress. Every American citizen must put security first. The question is, How do you get it?

Our position is that you will get the greatest security by the greatest scientific freedom, because this country, with its resources and its technological ability, can make the most of any scientific ideas that appear anywhere in the world.

Take a great electrical concern in this country. Its attitude toward trade secrets is likely to be less and less restrictive as it gets bigger and stronger, because it feels that the fewer trade secrets there are in the field, the greater its own progress will be, because it is sure of its own technical preeminence.

We can be sure at the present moment of the scientific and technical preeminence of the United States. It is in our interest, therefore, to provide for the widest exchange of scientific ideas on which we shall be able to capitalize for our own military security to a far greater extent than any other country in the world.

Dr. GUSTAVSON. In fact, the atomic bomb is an example of that. We were the only country that could and did take advantage of the

basic information developed in other parts of the world for the production of a bomb.

Dr. HUTCHINS. Nobody can say that the scientific ideas and knowledge underlying the atomic bomb were American ideas; they weren't. Our contribution on that score was probably less than that of six other countries you can name.

Senator AUSTIN. That is all, Mr. Chairman.

Senator JOHNSON. Dr. Gustavson, a moment ago you indicated that confusion was a great virtue and saved the world between 1935 and 1939. These dates are my own.

What leads you to think that confusion might not be a blessing from 1946 on for a few years, the world being in a chaotic state such as it is in? Might not a little confusion be very helpful for the time being until we get better stabilized politically?

Dr. GUSTAVSON. I think that is an interesting question. Of course, with respect to the first part of it, what I had in mind was, if you had a correct interpretation in 1934 and 1935, after the Fermi experiment, Germany with her preeminence as a nation of scientists or high technical skills in science and technological skills in industry would have had the bomb. There is no doubt about it.

Now, then, a great deal of the confusion on one of the most important discoveries has disappeared. There might be some confusion grow out of future experiments if some country should do an experiment which ultimately would give us atomic energy, but which result we didn't see at the moment; it might be again true that confusion would save us, but at the moment we have got a firecracker in our hands, and that is a reality, not the firecracker of the future, as I see it.

Senator JOHNSON. Then the political situation in the world is far from ideal at the moment.

Dr. GUSTAVSON. That is right.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. I gather from what you said, Dr. Hutchins, that no matter what you may think of the field of political science, you do not favor cloture on the other sciences. Is that correct?

Dr. HUTCHINS. Yes, sir.

Senator MILLIKIN. I believe that the work of this committee will more or less turn on how it accepts certain assumptions that you set out at the beginning of page 2 of your remarks. I would like to read those remarks again and bring them forward.

Any legislation in the field of atomic energy must be based on the assumption that war will in some way or another be averted. We cannot assume that there is going to be a war and then try to frame domestic legislation on that assumption. The assumption that there is going to be a war would lead to the conclusion that we had better start the war this morning, because only this morning can we be sure of having supremacy in atomic bombs.

No plans for atomic energy, and no plans for anything else, for that matter can be made on the supposition that we are going to have war. Any war we have will be so destructive that no plans can be carried out. We must plan in the conviction that we can defeat war and develop atomic energy in a world at peace.

As far as I am concerned, Doctor, if I could accept your assumptions there, the rest of the problems before this committee would be very simple. I should like to explore a little with you the basis for that theory and the basis for your assumptions.

What valid reason is there at the present time for assuming that war will be averted, beyond our hope that it will be averted?

Dr. HUTCHINS. Well, the question is not, Senator Millikin, whether war is going to be averted. The question is rather, What are the assumptions on which any legislation at the present time in regard to atomic energy can be based?

Senator MILLIKIN. But if we cannot accept a durable, valid assumption that war will be averted, we then have the job of assuming that it may not be averted, and the two lines of procedure as against one hypothesis or the other would be much different.

Dr. HUTCHINS. Well, would they be so different? Let us consider what the results of one assumption or the other would be. Let us assume that there is going to be a war. In that case, the thing to do is to start one, because at the present time we have the power to win.

Senator MILLIKIN. Let us look that right square in the face. I think that you have posed something there that we are all ducking, but let's look it right squarely in the face.

Suppose that we were to reach the conclusion that war is inevitable. Would you say that we would be warranted in using the bomb to destroy the nation that we figured would inevitably involve the world in war?

Dr. HUTCHINS. I decline, Senator, to be brought into that hypothesis as a participant. If you say that in your opinion war is inevitable, then it seems to me—and if you say that your first duty is to protect or defend your own country—you would be warranted in exerting all your efforts to getting the war under way at once, because we are in a better position to win now than we may be in the future.

Senator MILLIKIN. Let us assume that you reached the conclusion that war is inevitable.

Dr. HUTCHINS. You have my recommendation.

Senator MILLIKIN. I am delighted that you look that in the face and give that answer to it. It might come to that.

As you look around over the world, Doctor, what are the cheering prospects that will enable us to indulge in the assumption, so far as law making is concerned, that we have seen the end of wars?

Dr. HUTCHINS. Perhaps, Senator Millikin, we ought to make clear that we think that there are two issues here: One is the issue of the foreign policy of the United States, which is not, as such, before this committee; the other is the issue of what you are going to do with atomic energy.

Now, we have assumed that it is the foreign policy of the United States to maintain and promote peace in every possible way. We believe that atomic energy must be considered in the light of that policy, and that that is the only way really in which it is useful to consider it, because if that is not the policy of the United States, and if we are not going to find the ways to implement that policy, then the thing to do is not merely to sit on the atomic bomb, because sitting on the atomic bomb will not protect us from the atomic bombs that other nations will shortly be able to produce.

The answer, if you assume it is not the policy of the United States to promote peace and that we cannot obtain peace, is to start a war.

Senator MILLIKIN. There you have a divided subject. I think it is the policy of the United States to promote peace; of course it is.

I think that in the main that has always been our policy, and I am sure that it is our policy at the present moment.

But war is made, as is obvious, between several nations; and our policy does not necessarily control the war-making potentials in this troubled world.

Dr. HUTCHINS. I would like to point out, Senator, that this bill is subordinate at every point to the foreign policy of the United States. If the foreign policy of the United States changes, either because of a change in the Congress or the administration, or because of a change in the national situation, then the policy of the Commission and the policy of the Government in regard to atomic energy can change. So it seems to us that the bill provides for these fluctuations in the world situation to which you were referring.

Senator MILLIKIN. But that would raise the basic question, then, whether we would want to turn over—whether Congress, which has the job of supplying and maintaining our military forces and has the responsibility for the declaration of war, and so forth, would want to turn over to a commission the power to determine questions that are that vital.

Dr. HUTCHINS. I do not believe that the power is in the Commission to determine the foreign policy of the United States. The Commission is subject to the direction of the President in regard to the foreign policy of the United States and the utilization of atomic energy in the light of that policy.

Senator MILLIKIN. Let us suppose that the President of the United States, under that theory, conceived the notion that the world is about to come out of the present armistice and go into war, and let us suppose then that he instructed the Commission to govern itself accordingly.

Do you not think that the Congress ought to have something to say about that?

Dr. HUTCHINS. I should think it would. Congress does not abdicate by passing a single measure of this kind.

Senator MILLIKIN. Well, it abdicates if one bad decision were made and executed before Congress could act. I think that is what Senator Johnson was driving at a while ago.

Senator JOHNSON. That is exactly what I was driving at.

Senator MILLIKIN. We haven't had an answer to that. One bad decision, either to withhold the use of the bomb or to use the bomb, might shape the whole face of the earth for all time to come, and it might change the whole complexion of this country.

Dr. HUTCHINS. I don't see anything in this bill that changes the war powers of Congress. The use of the bomb is an act of war, isn't it?

Senator MILLIKIN. I say we give the preliminary power to a commission to accept the instructions of the President on the foreign policy of the country, and to govern itself accordingly. If that Commission acted, and acted promptly, it might then present the Congress with nothing more than a very unfortunate fait accompli, or it might be a fortunate one.

The CHAIRMAN. The President of the United States is the Commander in Chief of the Army and Navy, isn't he?

Dr. HUTCHINS. Yes.

The CHAIRMAN. As such, he is over the Army and Navy, and in the same way in charge of this establishment and this Commission, is he not?

Dr. HUTCHINS. I believe so, but the situation which Senator Millikin forecasts is one I find inconceivable.

What would happen as a result of it? There would be, let us say, some increase in the rate of production of atomic bombs, reports of which are required to be filed quarterly with the Congress. There is nothing in this act that would give the Commission the power to drop an atomic bomb. That would be an act of war on which Congress would have to take its own position.

Senator MILLIKIN. Let us turn it around, and let us suppose that the Commission, in response to the President's views on the state of our foreign affairs, had opened the way to the peacetime use of atomic energy, and had authorized the freest exchange to the ultimate extent of all the information available to us and that abroad, but that the President's estimate of the situation was wrong in that under the exact posture of the world we were not quite ready for that.

Would not the Commission have that power, and would not the President have the power to suggest that the state of world affairs is such that you can now make this free exchange?

Dr. HUTCHINS. The first question is the exchange of what? As we have indicated, in our judgment the exchange of basic scientific knowledge is not a danger to this country.

The second question is the exchange of technical information. Since the Congress would receive quarterly reports to amend its legislation, and since it would take considerable time for any nation to avail itself of the technical information that would be released by the Commission, even assuming that the Commission and the President were all entirely wrong, it would seem that there is sufficient congressional control provided.

Senator MILLIKIN. Well, it just depends on whether you want to give the Commission the power, then, to start on what might turn out to be a very bad policy for the United States, on the theory that we could recall the start if we didn't like it.

You are dealing here, I will remind you, Doctor, with a cataclysmic force. I said once before that when you talk about this thing in stages, it is like going over Niagara Falls in stages.

Dr. HUTCHINS. What would be your estimate, Gustavson, of the amount of time that it would take other nations with adequate industrial facilities to build an atomic bomb if they had all the scientific and technical information which the United States possesses?

A very large amount of the technical information that the United States possesses has already been published in the Smyth report by the War Department, and all the basic scientific knowledge is well known.

Suppose a nation now starts from scratch to build an atomic bomb.

Dr. GUSTAVSON. I think most people have estimated that it would take from 2 to 5 years. I think we can see that situation if we pick an analogy. Suppose that in this war we did not have the internal-combustion engine, but suppose that at the beginning of the war we knew that gasoline-air mixtures would explode, that you could explode them with the electric spark, that if the explosion took place in a piston, the piston would be driven out, and you could turn a wheel. That is basic information. How long would it take to build a tractor or a jeep, tank, or automobile, with that information?

Well, we know that with that scientific information, basic information, it would take us years to do it. The speed with which we

were able to build the atomic bomb in a matter of something like 3 or 4 years is a pretty good estimate of how long it would take somebody else to do it.

Senator MILLIKIN. Would that not be qualified by the fact that with this exchange of information there undoubtedly would be short-cut processes? Would it take us 2, 3, 4, or 5 years to repeat what we have done, in the light of our present knowledge?

Dr. GUSTAVSON. If you started with the basic knowledge we now have, I think it would take us just about as long to build an atomic bomb if we started from scratch again, to develop the plants and all that go with it.

Senator MILLIKIN. Then the question comes to what we are exchanging. If we are proposing to exchange that which everyone knows, then the bill is futile and there is no point in the exchange.

Dr. HUTCHINS. I beg your pardon, Senator. The regulations of the Manhattan district during the war were based on the assumption that nothing should be exchanged, nobody should talk to anybody, even scientists in different sections of the project shouldn't talk to anybody; and it is important to get the principle established by legislation that in the further development of atomic energy that restrictive process shall not go on.

Senator MILLIKIN. Let us assume that is correct. I am talking about exchange now with foreign nations. They either exchange something they haven't got or want, or we are just passing the Smyth report back and forth; or if you take that assumption, that we are just passing the Smyth report back and forth, then we are not really dealing with anything of importance, because they know about the Smyth report, and they have the facilities for making a compendium of known information the same as we have.

We must necessarily direct our attention, I suggest, to the exchange of something that they haven't got that they would like to have. Now, if we give them that—and let us say that it took them 2 years to use it—if we have misjudged the international situation, if we have misjudged the party to whom we give the information, 2 more years of life in the whole cycle of time is not very important.

Dr. GUSTAVSON. I see the point that you are making. Let me put it this way. I am sorry, for psychological purposes, that we started talking about the secret of the atomic bomb and implied that we had secrets of a fundamental nature with respect to the bomb.

Senator MILLIKIN. I am in entire agreement with you, Doctor.

Dr. GUSTAVSON. May I say just one thing more? I would have been delighted if, when we issued the Smyth report, the Federal Government would have said: "We were successful in building an atomic bomb. The world knows that. It has seen the demonstration. We are now giving you the basic principles on which the atomic bomb was built."

That would have resulted in a world feeling, it seems to me, that the American Government, the United States Government, developed a bomb and used it under a pressure of great necessity of national survival, but is not interested in atomic bomb warfare.

When we started talking about secrets, which we do not possess—because as far as basic information is concerned, they are open—then we started to indicate that we do have a military advantage in terms of fundamental basic knowledge, which we do not have, and we are lulling ourselves into a false sense of security.

Senator MILLIKIN. Doctor, I suggest that that comes down again to the fact that we are exchanging that which has no value of currency. We either have something that is worth keeping to ourselves, or we do not.

Now, if we are going on the assumption that the other fellow knows as much about it as we do, what is the point in all of this exchange talk? That can go on anyhow.

If, on the other hand, we have something that is of value which they want and haven't got, then we have an entirely different problem.

Dr. REDFIELD. Senator, if I may interpose, does not the bill provide for the greatest circulation of basic scientific knowledge yet to be learned?

Senator MILLIKIN. Yes.

Dr. REDFIELD. A provision of the bill which we here at this table seem to admire is that it prevents the interposition of such regulations as attended the Manhattan project with regard to future basic science, and therefore there will be something that other countries can use, but that we can use better than any other country.

Senator MILLIKIN. Suppose someone in the laboratory evolves a novel conception of a further step in this thing which will magnify its power 10,000 times. Now, that is a laboratory conception. Should that laboratory conception be circulated around over the world prior to the time we are convinced that the world is in for peace rather than war?

Dr. REDFIELD. As you put the case, Senator, it would seem to fall under the head of technical knowledge rather than scientific.

Senator MILLIKIN. I do not put it in the case of scientific. I put it in the case of laboratory conception.

Dr. HUTCHINS. Wouldn't we be interested in where that idea originated?

Let's look at the international situation with regard to the construction of the atomic bomb. Fermi was in Italy. Hahn was in Germany. Niels Bohr was in Denmark. Five or six of the most important men on the Manhattan project are Hungarians who had worked in Hungary in this field. The basic work of Chadwick in England was fundamental to the development.

Now, we grabbed them all—not the men, but we grabbed some of the men, as many as Hitler and Mussolini honored us by sending here; but we grabbed their ideas, and we made the bomb. I think it can be shown that there is some Japanese scientific influence behind the bomb as well.

Now, let us take the case that you suppose, and let us imagine that it is a basic scientific idea. If it arises here, you may wish to monopolize it; but suppose that it arises somewhere else in the world. We are not talking about a one-way street; we are talking about exchange, and when we say "exchange" we mean exchange. We are assuming a situation in which all scientific workers all over the world in the field of nuclear energy are busily engaged in laboratories and busily putting out their results. Our contention is that the United States will be able to get further with its own military security with the freest system of exchange, because we can capitalize better than any other nation on any other ideas that arise anywhere.

Senator MILLIKIN. Now would you mind giving me an answer to my question? Assuming that we have a laboratory conception of the

kind that I have mentioned—I am not talking about a technological development, but a laboratory conception—would you say that we should circulate it?

Dr. HUTCHINS. I should say that it would be in the long-term interest of the United States to have the freest circulation of such basic ideas.

The CHAIRMAN. Doctor, there seems to be apparently some impression that there is a provision in this bill which makes it automatic that blueprints of bombs shall be sent, upon the enactment of the legislation into law, posthaste all over the world. You have no such understanding, have you?

Dr. HUTCHINS. No, sir.

The CHAIRMAN. Now, there has also been some discussion about congressional control. I am one who is very sympathetic to having the most congressional control that can possibly be had within the traditional framework of our form of government. We have the executive, the judicial, and the legislative; and the legislative, as I see it, may only lay down a plan or program which the executive has to execute.

Now, in this bill I think you will find, will you not, several things that the Congress must do in the field of atomic energy that it does in no other field? For instance, it prohibits the Commission from introducing into our industrial life any application of atomic energy without reporting to the Congress and getting Congress' approval. Isn't that true?

Dr. HUTCHINS. Yes.

The CHAIRMAN. It also calls upon the Congress for its appropriations. Of course, that is the same as any other commission or activity of our Government. Congress has the blood stream which goes into it, keeping it alive or not.

It must report quarterly—the Commission must report quarterly—to the Congress for everything that it has done and everything that it plans to do; so it does have congressional control written into the bill.

Senator JOHNSON. I would say, if you permit me to, Mr. Chairman, that reports are very unsatisfactory controls.

The CHAIRMAN. If you can figure out some way, Mr. Senator, whereby the Congress can go down and operate the Manhattan district—we might just as well try to operate the Postal System, the TVA, run the Army and Navy, and have every Senator out with his own army on a battlefield.

Senator JOHNSON. I wouldn't go quite that far, but I am certain of this, Mr. Chairman: If Congress were controlling the Manhattan district, the Manhattan district wouldn't be working feverishly, day by day and month by month, creating atomic bombs until atomic bombs are under some sort of control. That is one thing that I have got to say.

I haven't been able to understand our good friend from Chicago who is very jealous of giving the military any power whatsoever, and yet in the bill which they have so completely approved we give the Commander in Chief of the Army and Navy complete control. But at the lower levels, when you get down to the Secretary of the Navy or the Secretary of War, they say, "No, no, that should not be done."

Dr. HUTCHINS. I don't think so, Mr. Senator. Speaking only for myself, I should have no objection to adding the Secretaries of War,

State, and the Navy to this Commission. What we are attempting to suggest is that the Commission must be predominantly a civilian commission.

The CHAIRMAN. That is exactly what Forrestal suggested the day before yesterday, that the Secretaries of War, State, and Navy be added to the Commission.

Senator AUSTIN. I was very anxious to have him put on the record—and he did so—his assent to the proposition that if Congress so reorganizes the military department that there should be a munitions board in it, he agreed with the theory that any commission or committee that is created by such a bill as this should be articulated with it, and, if so, that would accentuate the civilian control.

Senator MILLIKIN. I would like to explore another angle of the thing, Doctor. I assume that you accept the thesis of most of the scientists that inspection in any event is necessary to the control of the use of atomic energy.

Dr. HUTCHINS. I think that is a very interesting point.

Senator MILLIKIN. Proclamations, in and of themselves, are not sufficient, but have to be implemented with inspection.

Dr. HUTCHINS. There has to be some way to be sure agreements are kept.

Senator MILLIKIN. How can you assure a dependable system of inspection of any country that does not permit freedom of the press or general free exchange of news, or that operates—as Senator Vandenberg describes it—“behind an iron curtain”?

Dr. HUTCHINS. This bill, I think, Senator, does not attempt to deal with the question of international legislation in this field, nor does it attempt to determine international policy in this field.

It says that on the assumption that international agreements can be worked out and will be kept, this bill is subject to those agreements. If they are not worked out, or you think they cannot be kept, then some other legislation will have to be adopted. There is nothing in this bill that in any way imperils the security of the United States. This bill merely provides for the most rapid development of research and technology in this country, in this area.

Senator MILLIKIN. You would not contend, would you, Doctor, that in framing the bill we should frame it on a strictly domestic basis without any thought in our minds of international implications?

Dr. HUTCHINS. Our position is the opposite, that any bill must be subordinate to international agreements.

Senator MILLIKIN. So we must, of course, look at the situation over the world and let our minds play over questions such as states that operate behind an iron curtain, and as to whether inspection systems in those states will be worth the agreement that might be entered into respecting those systems.

Dr. HUTCHINS. May I put it this way, Senator? Some legislation in this field should be passed as soon as possible. General Groves has announced that he is reluctant to continue, that the Manhattan district is disintegrating, yet we know that work in this field should continue. Therefore, some arrangement for the continuation of the work, presumably not under the direction of the Army or of the Manhattan district, must be made.

Now, what arrangement can be made now that will provide for the continuation of the work, relieving the Army and the Manhattan

Engineering District, without imperiling the security of the United States? What can you do in advance of international agreements?

We see nothing in this bill that prevents the United States from entering into appropriate international agreements. We see nothing in this bill that endangers the United States if such agreements are not entered to.

The CHAIRMAN. I want you to stress that. In other words, it goes both ways. If we enter into agreements, there is nothing in the bill that prevents it. If we don't enter into agreements, and go into an armament race, we could undoubtedly of course go into it under this bill.

Dr. REDFIELD. You can put it stronger than that, can't you. This bill makes it as easy to enter into international agreements as any legislation which would meet the other considerations.

Dr. HUTCHINS. And meanwhile you advance research and development.

Senator MILLIKIN. One phase of the problem—and we might as well face that also—is what would be the objection to keeping the matter bottled up under military control for a reasonable period of time until we can see, for example, how the UNO is going to work out, until we can make a better estimate of the prospects of peace in this world? What would be the objection to that from a scientific standpoint?

Dr. HUTCHINS. I think there would be objection from the scientific standpoint, because the scientists, although they were willing to submit to restrictions which in some cases amounted almost to those of a concentration camp during the war, would not do their best work, and some of them I feel sure could not work at all if the regulations and program of the Manhattan district were carried out during peace.

Senator MILLIKIN. But if for security reasons it were thought wise—I don't ask you to accept the assumption—to continue the matter under military control, keeping in mind that at the present time we do not have the commercial use of atomic energy, and that we do have a weapon for a limited period of time, say 6 months or a year, science would not suffer irremediably, would it?

Dr. HUTCHINS. Of course, as you state the question, the answer must be "No." How could I say that science would suffer irremediably from anything, even, say, from the assassination of all the existing generation of scientists? There might be another generation.

Senator MILLIKIN. Science would suffer irremediably if you bottled it up forever?

Dr. HUTCHINS. Even then I suppose there might be a black market in scientific knowledge.

Senator MILLIKIN. I would not suggest that, even in trying to get a viewpoint on one phase of our problem, so my proposition goes to a limited, and I hope temporary, extension of the existing arrangement.

Dr. HUTCHINS. I would say, only as a retired professor of evidence, that the burden of proof is upon anybody who wishes that policy followed, because we do know that it will restrict scientific advance. We do know that it is not in the long-term interest of our country, even looked at from the security point of view, because the long-term security interests of our country are involved with the most scientific work in this field. Therefore, it is in the interest of science to remove restrictions.

Now, to the extent to which you insist on continued military control, to that extent science will be hampered, and anybody who proposes—in peacetime, at least—to hamper science, has the burden of proof.

Senator MILLIKIN. Yes, that is quite a burden, too; I agree with you entirely on that. But we are not, strictly speaking, in peacetime, Doctor.

Senator AUSTIN. It is usually stated the other way, is it not, that the burden of proof falls on him who takes the risk?

Senator MILLIKIN. Yes; I agree with that.

Dr. HUTCHINS. The question is, Where is the risk?

Senator MILLIKIN. We are not, I suggest, Doctor, in a state of peace. We are not even in a technical state of peace.

We still have all of our war controls set up under laws of Congress, unrepealed, and all you have to do is take a look around the world and you are convinced by what you see that we are not in a real state of peace.

Senator JOHNSON. We have an Army of 4 million men.

Senator MILLIKIN. Yes, and we propose to keep an Army of perhaps a million and a half.

Senator JOHNSON. And a Navy of more than a million.

Senator MILLIKIN. We will have a total Military Establishment of how many people?

Senator JOHNSON. On July 1 we will have an establishment in the Army and Navy of 2,100,000. As of January 1, we have an establishment of 4 million in the Army and nearly 2 million in the Navy.

Senator MILLIKIN. That suggests, Senator Johnson, that while we worry ourselves so much as to what we do as a threat of something, those who are much persuaded by that line of argument should give thought to whether a Military Establishment of that size is a threat.

Senator JOHNSON. I have one more question I should like to ask. I know it is very late and that all of us are anxious to get away, but I would like to ask Dr. Hutchins if he believes that there will ever be another world war in which the atomic bomb will not either be used to start it or to finish it, unless we develop some more terrible weapon than the atomic bomb.

Dr. HUTCHINS. Well, I should certainly say that if there is another war within the next 5 years, the atomic bomb will be used either in starting it or finishing it.

My unfortunate acquaintance with the university laboratories leads me to suppose that there are other weapons equally terrible, or even more terrible, that will be produced either before or during the next war, which may make the atomic bomb obsolete.

Senator JOHNSON. But you do think that that is a very important and fundamental question, nevertheless?

Dr. HUTCHINS. Yes, sir.

Senator JOHNSON. In dealing with this whole problem, I am optimistic enough to believe that the atomic bomb is the greatest instrument for peace that has ever been discovered, and these more terrible weapons that are to follow it and are following it will make world wars absolutely unthinkable, and, therefore, that we are headed for peace. I think that these weapons will bring about that peace, will force us to peace.

As you put it a moment ago, peace or suicide. No sane man, individually or collectively, is going to accept suicide when he can have peace.

Dr. HUTCHINS. The issue is certainly peace or suicide.

Senator MILLIKIN. Do you mind, Senator Johnson, if I carry that one step further?

Senator JOHNSON. No.

Senator MILLIKIN. Doesn't the logic of your whole thesis carry you to this, that if the bomb must be used, we should use it first?

Dr. HUTCHINS. If you believe that the bomb is going to be used, then you had better use it first.

Senator MILLIKIN. That is one place where we cannot be mushy-minded. If the authority should conclude that there is going to be atomic warfare, of course, we ought to be the first to use it. That assumes that conclusion.

Dr. Gustafson—and I think his estimate coincides with the other estimates we have had here—believes that, so far as the atomic bomb as we know it now is concerned, we have a period of grace of from 2 to 5 years, not because of any inherent secret in it, but because it would take that long to develop the know-how and to build the plants and to actually make bombs.

So the underlying question, Dr. Hutchins, I suggest—or one of them—is, What shall we do with that bomb in the period of grace to try to bring about a situation in the world where a bomb will never have to be used?

Dr. HUTCHINS. That depends on the foreign policy of the country.

Senator MILLIKIN. Exactly.

The CHAIRMAN. Certainly it would be unthinkable that we should drop them first, wouldn't it, Doctor, and maintain ourselves as a democracy?

Dr. HUTCHINS. I think the theory of the preventive war would be extremely unpopular in this country.

Senator MILLIKIN. Suicide is unthinkable, too. Between the two, Mr. Chairman, I shudder less at the thought of dropping the bomb than of having the country destroyed.

The CHAIRMAN. If there are no further questions, we will recess until Monday.

(Whereupon, at 12:15 p. m., the hearing was recessed until Monday, January 28, 1946, at 10 a. m.)

ATOMIC ENERGY ACT OF 1946

MONDAY, JANUARY 28, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met at 10 a. m., pursuant to adjournment, in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Tydings, Austin, Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

Dr. DAVIES, as I understand it, you represent the Federation of Atomic Scientists, and I believe that they wrote the committee and asked to have you represent them, and you were assigned to testify this morning.

Dr. DAVIES. Yes; I shall represent them insofar as anyone may represent the opinions of a large group.

The CHAIRMAN. But you were selected to represent them. Who selected you?

Dr. DAVIES. Members of the executive committees of these separate associations.

The CHAIRMAN. How many on the executive committee?

Dr. DAVIES. I think we have about seven or eight, and that is probably a typical number.

The CHAIRMAN. And that is composed of one from each site?

Dr. DAVIES. No; each site has an executive committee, and the executive committees exchange recommendations and then settle on a single candidate.

The CHAIRMAN. All right. Go ahead.

STATEMENT OF DR. HARRISON DAVIES, REPRESENTING THE FEDERATION OF ATOMIC SCIENTISTS

Dr. DAVIES. My name is Harrison Davies. Professionally speaking, I began life as a biochemist. During the war manpower crisis I was converted to a radiochemist. I have been an employee of the metallurgical project in Chicago and of the Clinton Laboratories at Oak Ridge. I have been engaged in chemical studies in the plutonium project since the summer of 1943.

Senator MILLIKIN. May I ask for something of your preliminary professional training before you became a radiochemist?

Dr. DAVIES. Yes, sir.

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I received a bachelor's degree in chemistry at Johns Hopkins University in 1935 and a Ph. D. in physiological chemistry from the Johns Hopkins Medical School in 1938.

Following that I was a research fellow in the natural sciences from 1938 to 1940 at California Institute of Technology at Pasadena, Calif.

Following that I was in industry for 3 years in the Lederle Laboratories outside of New York City.

Senator MILLIKIN. Whom were you with in the industry?

Dr. DAVIES. American Cyanamid, a subsidiary of the Lederle Laboratories. That is a biological house, making antisera, vaccines, and so forth.

Senator MILLIKIN. I am curious about what was involved in your conversion from a biochemist to a radiochemist. Can you tell us in untechnical language what that involved?

Dr. DAVIES. Yes, sir. A great deal of midnight oil.

Senator MILLIKIN. Can a man that is trained generally in chemistry and, let us say, expertly in chemistry, generally speaking, make a conversion rather rapidly from a biochemist to a radiochemist?

Dr. DAVIES. It is important that he have a good theoretical training.

Senator MILLIKIN. Let me tell you why I am asking the question. During the course of the hearings here, the question has come up frequently as to how quickly a foreign country could assemble or train the technical skill necessary to make bombs. The impression that I gained out of the testimony heretofore is that it is quite a long and arduous process, involving much experience and training, to convert a man who has been in one branch of physics or chemistry into the branch that has to do with this energy. What would you say about that?

Dr. DAVIES. I think it is very important there be at least a nucleus in the new group to start the training program. If there is such a nucleus—let us say one specialty man per dozen ordinarily trained chemists or physicists—then it will go pretty fast.

If such a nucleus is not present, I imagine the difficulties would be very much greater.

Senator MILLIKIN. If there were not a nucleus of that kind present, you would almost have to start your original research from the beginning, wouldn't you?

Dr. DAVIES. It would be much more arduous.

I am here this morning to present the views of the Federation of Atomic Scientists, composed of scientists and engineers who have worked on the Manhattan project. For several months we have studied the various proposals for domestic legislation on atomic energy. As scientists, we desire legislation which will foster research and development in the field of atomic energy and will preserve the freedom necessary for the further advance of science. As citizens, we fear unwise laws on atomic energy for the same reason other citizens fear them: We, too, value our lives.

Long before the atomic bomb fell on Hiroshima we realized that it would affect political and economic ideas all over the world. While the rest of the world was preoccupied with war, we came to the view that our work might well have more far-reaching results than the winning of the war itself.

While we debated the issues and strove for a plan which might secure safety for the world and yet realize the full benefits of atomic

energy, we lacked advice from other quarters. With the release of the bomb and the introduction of atomic energy legislation into the Congress, it became possible to form organizations, seek expert opinion in other fields, and publicize our views. We have done our best to add to our technical knowledge of atomic energy some understanding of the complex political, legal, and economic features of the problem.

The Federation of Atomic Scientists has developed a set of policies which our members believe should be embodied in atomic energy legislation. We now have the opportunity to compare our aims with the provisions of a specific bill. The McMahon bill satisfies these aims in great detail. The men who made the bomb are for the bill. I wish to report to the committee that S. 1717 has the strong support not only of more than fifteen hundred Manhattan project scientists and engineers, but of thousands of other scientists.

I appear here today empowered by the groups which make up the Federation of Atomic Scientists to tell you why we like the McMahon bill; why we think that, with a few minor changes designed to strengthen the obvious intent of the bill, it will be the best practical solution of the problems of domestic legislation.

Any bill should include two aims: security for the country and exploitation of the peaceful benefits of atomic energy. With these in mind, we have examined S. 1717 in terms of—

- (1) Contribution to the hope of peace;
- (2) Stimulation of research and development;
- (3) Provisions for studies and reports by the Commission; and
- (4) Administrative structure.

INTERNATIONAL CONTROL AND THE NATIONAL SECURITY

There can be no real national security in a world in which many nations possess atomic weapons. There can be no solution of the problem of security short of an effective international control of atomic and other weapons of offense and of the elimination of war as a method of settling international disputes. Any domestic legislation must therefore encourage the international control of atomic energy. We believe that S. 1717 fulfills this requirement. The problem of the production of atomic bombs is treated specifically; responsibility is so fixed that international regulation must take precedence. In this respect, we feel that the addition of a general section stating explicitly that international agreements will supplant the provisions of the bill will enhance the prospects for obtaining effective agreements.

The CHAIRMAN. I thought that language was pretty definite, Doctor.

In the bill it states that any provision that is in conflict with any agreement that is hereinafter made shall cease to be valid. Let's see if I have the correct wording on that.

Dr. DAVIES. This quotation appears under "Military Applications of Atomic Power" does it not, page 12, section 6?

Senator AUSTIN. Of course, you have no idea that such a statement is necessary in order to give effect to the international agreements, do you?

Dr. DAVIES. No; it is not necessary, but possibly it is helpful.

Senator AUSTIN. It is solely to have the bill express an attitude of the United States?

Dr. DAVIES. Exactly, sir.

Senator AUSTIN. And you think that that attitude might promote agreement among nations?

Dr. DAVIES. I do.

The CHAIRMAN (reading from S. 1717):

The Commission shall not conduct any research or developmental work in the military application of atomic power if such research or developmental work is contrary to any international agreement of the United States.

Mr. DAVIES. Yes; I think the feeling of the group was that that might well be given more prominence in an earlier portion of the bill.

The CHAIRMAN. Just a matter of emphasis?

Dr. DAVIES. Yes, sir.

Senator TYDINGS. You are in favor of the purport and intent of it, but you simply want it made more clear?

Dr. DAVIES. High-lighted.

The CHAIRMAN. Of course, you realize, as Senator Austin says, even if that clause were not in there it would still have the effect. If an international agreement were properly ratified by the Senate or Congress, our domestic legislation would, then, under the Congress, be superseded.

Dr. DAVIES. Yes; but I wonder if all of our foreign readers are aware of that.

Furthermore, the provisions of the bill for the domestic development of atomic energy are such that international control can be introduced without serious domestic dislocation. A commission, responsible to the President and to the Congress, controls the production and the distribution of fissionable materials; the Commission has full powers of inspection and can require reports on all work in the field; private monopolies are not permitted; premature industrial development which might prejudice international agreements, by the creation of vested interests and by complicating the inspection problem, is not allowed.

Senator MILLIKIN. I notice especially the sentence that you have read under your subhead I, as follows:

There can be no solution of the problem of security short of an effective international control of atomic and other weapons of offense and of the elimination of war as a method of settling international disputes.

Suppose that you should reach the conclusion that a dependable international agreement among the principal powers of that kind is not possible. Would that modify your attitude toward the bill in any way?

Dr. DAVIES. No. I think that in that eventuality the precise provisions of the bill will not be of much importance; that we shall have to change entirely our legislative structure and our plans for the future.

Senator MILLIKIN. And there would have to be another approach to it?

Dr. DAVIES. Yes; I suspect so.

Senator MILLIKIN. In that event, can you visualize perhaps a tighter military control of the subject than is provided for in the bill?

Dr. DAVIES. Well, I believe the proper steps to take will have to depend on the precise circumstances of this hypothetical eventuality, and I don't believe we can possibly specify it now in sufficient detail.

Senator MILLIKIN. Does that indicate to your mind that perhaps we are, for a brief period of time, premature in this matter?

Dr. DAVIES. No; because I believe that our very best chance of not getting into this precarious eventuality that you mentioned is to proceed with this kind of legislation as rapidly as possible.

Senator MILLIKIN. Do you believe this kind of legislation would eliminate the causes of war?

Dr. DAVIES. It will at least leave room for the first step in the elimination of the causes of war.

Senator MILLIKIN. What would you say the first step is?

Dr. DAVIES. I believe the first step is to indicate to the world that we do not mean to use this phenomenon in a destructive manner.

Senator MILLIKIN. Do you think that if we took that step that it would, for example, have influence on the problems in Iran, the problems of the Bosphorus and the Dardanelles, the problems in the Pacific, the problems of Poland; the problems of Lithuania, Esthonia, and Finland, the problems in the Balkan countries, Czechoslovakia and Yugoslavia—do you believe that this bill would make an important contribution toward the solution of those problems?

Dr. DAVIES. I feel it may be a contribution, because many of those problems have behind them a feeling of military insecurity, and this bill at least sets out on the road of eliminating this fear.

Senator MILLIKIN. That again comes down to the basic thing we discussed awhile ago as to whether the other important nations will accept the intent of the bill in good faith, doesn't it?

Dr. DAVIES. Yes, sir.

Senator MILLIKIN. It involves the complete exchange of information, not only scientific information but other information, among, let us say, the principal nations of the world.

Dr. DAVIES. Yes.

Senator MILLIKIN. And involves the elimination, you might say, of police powers, does it not?

Dr. DAVIES. It would help a great deal.

Senator MILLIKIN. Certainly we cannot achieve this basis that you emphasize—and I think quite properly—until things of the character I have mentioned are corrected or solved in some way or other. Is that not correct?

Dr. DAVIES. Yes. Perhaps it is a question of in what order to do things; and our feeling, I am pretty sure, is that we must undertake them concomitantly.

Senator MILLIKIN. Well, we do have a weapon. Insofar as we know, we are the only Nation that has that kind of weapon for the present for a period of grace estimated from 2 to 6 years. The question, therefore, is: What shall we do with this weapon prior to the time that we have the assurance of a dependable world peace? Is that not the question?

Dr. DAVIES. Yes, sir.

Senator MILLIKIN. So you would suggest to the committee that the committee give careful attention to that in relation to this or any other bill that may come before it?

Dr. DAVIES. Yes, sir.

The CHAIRMAN. Doctor, is there anything in this bill as it is proposed that would in any way jeopardize this country's security, as you see it, providing the world turns away from the UNO and goes down the path to war. Assuming that horrible state of affairs, is there anything in this bill that makes America less ready in that eventuality, as you see it?

Dr. DAVIES. The bill will not hurt us nor harm us in such a situation, in my opinion.

The CHAIRMAN. So I presume that Senator Millikin's point is based on the fact that our security might be lessened if these horrible things came about. Did you understand that that was the thesis of his questions to you?

Dr. DAVIES. No; I don't understand the last remark.

The CHAIRMAN. As I understood Senator Millikin—Senator, it is your view that if these things came about you certainly would not want any legislation that would prejudice the security of this country, naturally.

Senator MILLIKIN. That is entirely correct, of course.

The CHAIRMAN. Now, you say, Dr. Davies, as I understand it, that there is nothing in this bill, as you see it, if that does eventuate, that prejudices the security of this country in your opinion.

Dr. DAVIES. That represents my opinion.

The CHAIRMAN. I want to make sure, for that is mine, too.

Senator TYDINGS. Let me ask a question there, and make a short statement beforehand.

You recall the Washington Naval Disarmament Conference in 1922, when we scaled our Navy down to that of other countries. We took no account in that conference of land armies, but simply took the branch in which we were strongest and reduced it to the parallel of other nations without an over-all account of the relative strength of our country with that of the other great powers.

Now, if we do something with the atomic bomb in itself, even though it meets our approval and we do succeed in getting the nations to adopt your idea of what should be done, without any comprehension of their air forces and their armed might, 5 or 6 or 10 years from now, so that we will be inferior to them, would you still hold to that view that the atomic bomb, which is our main weapon, should be put on a parity with that of other countries?

Dr. DAVIES. Well, that is an eventuality a little like Senator Millikin's, is it not?

Senator TYDINGS. Let me put it to you this way with some concrete figures.

The history of our country is that we turn pretty rapidly from war to peace. Five years from now, if we follow the old pattern, we will have an army of a couple of thousand men. Much of our Navy will be tied up and not fit to go to sea. Our military air force will be reduced.

Now, let's suppose that nations X, Y, and Z do not follow that pattern. Let's suppose that nation X keeps an army of 5,000,000, and nation Y keeps an army of 10,000,000, and nation Z keeps an army of 2,000,000, plus 3,000,000 reserves. They have air forces that integrate into such an army, and we don't have those things. The one field in which we are dominant is the atomic bomb.

Now, would your idea be to let them share on a plane of parity, so to speak, in the atomic bomb field with us while nothing is done in these other respects?

Dr. DAVIES. Well, the great point is to avoid the beginning of the war, and we cannot put very much faith in the ability of these bombs to prevent the war beginning.

Senator TYDINGS. I agree with you, but the point is, is it fair for our country to reduce its strength without a comparable reduction of

strength not only in the atomic bomb field but in all other fields at one and the same time? Must not that action be simultaneous?

Dr. DAVIES. I believe that all weapons must be reduced on a parity basis.

Senator TYDINGS. I am trying to get an answer to it, and I want to make sure you understand me.

Dr. DAVIES. I understand your question, but I do not know the answer.

Senator TYDINGS. You see, we let the Navy down in 1922 and made ourselves relatively weaker. We made every other nation correspondingly stronger by the action we took in 1922 when we destroyed the strongest Navy we had.

Now, would it be your opinion, that, assuming we can reach an agreement for the control of the atomic bomb, we ought to reach that agreement without a corresponding diminution in the other arms of all other countries so that the relative picture is the same?

Dr. DAVIES. I feel that I am for such a proposal.

Senator TYDINGS. Which one now?

Dr. DAVIES. The proposal that other arms must be similarly reduced, particularly offensive arms.

Senator TYDINGS. In other words, you are willing to give as much as any other nation will give, but you want to make sure that we all give in the mutual undertaking for peace and the settlement of disputes by peaceful processes rather than war, and that you are not in favor of the reduction of the relative strength of the United States to that of some other country in one category unless that other country reduces the things in which it is strong so that we are on a parity with them in all respects.

Dr. DAVIES. That seems a proper approach.

Senator TYDINGS. Then I take it that you would be opposed to atomic bomb control alone?

Dr. DAVIES. If we began with the control of atomic bombs only, and did not in a reasonable time go on to the control of other offensive weapons of war, I should like very seriously to reconsider my position.

Senator TYDINGS. Then even if you start and secure the control of the atomic bomb only, you would make that as a lasting agreement contingent upon the happening of other events that would accomplish the things we had under discussion; that is, other disarmament?

Dr. DAVIES. Yes.

Senator TYDINGS. You would not, then, be in favor, as a lasting policy, of control of the atomic bomb only in a world that was armed in all other respects, and in many cases armed far superior to that of our own country?

Dr. DAVIES. The difficulty of going on to that last logical conclusion is that the alternative, in which we keep the atomic bomb and other people proceed to develop the atomic bomb, does not give us, in our opinion, any more security than we would have if we eliminated the atomic bomb and did not require a concomitant reduction of other kinds of armament.

Senator TYDINGS. It has to be an over-all overhauling?

Dr. DAVIES. I think the Chinese saying "No choice between evils" applies here.

Senator TYDINGS. I am going to adhere to the opinions that you are advocating, that any control of the atomic bomb as a separate undertaking should not be had as a permanent solution unless it is

accompanied by the control of other weapons which make other countries stronger than us.

Dr. DAVIES. If the possession of such weapons does endanger us, then I agree with you.

Senator TYDINGS. You know we had the last war in Germany without any atomic bombs over there, and it was a pretty good war. What I am getting at is this: Can we, as responsible legislators, in your opinion, reduce our atomic bomb potential unless other countries reduce their potential in other respects in which they are superior at one and the same time?

Dr. DAVIES. Not over the long view.

Senator TYDINGS. That is what I mean. Therefore, the efficacy of your atomic bomb control, a control that is understandable because the atomic bomb is a dangerous weapon, is predicated upon the contingency that immediately following, or simultaneously therewith, there be a scaling down of the defenses of other countries in whichever respects they are superior to us just as we are superior to them in the atomic bomb field.

Dr. DAVIES. Yes; if, as I have stated, that superiority really menaces us.

Senator TYDINGS. Well, certainly an army of 10,000,000 would menace us, wouldn't it?

Dr. DAVIES. Not necessarily. The British Navy has not been a menace to us for a century, although it was highly superior to our own at one time.

Senator TYDINGS. There was a time when the British Navy was a menace to us, and that time may come again. I don't think it will, luckily, but the point is that we have to legislate in the face of all possible contingencies.

Dr. DAVIES. Yes, sir.

Senator TYDINGS. And, therefore, your testimony is that you favor atomic bomb control between nations, but only if those nations which agree to it—and we will assume that they are all the nations—immediately make contingent upon its ultimate adoption as a lasting solution a corresponding reduction of other arms in the categories in which other nations are superior to us so that we will not have weakened our position and strengthened theirs?

Dr. DAVIES. Since I cannot get my qualification in—that is, I am not too sure of it myself—I will agree with that statement of yours.

Senator TYDINGS. Then would you be in favor of atomic bomb control alone without any consideration at all of the relative land or air strength of our countries in other fields outside the atomic bomb field?

Dr. DAVIES. For the present time; yes.

Senator TYDINGS. How long would you adhere to that?

Dr. DAVIES. Until those who were competent to advise me felt that we were beginning to be in danger.

Senator TYDINGS. Now, keep in mind as you answer me, the Washington Naval Disarmament Conference; when we had, then, what might be called the atomic bomb of 1922, which was the most powerful fleet in the world. We reduced our strength in that field to that of other countries, Japan and Britain. We took no account of their armies or air forces, their tanks or buzz bombs, or any disease germs or poison gases or any of those things. We just said, "There is one

thing we are stronger in than anybody else in the world. We don't want to be any stronger in that field than anybody else, so we will come down on a parity."

We said nothing, and let them go ahead in all other categories, so the net result was we weakened our ability to defend ourselves while correspondingly increasing their ability to attack us.

Do we want to do that again with the atomic bomb?

Dr. DAVIES. I wish to comment on the scuttling of the ships. The error in that seems to me not that they were scuttled but that, when disarmament was not achieved later throughout the world, we did not build it back again.

Senator TYDINGS. Would you want to go through the Washington Naval Disarmament program with the atomic bomb without a simultaneous consideration of the mutual ability to make war of other countries in other categories?

Dr. DAVIES. I think we should consider that.

Senator TYDINGS. You mean, you would start with it?

Dr. DAVIES. Start with it; yes.

Senator TYDINGS. But you wouldn't allow it to remain as a permanent solution unless there was this corresponding reduction of armament by other countries in fields in which they are superior to us just as we are superior to them in the atomic bomb field?

Dr. DAVIES. I agree with that.

Senator TYDINGS. I thought you would, but I wanted to be sure.

Senator HART. Mr. Chairman, may I ask a question?

The CHAIRMAN. Surely.

Senator HART. May I follow up the answer you gave Senator McMahon just now, that you see nothing in the bill which would endanger our security as of today? Inasmuch as the War Department and the Navy Department are the organizations upon which the security of the country rests, they are the ones who are responsible for that, do you think that at this moment, as of now, the War and Navy Departments should be divorced of all authority and influence as regards this weapon?

Dr. DAVIES. Of the power to set the policy of the Commission by vote, I think yes. Of the right to have contact with those who do set the policies, with that right I am in complete agreement.

Senator HART. Well, it is scarcely a matter of policy; it is a matter of fact and present-day condition where there is a weapon in existence in our possession and in the hands of the military.

Do you think the time has arrived for the Congress to say they must divorce themselves of all authority as well as responsibility?

Dr. DAVIES. This weapon is a policy, a political weapon. It has political significance, and for that reason it should not be in the hands of the military.

Senator HART. Inasmuch as the President and the Congress are in direct control of the military, what is the difference?

Dr. DAVIES. They are in direct control, but is that control directly exercised?

Senator HART. Well, can't you conceive that it would be just as directly exercised as any control over the Commission would be?

Dr. DAVIES. It could be, but it will not necessarily be.

Senator HART. It won't necessarily be in either case, will it?

Dr. DAVIES. No, sir. I merely see the likelihood of the policies in the field of atomic energy being more subject to the Government if it is in the hands of a civilian commission.

Senator HART. Thank you, Doctor.

Now, just one other small point. In response to the questions of Senator Millikin, you said something about making everything known. To be specific, do you think that, as of now, we should publish to the rest of the world the remaining secrets that we possess as regards this weapon, that we should inform everybody in the world exactly what the weapon is and how to make it?

Dr. DAVIES. I think publication of the knowledge of the Manhattan project should fall short of the method of detonating the atomic bomb. There is no reason that I can see why anyone should demand that information.

Senator HART. That is, you do not see that we should, as of now, publish to the rest of the world, or our allies, our few remaining secrets?

Dr. DAVIES. I feel that the information in other portions of the project other than that dealing with the detonation of the bomb is not important to our security.

Senator HART. But most of that has already been published, has it not?

Dr. DAVIES. The details, no. The general lines have been indicated.

Senator HART. Do you think that further details should be published?

Dr. DAVIES. I don't think it particularly important as far as our security goes. As regards a program for setting up international agreements in this field, it might help, it might create a very good spirit to do so.

The CHAIRMAN. Doctor, is there anything in this legislation that you think provides for any disarmament?

Dr. DAVIES. No.

The CHAIRMAN. Senator Hart suggested that since the military was under the control of the President and Congress, that it therefore follows that the President and Congress would have complete control while leaving it under War Department control, we might say, instead of under a civilian commission.

Of course, I suppose that, basically, electricity furnishes more of the sinews of war than any other component, does it not?

Dr. DAVIES. Or oil, perhaps.

The CHAIRMAN. I don't know that there has ever been any suggestion that we leave our national policy for either electricity or oil directly to the military, have we?

Dr. DAVIES. I have never heard it.

The CHAIRMAN. Now, on the peacetime application of this force, the peacetime use of it, do you see any precedent in all of our history for putting this under the War Department?

Dr. DAVIES. I can think of none.

Senator HICKENLOOPER. At the present time, Dr. Davies, atomic energy is a weapon only, isn't it? The only practical application of atomic energy that we have today is as a weapon.

The CHAIRMAN. No; that isn't so, Senator. How about medicinal uses?

Senator HICKENLOOPER. Let me find out what the Doctor says about that.

Dr. DAVIES. The only important application of atomic energy that has actually been made is the bomb.

Senator HICKENLOOPER. And there are collateral fields at the present time, considering the fact that the bomb was the objective and that we attained that objective, and we, at least temporarily, discarded the examination of the other fields, such as medicine, power, and all those things, in attaining this objective.

There are other fields for future exploration, such as its use in public health and its use for power, and the civil uses of atomic energy.

Inasmuch as today its only proven practical field of use is the weapon, and as we here in Congress must set up a temporary statute, I think most everyone admits that we cannot see too far into the crystal ball of the future and know just how we are to outline a complete program of legislation for further generations to come; and, therefore, the legislation must be approached, I believe, from a temporary basis.

Dr. DAVIES. Yes, sir.

Senator HICKENLOOPER. What do you think about not having full control of atomic energy lodged in the military, that is, the full control and direction, but to have military representation temporarily in any group that undertakes to go into this atomic field in the immediate future, until such time as international agreement for its outline or taking it out of the field of weapons is reached?

Dr. DAVIES. I would feel that the Commission should have among its members men of military experience, but that members of the Commission should be full-time members of the Commission, and not members of any other governmental group.

Senator HICKENLOOPER. But you do feel, as I understand it, that at the present moment, and for at least a period of time until matters are settled with respect to the weapon, the Commission should have the benefit of important military considerations, and that factor should be an important consideration during this period, so long as it is only a weapon?

Dr. DAVIES. It should be kept in mind that, if we are not in danger in this period of grace that Senator Millikin has mentioned, I do not believe it too important that those considerations enter our program.

Senator HICKENLOOPER. Well, you believe in keeping the battleships under the control of the Navy, don't you? They have scrap-iron possibilities, and various other uses that they could be put to in the industrial activity of the country, and yet the battleship is a weapon, and we consider that under complete military control, or at least as long as the battleship is a weapon it should have careful attention by the military whose duty it is to defend the country?

Dr. DAVIES. I feel somewhat more kindly toward the battleship than I do the bomb.

Senator HICKENLOOPER. You are just as dead when killed by a battleship as when killed by a bomb.

Dr. DAVIES. That is true; but my battleships, I feel, will protect me, while I do not feel my bombs will protect me.

Senator HICKENLOOPER. There is a difference in the conception of strategy of war, but in order to make my basis clear, I don't believe

this thing should be kept under the unlimited control of the military at all. I believe that until we can get satisfactory guaranties of the peaceful use of atomic energy—

Dr. DAVIES. Are you speaking technologically?

Senator HICKENLOOPER. No; I mean international agreements between nations for the peaceful use and the elimination of the military use of atomic energy. I feel that we should have some pretty strong and intimate representation by the military on any group; that is, by those who are expert in the military use of the weapon, whether they be civilians or whether they be out of the Department. That factor should be in there until we feel reasonably certain that the bomb has been eliminated as a weapon. After that, then I would say put it completely under civilian control.

Dr. DAVIES. I will agree that military experience should be present on the Commission.

Senator HICKENLOOPER. And the question of the possibility of national defense in the future, so long as the bomb is a potential weapon in the world, it should be a factor, shouldn't it?

Dr. DAVIES. I don't understand.

Senator HICKENLOOPER. By that I mean unless we can assure ourselves that it has been taken out of use as a weapon, we always have to consider the fact that somebody may use it against us, or we may have to use it in our national defense against somebody else, barring those guaranties of peace.

Dr. DAVIES. I would rather wait until we had real concern that it would be used or might be used against us to decide those questions.

Senator HICKENLOOPER. A bomb goes off awfully fast.

Dr. DAVIES. It takes time to make it, though.

The CHAIRMAN. I want to make one brief observation.

Do you know Admiral Land of the Maritime Commission?

Dr. DAVIES. Yes, sir.

The CHAIRMAN. He was a civilian when he served on the Maritime Commission, which is a civilian commission. Gen. George Marshall is now the Ambassador to China, not in his capacity as a general but in his capacity as George Marshall, citizen. That is true, isn't it? That is true; I can tell you it is true.

It just occurs to me that in the appointment to this Commission there is nothing in the world to prohibit somebody with former Army or Navy experience. For instance, Senator Hart has served as an Admiral in the Navy. There would be nothing in the bill to prevent his appointment, and yet Admiral Hart would go on the Commission as a civilian, would he not?

Dr. DAVIES. Yes, sir.

Senator HICKENLOOPER. I am not concerned whether "brass" sits around the table or not, as official uniformed people. I am concerned with the principle; whether he is a man of present capability along this line, or whether he is actually an official in some other branch of the Government makes little difference to me. I am concerned as to whether or not, so long as this is a weapon, we have the benefit of expert military knowledge and appreciation not only of what has gone on in the past but of our potential needs in the future so long as it is a weapon and so long as that is the conception in the world.

Is that a reasonable assumption?

Dr. DAVIES. I am not quite clear as to the sort of experience in the use of the atomic bomb that you have in mind.

Senator HICKENLOOPER. I am speaking about the experience in the responsibility for the defense of the United States. That is what the military is charged with, that is what it is trying for, and that is what we hold them responsible to. So long as this thing is a weapon, there is that potential possible need, and I am merely trying to explore the fact as to whether or not during this transition period from getting it completely out of the secrecy of military wartime control and into the hands of the public we should probably have the benefit of military experience, because it still continues to be a bomb, and will be for some time.

Senator JOHNSON. I want to ask the chairman if he favors placing Gen. George Marshall and Admiral Land on the Commission to be set up?

The CHAIRMAN. Oh, no. I was only using that as an example.

Senator JOHNSON. Are you opposed to them going on?

The CHAIRMAN. I don't think I have to answer that, or suggest who should go on the Commission, Senator.

I was merely pointing out that there had been plenty of precedent for men who had had military experience in taking civilian jobs, who became civilians. I do not, I will tell you frankly, believe in the military having control of atomic energy.

Senator JOHNSON. I join you in that, but you advanced a very interesting proposal here, and I was anxious to find out just how far you would go in that direction, whether you favored Gen. George Marshall and Admiral Land going on the Commission that is to be set up.

The CHAIRMAN. Well, of course, as you know, it is provided that the President makes the nominations.

But I will say this: If I were President and were called upon to make the Commission, and George Marshall had finished his work in China, and I could induce him to serve on the Commission, I think he is not only a grand officer, but he is a great statesman, and my answer to you would be that I would certainly give serious consideration to naming George Marshall on that Commission. I am not so intimately acquainted with Admiral Land.

Senator JOHNSON. I concur in your analysis and in your conclusion. I would join you in that wish.

I would like to ask the witness if he does not deem it advisable to place this new proposed Commission, insofar as it is possible, under the control of the Congress rather than under the control of the Commander in Chief of the Army and Navy, and the other departments under the Commander in Chief of the Army and Navy—Congress versus the administration?

Dr. DAVIES. Your point of view being that the bill, as it now stands, places the Commission more under the control of the Commander in Chief of the Army and Navy than it does under Congress?

Senator JOHNSON. That is correct, and that is something I am trying to correct in the bill. I want to find out if you have an opinion on that question, whether you think there should be tighter congressional control over this Commission than is now provided in the McMahon approach to the problem?

Dr. DAVIES. Congress has a voice in this undertaking.

Senator JOHNSON. Yes, of course, but that is about all they have, and I want them to have something more than a voice.

Dr. DAVIES. They have the opportunity to approve the nominations for the Commission; they hold the purse strings; they get the reports and an opportunity to legislate further on the committee's recommendations.

Senator JOHNSON. And you think that is sufficient? You are perfectly satisfied?

Dr. DAVIES. I think so; I really don't know what further provisions could be added.

Senator JOHNSON. You are perfectly satisfied with that condition, then?

Dr. DAVIES. Without further examination; yes.

Senator JOHNSON. There is another point, following Senator Tydings' exploration of your viewpoint.

It has always been difficult for me, and I am wondering how it is so easy for some of you, to segregate the atomic bomb weapon from all other weapons of war. You just seem to think that you can write off the atomic bomb and then go on with a nice little polite war that has everything in it of destructive nature except the atomic bomb.

I cannot do that in my own thinking, and I wonder how you folks are able to do it without more concern.

Dr. DAVIES. Why, I don't think we do separate them, Senator Johnson. We regard the bomb menace as the most severe of the menaces in the world, and therefore it is the logical one to attempt to remove first.

Senator JOHNSON. Well, war is a menace; war itself is a menace.

Dr. DAVIES. Yes, but we must have a way of going about its removal. One of the ways is the removal of the weapons of war.

Senator JOHNSON. By removing the weapons, you say?

Dr. DAVIES. Yes.

Senator JOHNSON. Well, that may be so, if it were possible to do. When Senator Tydings was interrogating you, it kept coming to my mind that while we were destroying our battleships Germany was building up her industries, and in modern war every heavy-duty industry is a war potential. Germany, instead of building battleships, was building her war potential by building up her peacetime industries to be converted to wartime industries, and in that way she was making herself strong.

Now, it seems to me you have to approach war not piecemeal, by segregating atomic energy and atomic bombs over here and letting other developments go forward. I was interested in your approach to this problem by saying that you thought we ought to begin with the atomic bomb. As I followed you, it seemed to me that you were very much opposed to permitting that to be the end. You wanted it to be the beginning, but not the end?

Mr. DAVIES. That is correct, sir.

Senator JOHNSON. In that, I agree. I think that that is being very realistic. But to dismiss all of these other potentials of war and single out atomic energy, which is the most efficient war weapon, the most effective war weapon ever created, it just occurs to me that that is making it too simple and too easy. There are many war weapons, and some of them are just as devastating, perhaps, or more so, as the atomic bomb. So instead of directing our efforts toward the elimina-

tion of the atomic bomb, why not direct our efforts toward the elimination of war?

I heard you say a moment ago that there is no defense against the atomic bomb. Well, while it isn't a satisfactory defense in any way, it is a defense nevertheless, and the only one we have, and that is the atomic bomb itself.

My hope is to make war such a certain suicidal adventure that by atomic bombs, and other potential weapons of that character, a war would be unthinkable, and therefore war itself will go out the window instead of specific weapons going out the window. That is the approach that I am trying to make to this problem, and I am rather distressed to find so many able and thinking people assume that we can segregate atomic bombs from war, and at the same time that we are accomplishing something.

We have asked a great many witnesses in this chamber whether they think that there ever will be another world war without the use of atomic bombs, or some of the later developments, and the answer has been invariably no.

Do you think there will ever be a world war in which atomic bombs, or something following that line of weapon, will not be used?

Dr. DAVIES. Not if the war goes on for any length of time.

Senator JOHNSON. Well, it will go on for some time unless the atomic bomb is used in the beginning to stop it.

Dr. DAVIES. Well, I suppose it would depend upon the particular military situation. In any long war, certainly a nation will have an opportunity to develop the bomb if it has not got it at the beginning.

Senator JOHNSON. I spoke of world wars, and world wars are long wars; so your answer is that in any long war, as you class it, or any world war, as I will call it, atomic bombs will be used?

Dr. DAVIES. Certainly.

Senator MILLIKIN. Many people think that the next 5 or 6 months will give us an opportunity to form a very good judgment on whether we can have real cooperation for peace among the present nations of the earth. There are several tests of that before UNO and several will develop within the next 5 or 6 months.

Having that in mind, let me ask you whether there would be an irremedial harm to science if the matter were kept bottled up, the way it is right now, over a short period—let us say 6 months to a year—until we can have a clearer view of whether or not the world is postured for peace?

Dr. DAVIES. If it is bottled up the way it is now, it will be a practically inactive field, I believe, in another 6 months or a year. It could be reconstituted if a real emergency arose and there seemed to be nothing else to do but return it, but, during the interim period during which you wish to keep it bottled up, the field would be deserted by most of the workers.

Senator MILLIKIN. Don't you think, if that were the policy of Congress, that enough scientists could be kept on the job, at least to keep things in stand-by condition?

Dr. DAVIES. What is the advantage of having it remain in its present position?

Senator MILLIKIN. I am not setting out to argue the case, but I will say that it seems to me that in any logical thinking when you propose a change you should answer the question "Why change?"

Now, this bill and other bills propose a change. I think we should ask ourselves, "Is the situation of the world such that we are warranted in making a change? If not, not at the moment, when can we foresee a period of time when we can redetermine our problem and reach a decision?"

Now, I have postulated that within the next 5 or 6 months, or maybe a year, we can reach a pretty fair conclusion as to whether or not this world is postured for peace. If it isn't postured for peace, clearly our policies are going to be much different than if the contrary be true. Therefore, I say—I am merely exploring this; this is not a theory of mine or a position of mine—I think we are duly bound to explore it. Why make any change? Why not keep the thing bottled up just as it is for, say, 6 months or a year?

You say, "We will lose scientists." I believe we will. We will lose scientists under any of the contingencies, because I assume that the scientists are not in favor of going on and making bombs.

Dr. DAVIES. That is correct.

Senator MILLIKIN. So from the scientific standpoint, except as to the peacetime use of power, a delay of 6 months or a year in the development of the peacetime use of power, what is the harm in keeping it bottled up as it is?

Dr. DAVIES. Well, we feel that shifting the responsibility for activity in this field to a civilian commission will further the probability of a peaceful world, and that this question of whether we shall have a peaceful or war filled world, which will be decided within the next 6 months, or a year, as you say, is partly determined by what we do now. This is one of those things which can help to bring us to the peaceful decision.

Senator MILLIKIN. Just how would that help to bring us to a peaceful decision? There is always a certain amount of vagueness when we get to that proposition.

Now, I would appreciate it very much if you could state specifically how this bill will help to improve the prospects for peace?

Dr. DAVIES. By giving the signal to the rest of the world that if it is humanly possible we will not employ this phenomenon in an aggressive way, but, rather, that we stand ready to come to agreement with them to prevent the beginning of an atomic armament race.

Senator MILLIKIN. Pursuing a little further the line of inquiry I am on, would we not serve precisely the same effect, and, in fact, stimulate it, if we were to say that once we are convinced that the world is postured for peace, and we are looking for positive signs and not words, not programs, not agreements, but looking for positive signs—once we are assured of that—then we propose that this thing be known to the world?

Dr. DAVIES. Senator, we are always waiting for the other fellow to make the first sign.

Senator MILLIKIN. What do you make out of that?

Dr. DAVIES. I mean, let us, by such a bill as this, make the first sign ourselves.

Senator MILLIKIN. I am trying to find out why. What is the virtue of it? Don't we make a sign when we say at the present time the prospects for peace—let us put it very conservatively—are not as good as they might be. We have a weapon. In view of the present state of the world, we do not feel that we should let go of this weapon,

but the moment that we have a sign that is a durable sign and a dependable sign, something on which we can shape our national policy, then we will make this thing known to the world.

Now, what is the matter with that sign?

Dr. DAVIES. I would argue that such a sign from the rest of the world is less likely to come if we continue the field of atomic energy under the present circumstances.

Senator MILLIKIN. All of these things that disturb the world—there is no use rehashing all of them; you know what they are as well as I know what they are—have been brought into being regardless of the bomb. There isn't the faintest assurance that they will be eliminated regardless of what happens to the bomb at this moment. If you wish me to make it more specific, I am willing to do so.

Dr. DAVIES. I believe I understand you, Senator.

Senator MILLIKIN. The ambition of some nations for warm-water ports is an age-old ambition, and it will never be forsaken. It cannot be forsaken in the national interest of those nations. Now, that ambition arose independent of the atomic bomb. Is there any demonstrable evidence that it will be forsaken by anything we do about the atomic bomb?

Since the atomic bomb has been in existence and has been used, there have been new developments in the international situation, despite our possession of the bomb, that greatly threaten the peace of the world. Perhaps my end point is that you are putting too much emphasis on what will happen to make the world a more peaceful place by what we do with the bomb.

I repeat, since the bomb was exploded, I could mention a half-dozen things that have been injected into the world picture that are war breeding, and that there is no reason to believe that there will be any retraction of them despite the bomb, or what we do about it.

If these things go on when we keep the bomb in our possession, is there less likelihood that they will go on if we share the bomb?

Dr. DAVIES. The atomic bomb legislation will certainly not of itself solve the sort of difficulties that you have described.

Senator MILLIKIN. Now I come back to this proposition: If a period of 6 months or a year will give us a durable hope that these conditions can be remedied by this new world organization which we have set up, and which is perhaps our last and best hope for peace, if 6 months or a year's experience with that organization will give us the sign that we are going to live in a world of peace or a world of war, what irremedial harm is done by just keeping it bottled up as it is?

The CHAIRMAN. Do you mind if I help him out?

Senator MILLIKIN. I should be delighted. I should like to have the answer.

The CHAIRMAN. Well, the only thing that Maj. Gen. Leslie Groves and I agree on with relation to atomic energy is when he says we had better set a domestic policy on it. The necessity is immediate, because it is important that we continue, as I see it, Senator, with all the resources at our command to improve and to accelerate our technological process in the art.

There is no question in the world but that all other peoples are busy at the matter. I think that we ought to keep ahead in our development of the business.

Now, General Groves stated in San Francisco that the project was disintegrating and called upon Congress for legislation. He said he was tired, that he was making decisions that he wished he didn't have to make, and I agree with him that we should get ahead with it.

Senator MILLIKIN. You have transferred the discussion from the witness to General Groves, and General Groves isn't here so I cannot pursue the matter with the general. My impression of the general's over-all reaction is that he wants an expression of congressional policy rather than a particular kind.

The CHAIRMAN. He has got a particular kind, Senator. He would like it to end up in his lap.

Senator HICKENLOOPER. It is my impression that his position is diametrically opposite to that. I think he expressed clearly here the fact that he thought it should not remain in the exclusive and secret control of the military, but that Congress should set up a body to take it over and take it out from under their dominion. That has been my impression of his attitude. I never got the impression that he wanted to keep control of this.

The CHAIRMAN. Well, it certainly has been my opinion.

Senator MILLIKIN. Perhaps the witness has benefited from this colloquy and could give me his reaction to the question I put.

Dr. DAVIES. Well, I felt that I had answered the question a little bit back by saying that this continuation of this field under the present circumstances has, to a certain extent, the effect of making more difficult a settlement of the bomb question, and, if we could not settle the bomb question now, we should have the greatest difficulty settling it later.

If we do not settle it later, it will be the most severe problem we have in the world.

Senator HICKENLOOPER. Mr. Chairman, may I suggest to Senator Millikin one possibility about a suggestion that has been made here concerning an indication to the world of our intentions.

I wonder if these new conditions that have come up in the world, mentioned by Senator Millikin, and new demands and new complications in the international situation may not be stimulated somewhat by a basic feeling on the part of other nations that we are not going to use the bomb as a weapon, and that therefore the real conviction on the part of the nations that we don't want to use the bomb as a weapon is already basically established in their mind. Therefore, added demonstration might not contribute anything to their already formed conviction on that point.

Dr. DAVIES. Well, this requires a considered judgment on the psychology under which they are operating. I am sure I cannot give it.

Senator HICKENLOOPER. That is based on the fact that if they were afraid of us they wouldn't have made these demands.

Senator MILLIKIN. The fact remains that many disturbing things have been injected into the international situation since we used the bomb.

Now, those who do those things do them in a calculated way. They may be taking a calculated risk. We don't know what their precise calculations are, but the end point is, I believe, as I have stated it, that despite our development of the bomb, and our use of the bomb, these troublesome things continue to pop up in our face every time we pick up the paper.

Senator AUSTIN. You have already in a brief reference to your prepared statement made a fundamental point that any legislation should high-light the subordination of our statute, whatever it may be, to the international agreements to be entered into. That being so, let us assume that already three great powers who possess the knowledge have agreed and let the world know that there won't be any exchange on a reciprocal basis of knowledge of the basic facts with respect to constructive use of this energy until security has been effectively established against the destructive use of this energy.

Now, we have two assumptions, you see. Let us assume also that our own Government has appointed a committee to advise it with reference to its position in the commission already provided for by the UNO. That is our third assumption.

Now, then, is it not wise for us to postpone a decision upon this matter of the organization of our atomic commission until we do know what the effect of these facts are that I have called attention to, and they are great facts because they are international?

Dr. DAVIES. Room is left in the bill for the results of these facts. I doubt if the decision of the international body will affect in great measure the day-to-day working of the domestic structure.

Senator JOHNSON. I don't want to be tiresome, but I would like to go back to the question I was asking, because I think I stopped short of a conclusion which I am very anxious to make.

I asked the witness, and my understanding is that he answered "Yes" to the question as to whether, if there is another war, the atomic bomb will be used.

Now, since he answered that question, I would like to ask the witness if under those conditions he does not think that any commission set up to control the atomic bomb or atomic energy should have military representation, since if there is another war the atomic bomb is certain to be used. Must not we approach it, then, from the point of view that the military part of it is inseparable and must always be considered, and that there should be military representation on whatever commission is set up?

Dr. DAVIES. No; we feel that it is not necessary now in any case.

Senator JOHNSON. Yet you say if there ever is another war, the atomic bombs are going to be used. If that is the correct answer, and I believe it is, then why not accept the fact and say, "Well, that being so, the atomic bomb is a potential military weapon, and since it is a potential military weapon we must keep the military in any commission that is set up for its control"?

Dr. DAVIES. I believe military experience should be present there, but policy making by the Army or Navy should not be permitted.

Senator JOHNSON. Well, I asked Senator McMahon a moment ago a question that I would like to ask you now. What would you think of General Marshall and Admiral Land as members of the proposed commission?

Dr. DAVIES. I am not too well acquainted with the admiral, but I should be delighted with General Marshall as a civilian member of the Commission.

The CHAIRMAN. You wouldn't want three General Marshalls, would you, assuming there were five?

Dr. DAVIES. Well, if it has to be three, then the Commission would have to call in expert testimony on a great many subjects which could better be obtained by broader representation on the Commission.

The CHAIRMAN. Doctor, we want to get to the floor at 12 o'clock, and you are only on page 3 of a nine-page statement, so I suggest that you proceed.

Senator MILLIKIN. Mr. Chairman, may I make a comment?

The CHAIRMAN. Yes, Senator Millikin.

Senator MILLIKIN. A number of people have commented to me on an article by Maj. Alexander P. de Seversky which has appeared in the Reader's Digest. They are interpreting his article as watering down the importance of the atomic bomb.

Seversky is a man of sufficient standing so that I would like to suggest that we call him before the committee and sift him on the statement that he has made. It might be well also to have Dr. Morrison and others who have been to Hiroshima and Nagasaki and have seen the effects of the bomb there, because there is some conflict in the testimony.

The CHAIRMAN. I think that is a good suggestion, Senator, and I might say that if any other Senator has any witness he wishes to question—we are taking them as they come and as they request to appear—if you wish us to contact someone and ask them to come here, we would be glad to have your suggestions.

Senator MILLIKIN. During the course of other testimony you repeatedly asked what would be the effect of the bomb, for example, on heavy structures such as in lower Manhattan. I get the impression from Seversky that he thinks perhaps that could be duplicated by bombs of the type that have been used in this war. The thing is so fundamental that I believe when any responsible person gets up and has a view on it, especially of the standing of a man like Seversky, we ought to have him in here and hear from him.

The CHAIRMAN. We will see that that is done.

I might say, Senator, that I wish to talk with the committee as quickly as possible about having afternoon sessions. I think we ought to get on with the hearings as quickly as we can.

You may proceed, Doctor.

STIMULATION OF RESEARCH AND DEVELOPMENT

Dr. DAVIES. Vigorous research and development in nuclear science must be maintained. The use of the fission phenomenon and its byproducts in physical, chemical, biological, medical, and industrial research, as well as in power development, should greatly enrich our country and indeed all mankind.

Bill S. 1717 will foster such research and development through equitable distribution of fissionable material and of byproduct materials to all research workers, by granting funds to independent research organizations, such as universities, private and industrial laboratories, through the widest possible dissemination of information, and by creating a division of governmental research to insure a complete program.

The provisions of the bill for allocation of fissionable and byproduct materials are the best guaranty for rapid development in the field of atomic energy. No requirement other than the capacity to satisfy health and safety standards is set forth. We consider this requirement sufficient.

Independent research is encouraged by the bill. Government research is not preferred above private research in the allocation of

funds. We regard this as a highly desirable feature of legislation in the atomic energy field or for that matter in any other scientific field. The full development of science rests upon independent research by many individuals in many laboratories throughout the world. The direction which scientific research will take at any time cannot be predicted nor can research be completely guided by even the most intelligent administrator or scientist. Ideas come from the most unexpected sources. Scientists in a well-staffed, well-equipped laboratory may work on a problem for many years and yet those new and revolutionary ideas which may completely change the complexion of their work can come from a single scientist or from a small group working in a poorly equipped laboratory in a small country. It is, therefore, of the utmost importance that problems be studied by many independent groups and individuals. All competent scientists should be allowed to study the problems of atomic energy and to obtain the materials and such funds as are necessary for their work.

The bill provides for the wide distribution of byproducts, such as the radioactive products. The use of these materials as tracers or "tagged atoms" in the study of biological, chemical, medical, and industrial processes will, we believe, lead to the first peacetime applications of fission. Study of the byproducts themselves will advance our knowledge of the fundamental properties of matter.

The dissemination of basic scientific information and, when possible, related technical information, is made mandatory. The bill, in fact, attempts to provide the freest possible exchange of scientific information. We strongly approve of such provisions, and feel they should not be abridged. Science cannot prosper in secrecy. Science cannot develop when workers in a particular field may not discuss problems with those in similar fields. The wide publication given to fundamental scientific discoveries in the last 40 years is largely responsible for rapid scientific development. The fact that S. 1717 encourages this point of view is applauded by the atomic scientists. For similar reasons we would like to see the force of the patent section maintained in guaranteeing freedom for use in this field of all discoveries and inventions.

We approve the security regulations of the bill. During the war most scientists not in the armed forces worked on secret war projects. Secrecy regulations were based on the Espionage Act and successfully denied important information to the enemy. We feel the Espionage Act will provide as much national security as can be found in a policy of secrecy. We are pleased that the McMahon bill bases its security regulations upon this act and does not set up any further power to make arbitrary secrecy regulations.

STUDIES AND REPORTS BY THE COMMISSION

The American people have a large interest in the development of atomic energy. Progress and policy in this field should be subject to public scrutiny. The bill provides that the Commission shall submit quarterly reports to the President and to the Congress. These reports must detail the activities of the Commission and must include the Commission's program for the following quarter. Thus the work of the Commission is constantly in the public view and a means is provided for insuring that the Commission will act in the public interest. The atomic scientists look to the continuing interest of Congress to insure the development of atomic energy for the maximum public benefit.

Senator JOHNSON. I should like to call the attention of the witness to the fact that there are virtually tons and tons of reports made to the President and to the Congress by the different agencies, and I want to emphasize the fact that that safeguard which he deems important is, in my opinion, of little or no importance.

Dr. DAVIS. I might remark, however, that this is a subject that might be of special interest to the Congressmen deluged with reports.

The CHAIRMAN. In other words, the state of wildlife in Arkansas might be overlooked but, as to what we are going to do with this thing, people might read it?

Dr. DAVIS. Exactly.

Further, the bill provides for studies of the social, political, and economic implications of atomic energy and that these studies shall be reported as a basis for new legislation, particularly with regard to future industrial uses. New developments in atomic energy will be studied from the point of view of their effect on our national economy and a sound basis will be provided for future developments. In addition, international agreements will be facilitated since premature or unformed legislation on such questions as the future large-scale use of atomic energy will be avoided.

Bill S. 1717 encourages research and development in the field of industrial application of atomic energy. The policy of postponing large-scale industrial applications is, in our opinion, a wise policy. Industrial processes should certainly be developed, and the bill provides adequately for their development. Widespread industrial application, on the other hand, may present us with new difficulties. The economics of atomic power development are too uncertain to permit a decision at this time. Furthermore, premature development of special interests in this field may prejudice the possibility of international control. The possession by individuals or private groups of the facilities for producing fissionable material—the production of power may be accompanied by the production of fissionable materials—would greatly complicate the problems of international inspection and control.

It is worth emphasizing once again that strong Government control, based upon a Government monopoly of the production of fissionable materials, protects us from the misuse of these materials and prepares us for the possibility of an effective international control system.

ADMINISTRATIVE STRUCTURE

The composition of the Commission has been discussed by the committee. Two hostile viewpoints have been presented. The Commission should be small for the sake of efficiency. On the other hand, the Commission, it is said, should be large in order to permit representation of the many groups whose affairs touch upon the Commission's activities. It occurs to us that a third and more desirable choice exists. We believe the Commission should be large enough to permit physically the discharge of its duties, but no larger. It should include among its members persons with pertinent specialized information. The Commission should include men with training and experience in, say, pure science and industry, not that the special interests of scientists and industrialists shall have voice but rather that the indicated experience shall be available. Commission members

should have but one interest, the public welfare. If the Commission is composed of men each of whom is clearly instructed to safeguard the interest of a special group, its policies will often be unsatisfactory compromises. A need for further coordination among Government agencies and the Commission can perhaps be achieved through the presence of representatives of such agencies at the Commission's deliberations. In our judgment, the number of commissioners should not be decreased. It is essential that their appointment be full time.

We wish to go on record most strongly as favoring complete exclusion of the military from any policy-making function on the Commission. By this we do not mean to exclude efficient liaison between the Commission and the armed forces. Provisions making this liaison mandatory as suggested by Secretary Forrestal would not be opposed by the atomic scientists. However, it is in best tradition of American Government that policy be made by civilians. A subject fraught with such tremendous significance to our foreign policy as the development of atomic energy in this country must certainly be freed from every vestige of military control.

The administrative structure of S. 1717 seems very satisfactory. Some of the functions of a future commission have now been recognized and the bill provides for them. Thus, divisions for production, allocation, research, and military application are established and their directors charged with the day-to-day supervision of these activities. This arrangement should leave commissioners free to formulate policy.

The system of Presidential appointment and removal eliminates the possibility of insulation against review and against change. The policy-making function of the Commission, together with the delegation of administrative duties to the divisions, makes real the functions of the appeal boards provided for by the bill. Were the commissioners also the administrative officers, we feel appeals would have little meaning, since they would be directed against those people who had already formulated the policies and made the decisions.

There are a number of minor changes, designed to clarify the bill's intent that we could suggest. We should be glad to submit those to this committee, if it so desires. We have not brought them forward in this testimony, since we do not wish to divert attention from the important points. The major questions we have discussed and the treatment by the bill of these questions lead us to regard S. 1717 as a very good bill. The atomic bomb project scientists strongly urge its rapid enactment into law.

Senator HART. Doctor, you have repeatedly made statements about the policy-making function, and recommended the complete divorce of the military function.

Dr. DAVIES. Yes, sir.

Senator HART. I am curious to know how far in your own mind you intend that policy-making function to carry. Is it your thought that this Commission shall settle all policies whatever in connection with atomic energy?

Dr. DAVIES. As far as the domestic policies go, yes, sir. Do you mean our domestic national commission?

Senator HART. Yes; what you are talking about, where the policy-making function should rest.

Dr. DAVIES. Well, one might for analogy compare it with the TVA authority, which is specifically instructed in its acts to cooperate in very specific ways with very specific governmental bodies.

Senator HICKENLOOPER. On page 7 you use this language:

We believe the Commission should be large enough to permit physically the discharge of its duties, but no larger. It should include—

and this is the pertinent sentence—

among its members persons with pertinent specialized information.

Now, apparently in that paragraph, or in this statement, you say that it is pertinent to have scientists on there, pertinent to have industrialists on there. So long as this is solely a weapon, why isn't it pertinent to have specialists in the military on there?

Dr. DAVIES. I think it is very pertinent.

Senator HICKENLOOPER. Well, I understood that in the last part of your statement you said the Commission itself should be completely divorced, so far as the membership is concerned, from the military.

Dr. DAVIES. That is right. I don't think those two are inconsistent. I don't think we should discriminate against those with military training, but they should not be members of the armed forces at the time they are serving on the Commission.

Senator HICKENLOOPER. Let me ask you this with reference to the question raised by Senator Millikin a while ago, and discussed by you, which I think is quite pertinent.

With reference to the suggestion that we turn this Commission into a civilian agency at this time, divorcing the military as a gesture of our willingness or our desire for peace, what is your opinion as to the effect on other nations of the world, for instance, if we would divorce atomic energy at this moment entirely from the military and set up a purely civilian commission, but at the same time if we set up a universal training program in this country and prepared the oncoming generations for military service? How would that balance up in the minds of the world as to our intentions toward peace?

Dr. DAVIES. One would certainly partially vitiate the other as far as getting the right psychological reaction.

Senator AUSTIN. The logical effect of your position is that the weaker we make ourselves the more powerful is our voice in international negotiations for security and peace. That is the logic. If that is true, we would not be able to carry out our foreign policies if we carried out your proposals here. Isn't that so?

Dr. DAVIES. No; I cannot agree with your assumption, your logical conclusion. We wish to be rid of the atomic bomb in order that the rest of the world shall be rid of it also.

Senator AUSTIN. But you are so honest in your mentality that I have refrained from suggesting this, which has occurred time and time again in my mind, and which I think I will suggest:

There was a great statesman here by the name of Bob Toombs from the South, before the Civil War, and in his campaign for election he declared, "We can lick the damn Yankees with cornstalks."

But after the war was over, he came up for reelection, and somebody in the crowd was unkind enough to pipe up and say, "Bob, didn't you tell us you could lick the Yankees with cornstalks?"

"Well, yes," he said, "I did; but the damn Yankees wouldn't fight with cornstalks."

Senator JOHNSON. Mr. Chairman, I should like to go back to the sentence on page 7 [of Mr. Davies' prepared statement] which Senator Hickenlooper read. It should include among its members persons

with "pertinent specialized information." Now, we are talking about the Commission. I have heard it said that scientists should always be kept on tap but never on top. Do you agree with that?

Dr. DAVIES. No, sir.

The CHAIRMAN. Doctor, I do not wish to lose sight of the fact that the bill does provide—and I don't believe you have emphasized it, or any witness so far has emphasized it—on page 21, section 11, that—

There are hereby established within the Commission a Division of Research, a Division of Production, a Division of Materials, and a Division of Military Application. Each Division shall be under the direction of a Director who shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at the rate of \$15,000 per annum. The Commission shall delegate to each such Division such of its powers under this Act as in its opinion from time to time will promote the effectuation of the purposes of this Act in an efficient manner.

Then it goes on to say:

Nothing in this paragraph shall prevent the Commission from establishing such additional divisions or other subordinate organizations as it may deem desirable.

Now, apparently it has been lost sight of that the military applications are to have a place within the Commission if this bill is adopted. I would assume that the Director of the Division of Military Application would be, or in your opinion should be, a military man; wouldn't you say so?

Dr. DAVIES. Yes; and there is no objection that he shall be in the military service at that time.

The CHAIRMAN. And he could be on active duty, could he not?

Dr. DAVIES. Yes, sir.

Senator HART. But he must have nothing to do with setting policies.

The CHAIRMAN. That would be set by the Commission; that is true.

Senator JOHNSON. He would take orders, but not give them.

The CHAIRMAN. That is right, and that is where I want to keep them, Senator.

Are there any more questions?

We will meet tomorrow, I understand, in the Agriculture room, room 324, the witnesses to be Dr. Shapley, of Harvard, and Dr. Rabi, of Columbia.

(Whereupon, at 11:50 a. m. the committee recessed until 10 a. m., Tuesday, January 29, 1946.)

ATOMIC ENERGY ACT OF 1946

TUESDAY, JANUARY 29, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 324, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Tydings, Johnson, Millikin, and Hickenlooper.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

We are fortunate to have with us this morning Prof. Harlow Shapley, who is director of the Harvard Observatory, and probably the country's outstanding astronomer.

Doctor, you have a prepared statement, I see.

Dr. SHAPLEY. I have, Senator.

The CHAIRMAN. Will you proceed, please?

STATEMENT OF DR. HARLOW SHAPLEY, DIRECTOR OF HARVARD OBSERVATORY

Dr. SHAPLEY. For the record, my name is Harlow Shapley; I am director of the Harvard Observatory, and a member of the faculty of Harvard University. Also I am president of Science Service and of the Scientific Research Society of America (Sigma Xi), and in preparing the following statement I have had some assistance from my colleagues in all of these organizations.

The Special Committee on Atomic Energy has heard much important testimony on the problems involved in legislation on the development and control of atomic energy. Recognizing my inexperience, I should like to spare you my views on many of the technical questions concerned and confine my remarks to the following topics, which I believe are all relevant to the problems before this committee:

1. The universality of atomic energy liberation;
2. Urgency of atomic energy legislation;
3. International aspects of science in the atomic age;
4. Coordination of the proposed Atomic Energy Commission with UNESCO and the National Science Foundation;
5. Comments on specific points in S. 1717.

With regard to these topics I have either some professional knowledge or some recent personal experience that may be useful. Probably

others have presented arguments on some of these points already, and therefore I shall handle each subject briefly.

I should like to preface my specific testimony with the statement that in general I find S. 1717 highly satisfactory. I can report that this is also the reaction I have obtained through direct solicitation of the views of my colleagues referred to above. In addition to them, I have the comments of many members of an informal temporary National Committee on Atomic Energy which I have formed for the specific purpose of obtaining a wide consideration of the many problems created by the current impact of science on society. A large majority agree with me that those who prepared S. 1717 have done an excellent service for the scientists as well as for the public.

UNIVERSALITY OF ATOMIC ENERGY LIBERATION

It is not at all farfetched, I believe, to remind this committee that the release of atomic energy, through methods comparable with the fission of uranium and plutonium, is the most basic operational fact of the universe, except perhaps for its creation. In announcing the fall of the first atomic bomb in Japan, President Truman referred to this fact that the atomic energy that produces sunshine is essentially the same as the energy of the bomb.

A generation ago the astronomers were forced to hypothecate the release of atomic energy in the hot interior of the sun—forced to it by the fossils in the old rocks of the earth. The fossil plants of the carboniferous age were discovered to be some 300,000,000 years old. This was demonstrated, incidentally, through the normal radioactive transmutation of this same uranium atom, the artificial splitting of which has produced an international headache and a crisis for humanity.

The great age of the fossils which lived by grace of the same kind of sunshine and the same amount of sunshine as works today in preparing us to be the fossils of the future, makes necessary a long-continued constant source of sunlight.

The CHAIRMAN. What are we going to be in the future—"fossils of the future"?

Dr. SHAPLEY. I said that advisedly. I say there is no escape from the fact that we ourselves are going to be the remnants of a past age. Perhaps I have said it a little lightly.

The CHAIRMAN. No; I just got quite a reaction out of it.

Dr. SHAPLEY. No other source is considered possible than that which arises from the energy of the atoms. The sun has been a steady producer for hundreds of millions of years, and to perform so steadily it has used natural atomic engines.

I should interpolate here that other sources of solar energy have been considered, like the infall of meteors, like the contraction of the sun, like the simple burning of the sun. They all can produce energy for a certain amount of time, but not sufficient energy to keep the earth heated long enough for the geological ages that we now recognize. The sun apparently is not depending on the splitting of uraniumlike atoms. It works at the other end of the periodic table, as Dr. Bethe has already explained to this committee. It gets its enormous energy sources from the synthesis of light elements out of the lightest of all elements—hydrogen. By far the most colossal source of atomic energy in the

universe is this transmutation in the stars of this most common of the elements. The stars can do it. We think we know how they do it. And we cannot follow their method because the maintenance of the necessarily high temperature, about 20,000,000, would be difficult if not impossible, and would be impractically expensive. The artificial transmutations of the lighter elements so far accomplished by man require much more energy than is produced. Our methods are not efficient.

Although in S. 1717 atomic energy is broadly enough defined in section 14 (a), throughout this Atomic Energy Act of 1946, as it is officially called, the emphasis and provisions are almost wholly confined to "fissionable materials" as defined in section 5 (a) (1). The helium synthesis is not included. I do not recommend the change at this time, but I want to point out that if we should find a way to sidestep the requirement of high temperature, we might soon need amended legislation. We might need an Atomic Energy Act of 1947, or of 1948, or 1950.

The CHAIRMAN. Doctor, just so that I make sure that I understand. In other words, the bill covers "fissionable materials," the splitting materials, of course.

Dr. SHAPLEY. That is right.

The CHAIRMAN. What you are talking about is the combining of certain elements in the periodic table to bring about, as you say, the synthesis process?

Dr. SHAPLEY. Yes.

The CHAIRMAN. Helium is one element, isn't it, and hydrogen and helium might be brought together?

Dr. SHAPLEY. Hydrogen into helium, thus releasing atomic energy.

The CHAIRMAN. So if we had that process come about, the definition would not be sufficiently broad, would it?

Dr. SHAPLEY. That is definite; and that is my thought.

The CHAIRMAN. Do you think that the immediacy of that is sufficient to cause us to change the definition now?

Dr. SHAPLEY. I would hardly think so at the present time. It may come, of course, at almost any time, and it may not come at all. It is a very difficult business, because the stars have the great advantage of enormous mass, and therefore the possibility of maintaining very high temperatures. We would have to find some very tricky way to sidestep that present basic requirement.

The CHAIRMAN. All right, Doctor.

URGENCY OF THE LEGISLATION

Dr. SHAPLEY. This leads to the observation that in revising S. 1717 it is to be hoped that this committee will recognize that prompt passage of a bill appears to be important. American scientists and technologists, as well as the Army and Navy, are anxious to know what the national policy is to be. The scientists of Europe, and the governments of Europe, need to know our plans in order that they can better shape their policies and help shape the urgent international policy with respect to atomic energy. Is it not, therefore, important, if you may permit me this suggestion, that the controvertible points, which might delay passage of the bill, be avoided as much as possible? We can keep in mind that on the basis of riper experience this legislation can be quickly amended. We need at the moment as good interim legislation as is possible.

In the spirit of expediency, therefore, I suggest that section 9, entitled "Dissemination of Information," might be greatly simplified. A statement to the effect that "for a period of one year, and until this bill is amended, no information about atomic bomb assembly and use can be released" would probably allay the fears of many and still not seem too crippling to scientific research and development, or contradictory to our widely approved plan of world-wide exchange of scientific knowledge and scientific personnel.

But if it were not for the widespread worry in many circles throughout America, and the need for prompt legislation, I would personally approve section 9 as it stands.

Senator MILLIKIN. Do you mind, Doctor, if I ask an interrupting question that bears on a somewhat different subject although related in a way?

Do you believe that the general exchange of scientific information between the nations and the exchange of scientists is feasible unless you have at the same time a general exchange of all kinds of information and the permission for all kinds of people to cross borders? Do you think it can be confined to scientists?

Dr. SHAPLEY. I believe, Senator, that the effective interchange of scientific information must be accompanied by the interchange of personnel. There is no check in published materials, or occasional papers at scientific meetings, that you are getting the whole story, and I believe that perhaps more important than increasing the already considerable exchange of scientific literature is the widespread travel of the scientists of all countries.

Senator MILLIKIN. Do you think that could be brought about unless at the same time you permitted general exchange of information of all kinds, scientific and otherwise? Do you think it can be limited to that in a practical way?

Dr. SHAPLEY. I had not thought of that, but I hope it couldn't be limited. That is, you are asking could we perhaps get information that is relevant to the atomic energy bill and not at the same time have all the information on agriculture, social development, literature, and history, and so forth.

Senator MILLIKIN. I mean, can you isolate just one department of human knowledge and say, "Now, after this we will exchange information and personnel but we will not exchange anything else." Is it practical to do that?

Dr. SHAPLEY. It might be practical, but it would be inadvisable, I think, and a very incomplete picture of the international amity toward which we must approach for the future security and future advance of human culture.

Senator MILLIKIN. I am sorry to have interrupted you.

Dr. SHAPLEY. Dr. P. W. Bridgman of Harvard University writes that he believes that the weakest part of the bill is section 9 (a) on basic scientific information. Instead of the abbreviation I have suggested, he proposes that the details might be more specifically stated. I should like to introduce his comment into the record for consideration in any further revision of the bill:

PREPARED STATEMENT OF DR. P. W. BRIDGMAN OF HARVARD UNIVERSITY

This [dissemination of information] is obviously a matter of very great difficulty to formulate adequately, and I believe that the sponsors of the bill have already spent much effort on it. The difficulty is added to by the fact, which I have

obtained from the best-informed sources, that there is now in the possession of the Manhattan district certain basic scientific information which the scientists closest to the project consider should not be published at present. In the face of this situation I believe that the full matter of basic scientific information can be dealt with only in much more specific terms. I would suggest that section 9 (a) be expanded into four sections, as follows:

(1) The Commission shall have no jurisdiction or control over any purely theoretical scientific activity which is based only on published material, nor jurisdiction or control over the free publication of the results of such activity.

(2) The Commission shall have no jurisdiction or control over any experimental or technical activity in the performance of which no materials are used the control of which is specifically allocated to the Commission and which utilizes only published results, nor jurisdiction and control over the free publication of the results of such activity.

(3) Basic scientific information obtained as the results of experiments performed with the aid of materials in the control of the Commission shall be freely publishable. In case of dispute as to whether certain information is of basic scientific character the decision shall be made by three scientists appointed by the President of National Academy of Sciences.

(4) Classified material at present in the control of the Manhattan Engineers' District or similar classified material relating to atomic fission resulting from activities sponsored by the Government during the war shall be declassified and published as rapidly as the Commission may decide is consistent with the public interest.

The CHAIRMAN. Do you subscribe to that definition, that revision by Dr. Bridgman, Doctor?

Dr. SHAPLEY. Not completely.

The CHAIRMAN. Will you tell us what criticism you have of it?

Dr. SHAPLEY. I would have left out the reference to the National Academy of Sciences. I would not have been quite so concerned about the freedom of publication as Professor Bridgman is. In general, I would prefer, as I stated before, that section 9, or at least 9 (a), be simplified in order not to alarm people into believing that we are injudiciously telling secrets that we should not tell, or giving away information—an act that for the time being is not consistent with the public interest.

The CHAIRMAN. Now, the Smyth report of course was authorized and given out by the War Department, and I presume that the Smyth report is a good example of what is termed "basic scientific information." That is true, is it not?

Dr. SHAPLEY. Yes; that is true.

The CHAIRMAN. Now, there has been some controversy over whether it was wise to publish the Smyth report. Have you had any criticism of that?

Dr. SHAPLEY. No; but I was startled to see it when it came out. I thought publication was perhaps a little hasty, but I was enthusiastic that our Government took the attitude that we are not concealing information of genuine scientific value.

The CHAIRMAN. In other words, do you feel that there was anything released in the Smyth report which prejudiced our security?

Dr. SHAPLEY. No.

The CHAIRMAN. Now, the War Department made the determination to release that. Under the terms of this bill, a civilian commission would have to come to the same determination to release information, basic scientific information, as the War Department released without consultation with the Congress, or with the President for all I know, or anybody else; isn't that true?

Dr. SHAPLEY. Yes.

The CHAIRMAN. Well, what I am trying to find out, Doctor, is why you have the feeling that the delegation by the Congress to a commission as it is finally set up in the bill, should arouse such a focal point of controversy as to delay passage of the bill. That is what I take it you are afraid of.

Dr. SHAPLEY. I am afraid of it, Senator. Frankly, I think it is rather silly that there is this worry and opposition. As I have said, I think section 9 is well written, and I agree to it completely as it stands, except as a matter of expediency at a time when I do think it important that we get our atomic energy bill passed. That is all.

The CHAIRMAN. Well, let's put it this way: I would like you to be the devil's advocate for a moment and to tell me what you think will be the argument made by persons who believe that this section would permit the giving away of secrets that should be kept—and I always say "secrets" in this field, Doctor, quote-unquote.

Dr. SHAPLEY. I believe that cannot be answered very rationally. We have in this country, as you know, a considerable, shall we say, journalistic worry that we are telling to various countries things that we had better delay for diplomatic reasons for some time. To me, it is a type of jingoism; to me it is perhaps tied up with the political struggle for an issue. I don't take it very seriously, and I am afraid I would not be a very good devil's advocate. I don't believe I could quite justify that attitude that we should not be free with our information and not proceed as you have described and planned in section 9.

The CHAIRMAN. Of course, I think it is important under the bill that basic scientific information must be given out.

Is that true?

Dr. SHAPLEY. That is right; and it should be, of course.

The CHAIRMAN. And in your opinion, it should be?

Dr. SHAPLEY. Very definitely should.

The CHAIRMAN. Can science prosper, Doctor, in an atmosphere of secrecy and restraint?

Dr. SHAPLEY. No; I think there is very little possibility that it can, and science has many times been hindered by selfish concealment of information over an interval of time. I think that will be even more true in the future, because the scientists are so interlinked, and it is so impossible for any one given investigator to control his whole field.

Therefore, we must have literature, we must have bibliographies; we must have collaborators in our big researches. I saw a paper published a few days ago which had 10 authors, indicating that no single man felt competent to issue that particular job on his own authority. It showed the need of collaboration. I think science has no chance at all of prospering in the way we would like to have it prosper unless we have very wide collaboration, very extensive cooperation in distributing information, and therefore any restraint on science or technology must be justified on the basis of procedural arrangements. It cannot be a good long-range policy.

The CHAIRMAN. Now, the Commission, as it is created, has to make the determination of what is basic scientific information, does it not?

Mr. SHAPLEY. That is right.

The CHAIRMAN. And it might be that they would not classify immediately something as basic scientific information if at that time its release at that particular moment might be highly prejudicial.

Now, the discretion is within the Commission, is it not, under the bill?

Dr. SHAPLEY. Yes; and a very high responsibility is within the Commission.

The CHAIRMAN. A very great responsibility. Do you know of any other way administratively to handle it than to give that discretion to a Commission? Congress cannot do it, can it?

Dr. SHAPLEY. I would think it would take high expertness in the Commission.

The CHAIRMAN. You cannot imagine the Congress debating each release of information, and just exactly how much we could release or couldn't; can you?

Dr. SHAPLEY. No.

The CHAIRMAN. I don't want to labor the point, Doctor.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. I quite agree that over the long term you do not help science by having to move in an atmosphere of secrecy and restraint, but, paradoxically, we had the biggest advance in this atomic fission business under secrecy and under the impetus of war that we have had in this country, which means exactly nothing, because, as I say, over the long term that would be a very bad policy, I think.

Senator McMahon, Senator Johnson, and I have been neglecting the Senate Military Affairs Committee for a long time. Will you excuse us so that we may be there for a few minutes now?

The CHAIRMAN. All right.

Dr. SHAPLEY. Section 6 (b) contains an important provision, namely:

The Commission shall not conduct any research or developmental work in the military application of atomic power if such research or developmental work is contrary to any international agreement of the United States.

The proposed legislation thus recognizes the internationality of scientific research. The build-up to the practical release of atomic energy came from many countries. Our legislation must be prepared to recognize that both the good of science and the potential evils that must be restrained are international. We must be prepared to encourage the exchange of scientific information and to aid in the foreign travels and foreign studies of our scientists, including graduate students and specialized technicians.

COORDINATION WITH UNESCO AND THE NATIONAL SCIENCE FOUNDATION

In this connection the Atomic Energy Commission could well make use of the facilities of the newly formed United Nations Educational, Scientific, and Cultural Organization. The charter of the subsidiary organization of UNO was signed in London in November 1945 by the representatives of 44 countries. A joint resolution, I believe, has just been introduced into Congress to provide for the adherence of the United States to this organization. An important function of UNESCO will be the world-wide dissemination of scientific knowledge; the sponsoring of special international conferences; and the breaking down, in the fields of science, education and culture, of unnecessary national boundaries and sectional restrictions. When it is in full

operation, UNESCO should prove to be an important instrument for assisting in various operations of the new Atomic Energy Commissions, both for the United States and for the United Nations.

There will also be need to coordinate the activities and responsibilities provided for in this Atomic Energy Act of 1946 with the activities and responsibilities of the National Science Foundation, which is under consideration by other committees of the Senate. The Commission and the Foundation both expect to sponsor research in nuclear physics; in the use of radioactive materials in medical research; and in the interests of the national defense. In both bills there is a consideration of the problems of the patents that might arise from the discoveries and developments that occur in the course of investigations subsidized by the Government. It would seem advisable to seek a common and consistent policy with regard to patent provision—and here I am speaking for a number of correspondents—and to consider the various other consequences of the overlapping coverage of these two highly important legislative acts.

I should like to make a number of comments on specific points in S. 1717, remembering that of course a number of them have been discussed before.

In sections 2 (a) and 2 (b) provision is made for an Atomic Energy Commission of five members, all of whom are full-time employees of the Government and are forbidden to have other business, vocation, or employment. This is a difficult point, I admit, but I would prefer the single full-time administrator, with full-time divisional directors, as provided in section 11 (a), and an unpaid advisory committee, that arrangement being made in order to get the services of the better men. But I shall not comment further on this point since it will be discussed in some detail, I believe, in a later session of this committee by President Karl T. Compton, of the Massachusetts Institute of Technology, with whom I have conferred. I may add that President J. B. Conant, of Harvard University, tells me that he also definitely prefers the single administrator with advisory board.

In section 5 (a) (4) on the Distribution of Fissionable Materials it is prescribed that—

The Commission is authorized and directed to distribute fissionable materials to all applicants requesting such materials * * *

The word "directed" will make it possible for any crank to obtain fissionable material so long as he is equipped to observe such safety standards as may be established by the Commission. I grant that the Commission may find it hard to distinguish between the various orders of cranks in the fields of scientific research, and therefore I suggest no substitution for the word "directed." You may decide it is profitable to gamble on these unorthodox explorers who in turn probably believe that the "authentic" scientists are the cranks. So I pass that point.

Section 5 (a) (3), entitled "Prohibition" will make a great many innocent landowners into lawbreakers. This production of common criminals seems to be the usual experience when prohibition is put into the law.

I have in my pocket, Senator, a common piece of rock which I picked up on my way to this hearing. It is not my custom to come armed to a senatorial hearing, but I bring this to illustrate a weakness

in the phraseology. This piece of rock contains approximately 10,000 trillion atoms of uranium-235.

Uranium, as you know, is a very common, well-distributed element; It appears in minute quantities all over the earth, and where there is ordinary uranium, there is uranium-235, which is fissionable material.

My suggestion is a change in the phraseology, which probably has been pointed out by others.

My objection is to the phraseology, "It shall be unlawful for any person to own any fissionable material."

Incidentally, I have computed there are about 10 tons of uranium-235 within 5 miles from where we are sitting. It is a common element in the rocks, although not very easily obtained therefrom, as we have found. Uranium is, of course, also a constituent of the dust on the floor. This prohibition which I have mentioned naturally affects all mineralogical museums, and certainly the provisions of section 5 (a) will confuse the problems of ownership and provide endless bookkeeping. I believe the situation can be largely corrected by changing the phrase just quoted, which was, "It shall be unlawful for any person to own any fissionable material."

The CHAIRMAN. Doctor, that can be easily remedied by distinguishing between source materials and the finished product, can't it?

Dr. SHAPLEY. Yes. Or my suggestion is: "It shall be unlawful for any person to own any fissionable material except as permitted and authorized by the Commission." That exception already appears in the next provision of the prohibition clause.

The CHAIRMAN. I might interrupt you, Doctor, to say that of course it wasn't the intention when we drew the bill to make any unaware owner of source materials responsible criminally. I don't get them out of a reading of it, but I think that we ought to be careful that that point is cleared up. I just wanted you to know that wasn't the intention, of course.

Dr. SHAPLEY. Obviously, it wasn't the intention. It is merely a matter of phraseology.

In section 12 (a) on Enforcement, is a phrase that may cause considerable anxiety. It is the stipulation that any willful violation, attempt to violate, or conspiracy to violate "any regulations or orders issued" under this act is punishable. Throughout the bill there is much left to the power and judgment of the Commission. An arbitrary Commission could make rules that would ruin scientific research. In this bill, which no doubt will be amended as time goes on and experience accumulates, it would be possible, without danger, to leave out the phrase "or any regulations or orders issued thereunder," in line 19 on page 23.

My only concern is the worry that might be caused in nervous quarters by the phrase "any regulations or orders."

In conclusion I should like to record a protest which is perhaps not appropriate here, against the loose phraseology of the Atomic Energy Resolution adopted by the General Assembly of the United Nations Organization in London last week. The protest is relevant because our domestic policy must be coordinated sooner or later with this United Nations resolution, and with the international activities created thereby. The first sentence of the resolution provides for the establishment of a commission "to deal with the problems raised by the discovery of atomic energy and other related matters." Instead

of "the discovery of atomic energy" we should use the more correct statement "the discovery of large-scale artificial liberation of atomic energy" or "the discovery of the fission of the uranium atom." The discovery of atomic energy occurred 50 years ago at the dawn of our knowledge of radioactivity, and that discovery is not the problem which incited the resolution adopted by the General Assembly of the United Nations Organization last week.

The CHAIRMAN. I guess they will know what they have to deal with over there, regardless of how the regulation is written.

Dr. SHAPLEY. It is a loose phrase, that is all.

The CHAIRMAN. Doctor, do you believe the Government should own all fissionable materials?

Dr. SHAPLEY. Yes.

The CHAIRMAN. And that private ownership of fissionable materials should not be permitted.

Now, private ownership of fissionable materials was permitted in S. 1463, which was the first bill introduced on this subject, the May-Johnson bill. You agree that was in error, and that was corrected in this bill, if I understand you?

Dr. SHAPLEY. Yes.

Senator MILLIKIN. Would you mind stating, Doctor, why the fissionable materials should be owned, as distinguished from controlled? Let me preface my question with this: These materials in my State occur in the regular incidents. They are found in connection with other mining operations. It would be somewhat impracticable for the Government to own all of the deposits that might have that kind of material associated with other commonly mined materials.

Dr. SHAPLEY. I can see that point, Senator, and I have thought about it, although to comment on this subject is, of course, outside of my field of competence.

At the beginning of the arrangement for the control and production of atomic energy we must do a great many things that heretofore did not seem reasonable. It is not a time in which the older system of operation can be followed clearly.

I would like to see the Government owning—and that word "own" might be in quotation marks, because it may take a special kind of ownership or right—all the fissionable material at the present time. After some years of experience, that plan might be modified, but I would sooner start from the total Government control and ownership, rather than do a part-way job and have to work then, perhaps, toward further Government control.

The CHAIRMAN. Doctor, I think you were talking about source materials rather than the finished product.

Senator MILLIKIN. Then my question was misdirected.

The CHAIRMAN. Of course, Senator, as you know, as far as source materials are concerned, the Commission has the authority to buy or condemn any source materials. There might be an objection raised that the byproduct, that is, the byproduct of mining vanadium, we will say, would lie there dormant and the Government, which would be the only purchaser since it would be the owner of the end product, fissionable material, could set a very unfair price, it seems to me. But after all, your miner wouldn't have to accept it. He could say, "Condemn it," so he could have access to the courts to get a fair value for his product.

Senator MILLIKIN. I was striking only at the point of the ownership of the raw material. I see no point in it at all. It seems to me it could be controlled just as well as it could be owned. In fact, I think if you want to develop uranium ores, for the Government to own them unless it is going into general mining operations, general exploratory operations, would be a restrictive thing rather than a helpful thing. I have no doubt in my own mind that raw material can be controlled at the source, but a general program of ownership in view of the way the ore occurs, at least in my State, would involve the practice of the whole State of Colorado and would probably end all mining operations in the whole State of Colorado. Of course, I am "agin" that.

The CHAIRMAN. Of course, that isn't provided for in the bill. The Commission licenses the movement of ingredients essential for the production of fissionable materials so that it can assure an adequate supply and prevent a diversion of those materials. They have authority to condemn or buy, but certainly there is no intention or authority in this bill to go out and buy up the State of Colorado for the purpose of getting any monopoly of such material.

Senator Millikin, have you any further questions?

Senator MILLIKIN. No.

The CHAIRMAN. Senator Hickenlooper, you just came in. Dr. Shapley is a noted astronomer from Harvard and has given us the benefit of his testimony.

Senator HICKENLOOPER. You haven't located any uranium on any of the other planets, have you, Doctor?

Dr. SHAPLEY. No; we haven't. We haven't the slightest doubt that it is there, but it is difficult to detect. We have detected some 50 of the earth's elements on other stars, but not uranium.

The CHAIRMAN. Doctor, I notice on page 5 of your statement that you say you would prefer a single full-time administrator with full-time divisional directors. In other words, I take it that you approve of the divisional set-up that is erected in the bill?

Dr. SHAPLEY. That is right.

The CHAIRMAN. Each having at the head of that particular section a most competent man in that particular field.

Dr. SHAPLEY. Full-time and employed in this only.

The CHAIRMAN. Now, what objection have you got to the Commission approach? I notice that you say that you would rather have a sort of advisory committee, an unpaid advisory committee.

Isn't it your experience, Doctor, that unpaid advisory committees give just about as much as they are paid for?

Dr. SHAPLEY: Yes; and when I said "unpaid," perhaps I should have modified that a bit. I meant they were not full-time employees but were employed in the way one hires special consultants. But I think there is something in that point you make.

If we have a full-time advisory or managing commission, I think we cannot get the best men; our commission is likely to be made up either of heroes, or emeriti, or men whose interests are in part elsewhere.

It has been suggested that one could get men on such a full-time commission for a period of only 2 or 3 years. But men who are working for 2, 3, or even 5 years and then returning to some other interest—university or industry—cannot be entirely free of pondering the future.

The CHAIRMAN. Doctor, you know there is something contradictory in what you have just said to an observation you made to Senator Millikin a few moments ago, when you said we could not think in the usual terms in several facets of this situation. It has occurred to me that when we talk about staffing this Commission with competent high-class men there is one place at least in which the imagination isn't let to roam, to the extent that the highest-class men would be attracted to this because of the importance of it both to our future prosperity, perhaps, and even our existence as a nation.

Don't you find that a little inconsistent in your own mind?

Dr. SHAPLEY. I grant your point, and, recognizing it, I used the word "heroes." I mean by "heroes" men who do see that this is an unusual situation and who are willing to sacrifice their past and future, if it is a sacrifice for them, to take positions and responsibilities on the Commission. But suppose we were constructing a Commission at the present moment: I can think of a dozen men whom I think would be competent to be on that Commission, approximately a dozen men. All of them have either industrial or university affiliations at the present time, and to ask them to give them up would be requesting the unusual service that you suggest. So, I grant your point. I was inconsistent if we are applying to industrial and mining enterprises the same principles that we apply to principles of social service.

The CHAIRMAN. Well, suppose we made the salary—we couldn't compete with private industry, for Government just doesn't do that with \$100,000 salaries, but suppose we paid the Supreme Court salary; don't you think that that would be sufficient to attract the type of men that we would need who would serve because they recognize the vital importance of this?

Dr. SHAPLEY. I don't believe the salary is a thing that will take care of that.

The CHAIRMAN. Not exclusively, of course.

Dr. SHAPLEY. I don't believe it is a very essential point.

I think the request that these individuals on the Commission abandon their former connections, their former associations and the way they have built up their lives—because they wouldn't be competent on this Commission unless they did have a record of great service and of great accomplishment—and divorce themselves entirely from these associations may be successful, but I would worry that such men could not be found. I think that we could do a good deal of damage to this Commission if we select men who look at it either as a political plum or as something that is worth their doing only because they haven't much else of importance to do.

Also there is one other point that may come up in further discussions, especially if Dr. Compton testifies on this matter, and that is what would be the activity of these five men? There are division administrators to look after the divisions. The topman, the chairman, would have plenty to do, but unless there were some partition of the work, could you get these highly competent administrative or scientific individuals to find profitable employment for themselves commensurate with the responsibilities that they have given up?

That is a question and not an assertion.

The CHAIRMAN. It would strike me that a person who is on this Commission would have the advantage that we Senators do not have,

a little time for reflection for the vital problems that they would have to pass on. We don't make much provision for that in Government; I think probably we lose thereby.

Dr. SHAPLEY. Nearly all of us work too much, think too little.

Senator MILLIKIN. Because I wasn't able to hear your entire address, Doctor, I know I have missed your position as to whether the commission should be composed of scientific personnel.

Dr. SHAPLEY. No; that matter wasn't brought up.

Senator MILLIKIN. Do you think it should be?

Dr. SHAPLEY. I don't think it should be exclusively scientific personnel, if by scientific personnel we are thinking of nuclear physicists or even natural scientists.

Senator MILLIKIN. It seems to me that what you have just said is consistent with your statement a while ago that in some phases of these problems it may take 10 men to work up a proper symposium, and of course if you attempted to put a physicist or a scientific man to represent every problem in this whole field, you would have a congress of scientists rather than an effective administrative commission.

I put that also not as an assertion but as a question.

Dr. SHAPLEY. The bill, of course, provided for all the necessary machinery in the way of special committees and advisory boards and subcommittees. On the advisory board, it would seem to me that one must have representation of the social scientist and of Government as well as of the technical scientists associated with atomic energy release, and that would be true whether it was strictly an advisory committee or a full-time committee. The problems cover so many fields.

Senator MILLIKIN. This is a routine question of mine, so I will ask you: Do you think science would be irremediably injured if this whole subject continued to be bottled up for, let us say, 6 months or a year?

Dr. SHAPLEY. No.

Senator HICKENLOOPER. With reference to this—I don't remember how you referred to it, Doctor—general full-time administrator with an advisory board, would you recommend that this administrator be appointed by the President and his power defined by law, or would his powers be limited and directed and his policies controlled by the advisory commission that you suggest?

Dr. SHAPLEY. At least the advisory commission should be consulted if it is a well-chosen commission on the problems that would be written into the bill.

Senator HICKENLOOPER. I assumed under any circumstances, that being the case, that the advisory commission would be consulted by the very nature of their set-up as an advisory commission. As to the ultimate authority for decisions, what would you suggest concerning that? Who would be the final authority on definition of policy and administrative activities?

Dr. SHAPLEY. The President of the United States.

Senator HICKENLOOPER. Well, what authority would that administrator have?

In other words, if he were in direct conflict with the suggestion of his advisers, would he say, "Well, I have your advice; thank you. It will be this way." Or would he be controlled in his policy by the advisers' determination in this thing? Or would the administrator and

the advisory commission both have to take their quarrel to the President and say, "Here, we don't get along; you decide who gets the apple."

Dr. SHAPLEY. That matter has been discussed a good deal in our National Science Foundation organization, and I have felt that the people who know how to administer bureaus and departments in Washington are much more competent to speak on that subject than are the scientists who have not had experience. Therefore, in a way, I am quoting what I have heard from competent and trustworthy administrators when I say that I believe that the administrator should be a person of authority in those matters, that the advice that he would get from his committee should be not mandatory but useful. That, of course, would have the result, then, that he is alone responsible for the outcome and responsible to the people and to the President.

Senator HICKENLOOPER. Thank you. I was merely trying to at least pursue this proposal down to where the final authority would rest. I think you have answered the question.

The CHAIRMAN. Thank you, Dr. Shapley.

Dr. Rabi, suppose you give your name for the record, and tell us of your qualifications to come and advise us here today.

**STATEMENT OF DR. ISIDOR I. RABI, PROFESSOR OF PHYSICS,
COLUMBIA UNIVERSITY**

Dr. RABI. I am not sure of my qualifications, but in any event I am a physicist and a professor of physics at Columbia University in New York.

For the period from late 1940 to late 1945, I was at the Radiation Laboratory in Cambridge with the position of associate director. This laboratory was, I believe, the largest laboratory under the auspices of OSRD and was devoted to research and development in the field of radar. From early 1943 to the end of the war, I was also a consultant for the project at Los Alamos, N. Mex.

The first thing I would like to say is that I am in general agreement with the intent and provisions of S. 1717. The provision of a commission is a very wise one, in my opinion. As I understand the bill, the Commission is essentially a policy-making body in the vast and complicated field of nuclear energy. It seems to me very desirable to have a body of men who can devote themselves to the planning, coordination, and general direction of policy.

The establishment under section 11 (a) of the four divisions of research, production, materials, and military application is also in line with the best experience, both in private industry and in the war effort. For the protection of research, it is very important to separate it from the field of definite application and production. This has been the experience of large organizations, of which the American Telephone & Telegraph Co. and the General Electric Co. are two outstanding examples. In a new and active field like nuclear physics, which at the present moment rests on the very inadequate theoretical basis, it is vital that research be as unhampered as possible and that the scientist be encouraged to explore this field with the freest use of his imagination. Because of this, it is particularly important to separate research from the activities of the practical production of nuclear energy or implements of war. The exploration of this field

with the broad objective of obtaining a clear understanding of the fundamental basis of such phenomena as nuclear forces, the production of energy in the stars, cosmic rays and the associated new particles such as the mesotron, will find a basis for the new technology of atomic energy. One will then be able to proceed with further developments with the assurance that no vital avenues of approach to the problem have been neglected.

I would also like to say that I like in this bill the idea of a civilian commission, and I think that is directly in line with our war experience, that the most effective connection the military have with such activity is in the form of liaison.

I want to add to my own statement a statement of Dean Pegram.

Senator MILLIKIN. May I ask a question, Doctor?

If the war had not come along and made the development of this energy a matter of extreme urgency, how long do you think it might have been before we would have acquired the same amount of knowledge?

Dr. RABI. I don't know whether you mean we or the whole world, or some other country. It was quite clear that beginning in about the middle of 1939 this sort of this thing was possible, and it was merely a question of who would decide to go for it in a big way. We did because of the pressure of war.

Some other country, poor in natural resources like coal and oil, might have gone for it for other reasons. One cannot predict at all, I think.

Senator MILLIKIN. Would it have gotten out of the laboratories without having behind it the profligacy of war expenditure?

Who, for example, or what nation in peacetime would have started to translate the laboratory knowledge into results?

Dr. RABI. Well, many nations, with many reasons for doing so. For example, an empire like Great Britain has many areas in which coal is scarce and where energy is desired, and they could have set it up.

Senator MILLIKIN. Well, we spent two and one-half billion. Let us assume that a large part of that would not have to be respent if someone were approaching it fresh. Let us say that it took \$500,000,000 to do the job. Merely mentioning a sum of that kind and then correlating it with the peacetime activities of Government is, I believe, expressive of very serious doubt as to whether there would have been this sort of translation from the laboratory into results for a very long time.

Dr. RABI. Do you mean, Senator, that the war would simplify the overhead cost, and that the capital expenditure for peacetime use would not have been made, so that we would get atomic energy now for peacetime use possibly merely as a byproduct of the war and that there is no other human activity which would give such support to the scientific research?

Senator MILLIKIN. That is the general effect of what I was driving at, but I would like to exclude from the inference that I have given you that I mean that it would never have come about. I am speaking in terms of the foreseeable future.

Dr. RABI. I think it would depend upon the temper of the particular country. If they were in the mood for great expansion, such as our drive out to the West, they would go for this sort of thing. If they were in a conservative mood and said, "We have other things to do," they wouldn't.

Senator MILLIKIN. It is highly speculative, isn't it?

Dr. RABI. Yes; it is a big world, and all sorts of things could happen.

Senator MILLIKIN. It is entirely speculative as to when we would have gotten to the point we are now, had it not been for the urgency of war.

Dr. RABI. I don't think we would have gotten far with it unless we had this immediate urgent application.

Perhaps some of the Senators from the Southwest or other regions where coal might be difficult to get at, say California, might say, "Here is a source of energy which would be very important for irrigation and other purposes," and get the Government to go in for it at a reasonable rate of \$25,000,000 a year, and they would have it in about the same time we are going to have it anyway, I guess.

Senator MILLIKIN. Again, that is entirely speculative?

Dr. RABI. Yes.

Senator MILLIKIN. Now, the point I am coming to is that this acceleration in the development of the science, this bringing it to at least the beginning of a fruition, came about under military direction.

Dr. RABI. It is a difficult and complicated question. I mean that military direction has various shades of meaning. I would say "military connection"; the military were more the people who could get the money from the Government. They held the pursestrings, and a few were willing to take the responsibility for spending such sums, to the military already spending such very great sums that this was something additional.

Senator MILLIKIN. I think it is incontestable that there was an over-all military direction and under that—let us call it regimentation, a very obnoxious regimentation of the scientists. I would not for a moment have you draw the conclusion that I would favor a permanent military control of the subject. I was just putting a little counter into your thought that only science can achieve anything and can head this way in an adequate way, my point being that the greatest development of the subject has come under top military control.

Dr. RABI. I see what you mean, Senator, and there has been no quarrel between us.

You drew an inference, not from any remark I made. What I said was that our experience in the war has been that for scientific development the best position of the military is the form of liaison. I was referring not to the Manhattan district which was a very special sort of thing, or made very special, but to the vastly more complicated operations, I think, of the OSRD, of which our laboratory was one of the chief elements, the Radiation Laboratory. I was simply talking from experience. Also let us say from the form of organization of laboratories, like the Naval Research Laboratory, where the civilians run the thing and the military there are there for liaison and for providing basic administration. They take care of the buildings and do the paper work, and then otherwise are there for observation, for transmission to their different military branches.

Senator MILLIKIN. I have gotten a very distinct impression from the testimony that the over-all direction of the matter was in the military. Of course, the military availed itself of a wealth of science and perhaps without science the military would have been entirely futile in the thing, but somebody headed it. It is my understanding it was the military.

Dr. RABI. Well, sir, you can go back step by step. General Groves was, in essence, the head of this thing for a time. Behind him was another committee; and behind him stood another group, which was civilian; and behind them all stood the President of the United States, who was a natural-born civilian, so I don't know where you are going to draw the line. At some point, somebody had to be given some money, had to spend it and had to have some organization for spending this money. You would have an organization with people in brown suits or people in ordinary costume. There was nothing in the previous history of the organization, the United States engineers, which made it anything special for them. They never ran much in the way of laboratory, certainly no such vast research approach. It was a job which was given to them during the course of the war, and such things happen all the time.

I don't think we can draw a proper inference from it, until we have the detailed history of the activities of the Manhattan district, and all the important decisions, how they were made and what the reasons were, and a careful examination of whether those were or were not good decisions.

What we have here is, to begin with, somebody gave somebody else some money, and then after a few years, as an end result, a bomb materialized. Now, the end result of the bomb does not prove that the administration was good throughout or bad throughout. I think the whole thing will await further study.

I am speaking, however, more from my own experience in another field which the general public knows more than any of the other operations of the OSRD, our particular laboratory, the Radiation Laboratory. The costs of the products of the Radiation Laboratory, the things which were developed there and then went into production, and which were produced as a result of the Radiation Laboratory were just about as great as what the Manhattan district spent. I think it amounted to about a billion and a half, and the Manhattan district was two billion; so the Manhattan district isn't our only example of the initiation of an important scientific project and its development and use against the enemy.

Senator MILLIKIN. I wasn't making any point, Doctor, as to whether the administration was efficient or inefficient. If it was inefficient, then under your theory the parties made accountable in a major way are the scientists. Starting at the top, the decision to go ahead was made by President Roosevelt, who was, as you say, a civilian, and also Commander in Chief of the Army and Navy. Below that, the time came when there was an over-all direction or coordination or liaison, or whatever you want to call it, by the military, and the record here is full of the resentment and not resistance—because they cooperated splendidly—the uncomfortable cooperation of scientists who felt they were being regimented. That is all I was trying to develop, and that is why they want to get out from under it now. That is why they want a civilian commission.

I don't believe those things are contestable, Doctor.

The CHAIRMAN. Doctor, I don't think that we should hold you up very long to comment further on the Manhattan district and the way it was operated. I thought about it a good deal. We had the scientists with the ideas and the basic scientific knowledge, and then we had some of the most prominent engineering organizations in the

country who were called in. Then, we had the Army with an unlimited amount of money and without any regard for priorities, which got what the other two groups said they needed to do this job. Isn't that true?

Dr. RABI. As far as I know.

The CHAIRMAN. And they did act as procurement agents for this project, and they did set up security rules for this project. Is that right?

Dr. RABI. Yes; as far as I know.

The CHAIRMAN. Now, do you know or have you heard of any engineering accomplishments per se that were contributed by the Army other than the three or four private industrial and engineering organizations that were brought in under contract to do the job?

Dr. RABI. Well, sir, my connection with the project was only through the Los Alamos Laboratory, which was charged with making the bomb and they required a minimum of outside engineering, so I cannot really say. I had no connection with the other branches that approach it.

The CHAIRMAN. I think it is a subject we can well delay in view of the more important and immediate things we have got to do. When the final history of the thing is written, we will be able to decide those things.

I don't want to be understood as playing down the Army's contribution, which was undoubtedly a great one, but I just want to keep it in proper focus if we can, inasmuch as it might have some influence upon who should operate it in the future. The amount of credit that the Army is entitled to might indicate its essentiality in running this for the benefit of the country.

Senator MILLIKIN. Mr. Chairman, may I make one brief remark? The chairman has defined, with one exception, the attributes of a top executive. He has said he got the money; he said he did the procurement. It has been admitted he did the liaison. There is one thing the chairman has omitted, and I think they will admit that is true: The Army defined the objective.

When you have those things, you have every element of top direction.

The CHAIRMAN. I think President Roosevelt defined that, Senator.

Senator MILLIKIN. Wasn't he Commander in Chief and weren't we told how good he was as a Commander in Chief?

The CHAIRMAN. And that is one of the evidences that proves it. I say, "Touché."

Go ahead, Doctor.

Dr. RABI. I have discussed this bill with Dean Pegram, of Columbia, from two points of view; one is the general declaration of policy and the other is the point of view of a sharper definition of some of the provisions of the bill, particularly as they relate to specific scientific matters.

Now, the following portion of my statement was written by Dean Pegram who has been associated with the problem of atomic energy since its inception, and I subscribe most heartily to the point of view which he expresses. I would like to read that into the record.

This is Dean Pegram's statement, which resulted from our discussions:

A bill for the Government control of atomic energy is very necessary and the general intent and plan of such control as set up in the bill merits approval and

support. The following remarks on features of the bill and suggestions for revisions, while critical, are offered with the hope that they may be helpful in clarifying the bill.

These remarks are limited to:

1. The basis of a bill for the control of atomic energy.
2. The need in such a bill of exactness of terminology and of clear limitations of the scope of the bill with respect to the materials to be controlled.

REMARKS ON THE DECLARATION OF POLICY, SECTION I (A)

Presumably this introductory section should give a forthright statement of a sound basis for the bill. As it stands this section fails to base the bill on the real and valid reason for the proposed unprecedented governmental control of certain materials and their uses, which good and sufficient reason is that if these materials are not strictly controlled by the strongest agency possible, they present an unprecedented menace to the public welfare and to national security. Instead of making this direct and obvious approach, this section rather artificially or disingenuously bases the bill on the probability that the use of atomic energy for civilian purposes can improve the public welfare. This is obviously a most debatable reason. If this were a sufficient reason for the seizure and control of uranium, it would be applicable also to any useful material—tungsten, tin, copper, iron, sulphur—anything.

The argument offered here is not against the Government ownership and control of certain potentially dangerous materials in their benign uses for civilian purposes. The argument is first that the Government must guard the public safety, next that in its strict control of certain materials for the public safety the Government should not interfere with, but should rather aid, proper uses of atomic energy for the public good.

More fully developed, a natural and logical statement of the reasons for such a drastic bill as this would cover the following points:

1. Atomic explosives present so great a hazard to the public welfare and the national safety that only through the strictest control by the Federal Government of certain fissionable materials and any use of them can the people be assured of protection. State or local government would obviously be unable to handle this problem.
2. These materials, of which the misuse could be so disastrous, can when properly used provide a new source of energy for the benefit of the public.
3. The necessary Government control to remove the hazard of the misuse of these materials ought not to prevent the useful developments that can come from this new source of energy. Therefore to insure this, an adequate policy should be declared and put into effect.
4. "Accordingly it is * * *" (lines 3 to 8, page 2 of this bill).

REMARKS ON SECTION 5 AND ON THE USE OF "FISSIONABLE" THROUGHOUT THE BILL

A conspicuous fault in the bill is the unwarranted use of the word "fissionable." It is hardly to be conceived that the bill intends to give the Commission power to assume ownership of all lithium or boron compounds, yet both lithium and boron are fissionable. It is well known that if a proton is shot into the nucleus of Li-7 fission results, giving two equal parts each a helium-4 nucleus. This is no negligible fission from the energy standpoint; 17.6 million electron volts is released from the fission of one atom, more per pound of Li-7 than comes per pound from the fission of U-235. No one conceives of lithium or boron being dangerous materials, but U-235 is certainly dangerous. The all important difference is of course, that with U-235 a chain reaction can occur, with lithium it cannot. The potentiality of a cumulative fission by a chain reaction is necessary in any explosive material, be it gunpowder, TNT or U-235. Hence in this bill, as much stress should be put on the potentiality of a chain reaction in a material as upon the material being fissionable.

To do so will require a few more words in the bill but should make the bill more palatable to those who wish to know just what is intended by the bill.

Senator MILLIKIN. May I ask, Doctor, would it be disturbing to industry, for example, if it were concluded that lithium were one of the objectives of this bill? Who would be disturbed by it?

Dr. RABI. It is so widely used, is so widely present, it is certainly not in accord with the spirit and intent of this thing.

The CHAIRMAN. In other words, Doctor, you would like it to be defined as "fissionable material in which it is possible to have a chain reaction"?

Dr. RABI. Yes; and this statement goes on to make a large number of specific recommendations for changes throughout the bill.

If you prefer, I will read just one or two more short paragraphs, and then introduce the letter, rather than go through the thing line by line.

The CHAIRMAN. It is criticism on definitions?

Dr. RABI. Yes, and changes here and there throughout the bill.

Senator MILLIKIN. Will you give us what you think are the more important of them, Doctor.

Dr. RABI (reading):

The same definiteness could be secured if the bill should give a new definition to "fissionable material" by stating that a "fissionable material" shall mean a material containing atoms of which the nuclei are capable of being split into fragments in such a way that a cumulative chain reaction can occur resulting in the release of energy. If this new and more specialized meaning could be given to "fissionable," the nuclear physicists could perhaps use "splitable" as they have hitherto used "fissionable." If such redefining were to be done for the purposes of this bill, it would be desirable to add further to the definition given above the following words "in amounts of one hundred or more electron volts per fission."

It may be remarked that it is not unlikely that means will be found to cause nuclear fission in many kinds of atoms—fissions without the possibility of cumulative fission by a chain reaction, and these should certainly not be included under the control of the proposed commission.

Senator MILLIKIN. Is cumulative fission the thing that happens when you have a chain reaction?

Dr. RABI. That is what is meant here.

Senator MILLIKIN. And when you have a chain reaction, you have cumulative fission?

Dr. RABI. Yes.

Senator MILLIKIN. Why the word "cumulative," if we are going to get cranky about the words?

Dr. RABI. One sends off another, or more than one, so the number of fissions accumulates.

Senator MILLIKIN. But isn't it sufficient to say a chain reaction, if that is what happens?

Dr. RABI. I think it would be sufficient. On the other hand, you might have a chain reaction which goes along in a chain and then breaks off before it accumulates, you see, and that would not be a dangerous thing.

Senator MILLIKIN. You mean it is not completely synonymous with chain reaction?

Dr. RABI. Not completely. It would mean a chain reaction which goes faster. You might mean a chain reaction which is breaking down.

Senator TYDINGS. Doctor, why do you fix the figure of 100?

Dr. RABI. It is a nice figure. Anything below that would not result in an explosive which would be very much more dangerous than TNT and doesn't need such an extraordinary measure.

Senator TYDINGS. How high above that could we go without being much more dangerous than TNT? In other words, to stay out of the atomic field, to stay out of the cumulative fission as you have defined it, how much higher than 100 could you go?

I am assuming in my question that 100 has a reasonable factor of safety in it. Now, when you get to the point of what might be called equality factors, rather than having three times the necessary safety provision, how much higher could you go than a hundred before you would tread on dangerous ground?

Dr. RABI. I doubt whether you could go more than 10 times as high.

Senator TYDINGS. You mean 10 more points as high?

Dr. RABI. Let us say 1,000. I don't think you would want to go as high as 1,000, because 100 already is several times, 10 times or so, what you would get from ordinary explosives, but 1,000 would be 100 times as great.

Senator TYDINGS. How about 110, for example?

Dr. RABI. I would not cut it as fine as that. One hundred was simply taken arbitrarily.

Senator TYDINGS. How about 150?

Dr. RABI. I would buy that, too, if you insisted.

Senator TYDINGS. What point do you generally meet as an over-all place where you equalize your factor of safety with that of the danger involved?

Dr. RABI. That is an indefinite thing. We are trying to make a principle there. I would rather set a limit by actual further study.

Senator TYDINGS. That has a factor of safety of several times what probably is needed, your 100 figure?

Dr. RABI. That is right.

Senator TYDINGS. And you feel that that factor could not be further reduced?

Dr. RABI. It certainly adds clarity to this to bring it in.

Senator TYDINGS. You pulled it down far enough, in other words, to make your factor of safety waterproof?

Dr. RABI. That is right.

Senator HICKENLOOPER. Still I understand, Doctor, that the factor of safety you have named would in your opinion not interfere with the reasonable use and experimentation with this material?

Dr. RABI. Yes, sir.

Senator HICKENLOOPER. That is other material that would not produce any more than this.

Dr. RABI (continuing to read):

The present wording of section 5 is puzzling. Is pure metallic uranium, with the isotopes present in the natural ratios a "fissionable material"? or is it a "source material"? Would the pure isotope U-238 be a "fissionable material"? Is uranium nitrate a "fissionable material"?

Senator TYDINGS. Doctor, I don't want to bore you with that 100 figure, but how did you arrive at that?

Dr. RABI. Simply that 100 gives you about 10 times the energy per item that you would get from TNT.

Senator TYDINGS. How would you rate TNT in that scale?

Dr. RABI. About from 5 to 10.

Senator TYDINGS. What would be the next intermediate explosive force between TNT and the fission of the atom?

Dr. RABI. I don't know of any.

Senator TYDINGS. Then, you are jumping from 10 to 100?

Dr. RABI. I don't know the details of some of the new explosives, but I doubt if they have a factor of 2.

Senator TYDINGS. Let us put it this way. For the purposes of your testimony, you are excluding practically everything from the scope of this control that now exists except nuclear fission?

Dr. RABI. That is right.

Senator TYDINGS. Is that correct?

Dr. RABI. That is right.

The CHAIRMAN. Go ahead, Doctor.

Dr. RABI (reading):

Section 5 (a) (3) (a). Shall it be unlawful for a man to own 10 grams of metallic uranium? One-tenth of a milligram? One microgram?

Certainly the Commission will consist of reasonable men, but so far as practicable we should be governed by law and not by men.

In section 5 (b) (1) why beryllium? why not copper, iron, carbon and other things that can be used effectively in, or in preparation of, an atomic bomb?

This was the general statement, and now I have here a series of suggested revisions in line with the foregoing remarks, going through the thing page by page and section by section.

The CHAIRMAN. If there is no objection, we will turn those over to the staff and let them work on them and include them in the record.

Senator MILITKIN. I assume in due course we will have a tabulation of all suggestions for amendments.

The CHAIRMAN. That is right. We are having them drawn up now as each one comes in. They are being tabulated. When the testimony finishes, Senator, what we plan to do is to have the original bill and the suggested changes side by side so that we can see what they are.

Now, Doctor, have you anything else of your own to add?

Dr. RABI. No, sir.

The CHAIRMAN. The suggested revisions will be included in the record at this point.

(The suggested revisions read as follows:)

COLUMBIA UNIVERSITY,
January 28, 1946.

Suggested revisions in line with the foregoing remarks:

S. 1717

Section 1 (a), p. 1, line 8. After "evident", insert "and the necessity of unusual governmental controls and safeguards is equally evident. The destructive power of atomic explosives is so great that their misuse with criminal intent or by accident, might suddenly destroy cities, even the seat of government, hence for the protection of the nation and the safeguarding of the public welfare, it is imperative that strict control by the government of such super explosives be established and continued."

Page 2, line 2. After "life" insert "Such strict governmental control as is necessary for safety should be exercised in such a way as not to deprive the people of the advantages of this new source of energy, and to this end a policy is needed."

Page 2, line 22. Before "fissionable materials" insert "certain".

Section 4. Title, page 4, line 16, change title to "Production of Materials Capable of Releasing Energy Through Nuclear Fission by Cumulative Chain Reaction".

Section 4 (a), page 5, line 18. Change "fissionable materials" to "materials capable of fission by chain reaction".

Page 5, lines 19, 20, and 25. Insert "such" before "fissionable".

Page 6. Insert "such" before "fissionable" each time the word is used.

Page 7, line 5. Change "fissionable materials" to "materials fissionable by chain reaction".

Section 5 (a), page 7, line 13. Change title to "Materials Fissionable by Chain Reaction".

Page 7, line 14. Change "fissionable materials" to "materials fissionable by chain reaction".

- Page 7, line 18. After "material" insert "sustained by a chain reaction".
- Page 7, line 19. Title. Change "fissionable materials" to "materials fissionable by chain reaction".
- Page 7, line 21. Insert "such" before "fissionable".
- Page 7, line 24. Change "fissionable material" to "material fissionable by chain reaction".
- Page 8, lines 1, 3, and 6. Insert "such" before "fissionable".
- Page 8, line 8. Change "fissionable materials" to "materials fissionable by chain reaction".
- Page 8, lines 10 and 15. Insert "such" before "fissionable".
- Page 8, line 18. Insert "amounts of such" before "fissionable".
- Page 9, line 2. Omit "beryllium" and put the "or" before "thorium".
- Page 9, line 4. Change "fissionable materials" to "materials fissionable by chain reaction".
- Page 10, lines 3, 4, and 5. In the two places where "fissionable material" occurs, change to "material fissionable by chain reaction".
- Page 10, line 23, change "fissionable" to "materials fissionable by chain reaction".
- Page 11, line 1. Change "fissionable" to "materials fissionable by chain reaction".
- Page 11, line 21. Change "fissionable" to "materials fissionable by chain reaction".
- Page 13, line 6. Change "fissionable materials" to "materials fissionable by chain reaction".
- Page 13, lines 9 and 14. Insert "such" before "fissionable".
- Page 14, lines 19 and 20. Change "fissionable materials" to "materials fissionable by chain reaction".
- Page 15, line 11. Change "fissionable materials" to "materials fissionable by chain reaction". P. 15.
- Page 15, lines 13 and 17. Insert "such" before "fissionable".
- Page 18, line 21. Change "fissionable material" to "material fissionable by chain reaction".
- Page 19, line 14. Change "fissionable materials" to "materials fissionable by chain reaction".
- Page 21, line 25. Change "fissionable" to "materials fissionable by chain reaction".
- Page 25, line 1. Change "fissionable material" to "material fissionable by chain reaction".

(The foregoing suggested revisions would introduce 112 new words in section 1 (a). The proposed changes relating to the word "fissionable" throughout the bill would add about 100 words.)

The CHAIRMAN. Are there any questions from the committee?

Thank you very much, Doctor.

That ends the testimony for today.

Since we have 20 minutes of the session, I would like to have a short executive session on procedure.

(Whereupon, at 11:40 a. m., the committee retired into executive session.)

ATOMIC ENERGY ACT OF 1946

WEDNESDAY, JANUARY 30, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Austin, Millikin, and Hickenlooper.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

Mr. Davis, I believe you are the director of Science Service. Will you further qualify yourself, Mr. Davis, and tell us about your organization?

STATEMENT OF WATSON DAVIS, DIRECTOR, SCIENCE SERVICE

Mr. DAVIS. Science Service is a rather unique institution in that it serves as a newspaper syndicate and a liaison organization between the scientists of the Nation and the public in various ways.

One of our principal functions is to report day by day the scientific news and interpret it to the public. We have been doing that for 25 years, so that while I am no expert in the sense that I have never split an atom knowingly, at least I have been an observer of many things that have happened.

The CHAIRMAN. Do you suppose unconsciously you may have split an atom?

Mr. DAVIS. I think maybe yes.

Senator AUSTIN. You might have split an infinitive anyway?

Mr. DAVIS. Yes, Senator; probably quite frequently.

The CHAIRMAN. You say this organization has been in existence for 25 years?

Mr. DAVIS. Yes, sir.

The CHAIRMAN. Do you run a subscribed service organization?

Mr. DAVIS. No; it is a nonprofit business operation; that is, the newspapers pay a fee, but it isn't a stock concern in any sense of the word.

Our trustees are operated by the National Academy of Sciences, and the National Research Council, the American Association for the Advancement of Science, the newspaper profession as such, and the E. W. Scripps estate, from which the original endowment came.

The CHAIRMAN. Will you mind submitting later, of necessary, a list of the directors of your organization?

Mr. DAVIS. I will be glad to do so.

The CHAIRMAN. You say it is a nonprofit organization?

Mr. DAVIS. Yes; and its job has been, during those 25 years, to get science before the public in an accurate and understandable way.

Senator AUSTIN. Who was the founder of your institution?

Mr. DAVIS. Two men really conceived the idea: E. W. Scripps, a newspaperman, and William E. Ritter, the California biologist. They said, "If we want to have an intelligent world and intelligent people, we have got to tell them about science."

They persuaded the scientists of the country to undertake this work.

The CHAIRMAN. And each scientist sends in his findings to you. Is that it?

Mr. DAVIS. We have an expert staff of about 10 people that correspond with professors in universities. They process this material and make it understandable.

The CHAIRMAN. You popularize it?

Mr. DAVIS. Yes; and we operate as a newspaper press association in the field of science exclusively.

We have a lot of other functions, too, Senator, that are extremely interesting, such as science clubs. There are 9,200 science clubs in the high schools of the Nation which we service or aid in the study of science.

That is a very important function in connection with this whole understanding by the people of such problems as the atomic bomb.

The CHAIRMAN. Have you a prepared statement?

Mr. DAVIS. I have; yes.

The CHAIRMAN. You may proceed.

Mr. DAVIS. The problems, Senator, before the committee, as I understand it, are essentially to provide for the reconversion of atomic energy, and to set up means of protecting the welfare of the world and nations from the misuse of atomic energy.

The committee has heard in previous sessions much about the dangers of the atomic bomb and the necessity for international control. It seems to me that there should be discussion and consideration not alone about the fears of the destruction of the world by the atomic bomb, but the essential usefulness to mankind of atomic research and its many byproducts.

One of the primary objectives should be to get atomic science reconverted. Valuable months are being lost. We must go on making the world a better place to live in regardless of our fears that, if we cannot control atomic energy, it will wipe out what the war left of civilization. There is so much yet to be done.

As a result of atomic bomb research, new elements have been discovered—elements 95 and 96—which are yet unnamed. We have new tools for research, such as carbon-14, that can be used as the means of discovering perhaps the secrets of the cause of cancer, the way the green leaf utilizes sunlight, what happens in some of the most fundamental processes in the body, and hundreds of other things.

There is no reason why researches in these fields should be delayed, and I imagine they are not in large measure, and there is no reason why they should be kept secret.

There is no military necessity that they be concealed, as far as I can see. There is a human necessity that they be done as fast as possible and with full announcement of results.

It seems to me that the control and research upon atomic energy are essentially scientific and administrative jobs.

I don't think it is too much to ask that no military men or ex-military men be on the Commission, if a commission is established.

It is quite possible that an administrator, with an advisory committee might be a more satisfactory arrangement.

One of the most useful of the provisions in the bills before the committee is the accent in the McMahon bill on the continuance of research and the dissemination of information.

Senator AUSTIN. Would you mind a question before you leave the subject of the composition of a commission, if we have one?

Are you familiar with the major divisions of the enterprise up to date?

Mr. DAVIS. Yes; roughly so, Senator.

Senator AUSTIN. That is, here you have already had a successful commission of industry, government, and science. Have you any comment to make on the theory of having your permanent organization combine all three elements of our economy?

Mr. DAVIS. I think that the control of atomic energy and research in the field is essentially an administrative problem, and can be approached in the same way that other administrative problems are.

I think it is relatively unimportant as to whether you have a good commission or a good administrator. Both of them work, in our scheme of things. For instance, in science we have had a prime example of administration by an administrator under the OSRD, Dr. Bush, and that was set up in connection with the Government bureaus. We also have a very splendid example of a successful operation of a commission, the National Advisory Commission for Aeronautics. I don't think it is a very critical point.

Senator AUSTIN. I don't think I made my question clear.

Assuming that we are to have a commission, my question was, what guides should we follow in the composition of the Commission? Should we follow the experience which we have had thus far in the development of atomic energy, and combine in this Commission representatives of Government, of industry, and of science?

Mr. DAVIS. Well, it would be hopeless to put upon the Commission all of the experience and knowledge that we have that will be needed to be called upon. The Commission in a sense is a policy-making body, a determining body, rather than an information-gathering body. I think that, from the standpoint of world confidence, there might be a great deal to be gained by actually taking the control of the Commission out of the hands of the military and putting it into scientific hands, rather than doing the reverse.

That does not mean, Senator, that it wouldn't be necessary to have all of the advice that we can possibly get from the military, from the industrialists, and from all others who have been concerned with this magnificent achievement. But I think that can be had through the Commission itself, through service aid to the Commission by advisers.

Senator AUSTIN. That is all.

The CHAIRMAN. You know, Senator, I thought about that when we were writing the bill, and there are so many classifications in our society that demand representation—small business, big business, farmers, scientists, and the labor organizations—that it is quite a problem. That is why I left it open.

Mr. DAVIS. I believe Mussolini tried that method of government.

The CHAIRMAN. I don't know about that.

Mr. DAVIS. I know very little about it.

Mutual confidence between nations is necessary to prevent a disastrous atomic bomb race. The mere control of fissionable material by various nations is not enough. We can control atomic energy within our own borders, just as we control the manufacture and use of narcotics, explosives, firearms, or poisons.

We can do this because there are laws made by the Congress whose enforcement is desired by the vast majority of the population, and there is a sufficient degree of confidence among our people to make such control and regulation effective.

Other nations can, and undoubtedly will, control atomic energy within their own borders. There must be developed the same degree of world control that is considered normal and accepted on a national scale.

The world, in effect, must become one nation, with government X just as confident that government Y will not engage in atomic-bomb warfare as Florida is that Maine won't bombard it with subzero weather.

In connection with the establishment of world confidence, there should be an information offensive. We should distribute to the peoples of the world, the facts and information that will convince them of the stake that all of them have in the unification of the world, that will convince them that we will not use the atomic bomb which we possess in an offensive defense.

Understanding that must be arrived at to allow the free interchange of information is not alone on the political or diplomatic level, but goes deeper than that.

In convincing the rest of the world that we are no menace to them, and in convincing the American people that we can cooperate with peoples of other nations, it will be valuable to have as many people of the different nations as possible visit with other peoples.

This will be particularly effective in the case of scientists and professional men. Resumption of the interchange of visits of scientists and of the free interchange of scientific information should be encouraged, and this would be aided and not hindered by the McMahon bill in atomic physics and related fields.

Secrecy in scientific research is a short-sighted and dangerous policy, not only for those from whom the information is kept, but for those who try to keep the secrets.

The progress of science and of our civilization based on it is dependent upon an advance made here, and another there, synthesized by time and ingenuity into some real step forward.

A rigorous and complete scientific intelligence service is a necessary part of our atomic energy program. Scientific intelligence is needed in all fields of science and technology, but it is supremely urgent in the explosive realm of the atomic nucleus. We must never forget that atomic fission was discovered in a nation that was on the verge of starting a world war. Only the world's traditional freedom of scientific publication caused that key experimental result to be announced to the world.

The CHAIRMAN. Which one do you refer to?

Mr. DAVIS. The Hahn-Strasser paper, which appeared in January 1939.

The CHAIRMAN. In January '39—that was in Nazi Germany, wasn't it?

Mr. DAVIS. Yes.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. It is an ironical thing that that announcement which came to our attention precipitated us into making the bomb on the theory that we were in a race with Germany.

After the war was over we found that there was no race at all, that Germany had not gotten out of the laboratories, had no bomb-making plans, and hadn't even commenced.

I don't urge that as a reason for not having exchange of information; I urge it as a very bloody and ironical fact connected with this whole subject.

Mr. DAVIS. Well, Senator, perhaps we didn't realize how inefficient in that particular respect the Germans were. They weren't inefficient in some other ways. I don't know the facts in connection with their development of atomic research.

Senator MILLIKIN. Let me make it very clear that if I had had to make the decision as to whether we should go ahead and perfect a bomb under the information that we had, I should have made the same decision that was made by those who did decide to go ahead. I merely mention it as an interesting irony in the picture.

Once you reflect on that, you can see that had the whole subject been left to peacetime impetus, we might never have had a bomb, or certainly a bomb might have been long delayed and the commercial uses of the thing, involving as they do such a large capital expenditure, might not have been considered practical in peacetime, and that, too, might have been long deferred.

Mr. DAVIS. What might have happened, Senator, is that if the Germans had taken their time they would have launched a sudden offensive. If they had delayed the start of the war, they could have perfected the bomb, and we certainly would not be here talking about it today.

Senator MILLIKIN. But the irony of it is that they did not, and we did.

The CHAIRMAN. Mr. Davis, you opened up an interesting thought, at least to me.

In Germany, as it was run under the Nazis, were there any restrictions on the dissemination of scientific information?

Mr. DAVIS. I am not very competent to answer that question, because I don't know what has been discovered by our scientific intelligence people since the close of the war. But there was a surprising amount of publication of scientific results under the Nazis.

Now, I don't know whether or not that was due to the lack of realization of their leaders that this material was really useful; it probably was. I don't think that is ever mentioned.

The CHAIRMAN. All right, sir.

Mr. DAVIS. If an equivalent experimental finding, such as the one I referred to, were discovered in one of our Manhattan project laboratories, it probably would not be announced now.

One of the needs in the present situation, is to assume that such new knowledge, wherever disclosed, will be announced, and that it will be available to us. Our scientific intelligence service must be

inclusive, alert, highly qualified, and closely integrated with the research.

Our traditional industrial research set-up, based on a system highly competitive in some aspects, may cause the loss to the Nation of some important advances that might be synthesized out of dovetailing facts discovered in different laboratories. Unnecessary secrecy in the name of military security sets up such a situation artificially with equally dangerous results.

There is, of course, a certain amount of material, such as the actual making of the bomb itself, and things that are equivalent in the atomic field to the design of artillery that would, of necessity, under present conditions and until the world control is achieved, have to be kept secret.

But the fundamental material of research, results of research, can in a large measure be freely announced, and we can get better results in that way, even if you wish to look at it for the moment from a purely selfish standpoint.

The CHAIRMAN. Why?

Mr. DAVIS. Because research is a rather peculiar process in that you have got to have the play of a large number of minds. I suppose research is something like the development of legislation. While certain facts are discovered by one person, the way in which those facts hinge upon the whole situation is determined by the interplay of a large number of minds, and the bringing in of new facts. I think that is a rather common human experience.

The connection of control and use of atomic energy with the proposed establishment of the National Science Foundation is intimate and important. There should be a high degree of coordination. Action upon S. 1720 is important, because it would implement a broad scope of research which may bring results as fruitful and as far-reaching as nuclear research.

I think it is important to realize that unless nations and those who lead them are peace-loving in the real or psychiatric sense, there will be no peace.

Peoples, like persons, suffer from manias, and one of these is national sovereignty.

Germany and the Nazis were a Napoleon among nations.

We should be alert, as we were not before both world wars, to the danger signs which are so plain and unmistakable. I am going to be bold enough to suggest that the committee should call in psychologists and psychiatrists to give them information on these aspects.

The key factor in the peaceful solution of utilization of atomic energy is human behavior, which is based on understanding and the capacity to understand.

Then, of course, atomic energy is only one aspect of development to the world scene. We are faced with other possibilities for warfare, essentially untried, which, while not so sudden or extensive, are of the same order of the atomic bomb. I refer to biological warfare.

Senator MILLIKIN. Under principles of human behavior, has any aggressor nation ever put aside its aggressive designs because some other nation practiced self-immolation as far as war power is concerned?

Mr. DAVIS. That is a good question for a historian, Senator.

Senator MILLIKIN. It also rests on human behavior?

Mr. DAVIS. Yes. A mad nation may be only restrained in the same way that we restrain an individual who is mentally ill; that is, by putting him where he cannot do harm. There certainly are, and have been at times, nations in that state.

Before the war which has just ended, there was a time when if the people had had a real understanding of the nature of the national psychosis that Germany was suffering from, for instance, something could have been done about it.

Senator MILLIKIN. Would you say that it would be a national psychosis if we were to strike down our own war power so long as there is any indication that powerful nations have aggressive designs?

Mr. DAVIS. That again is something you ought to ask a psychiatrist. I am getting into terminologies in which I am not expert, but I should think that would certainly be bad judgment. Whether you would make it a matter of mental illness on the part of the nation, if you want to use that analogy—and of course it is an analogy.

Senator MILLIKIN. It could rest upon emotionalism that would approach psychosis. Not applying those labels to what I shall now mention, I will remind you that we had a disarmament conference in this country, and we immediately started to disarm and did disarm to the extent we agreed to. Nations that were aggressors at heart, did not keep their agreements, and did not in fact disarm.

In fact, when we disarm, we of course give that much encouragement to a nation that has aggressive designs.

We and other nations signed the Kellogg Pact in which we thought we could talk war out of existence; but instead of serving that purpose, it simply furnished a mask behind which aggressor nations could perfect their war-making ability, while the rest of the world thought it had talked war out of existence.

Mr. DAVIS. That is exactly why we need the best scientific advice in all fields, to be able to tell us when a dangerous situation exists, either in our own country or in other nations.

Now, it is obviously much more difficult to see our own difficulties within our own country in most cases than it will be to see the difficulties in other nations.

The record of psychological warfare, what Captain Zacharias did in connection with Japan, is so impressive, that it seems to me that all that body of knowledge is of the same order of importance as the physical and chemical research that has done so much to give us these magnificent answers in atomic and nuclear research.

The CHAIRMAN. If I gather what Senator Millikin is saying, he certainly would not walk down the street of a town where every man in the town had a gun, and throw his away. You wouldn't do that either, would you?

Mr. DAVIS. No, sir. I think the Senator had a very good point. If you are going into a civilization that carries six-shooters, you have to carry one, obviously. Otherwise, you won't exist very long.

The CHAIRMAN. It might be better if we had a seven-shooter in a town like that.

Mr. DAVIS. Yes; or an atomic bomb.

The CHAIRMAN. If you have got one and somebody else has got one in that town, both of you had better put it away, don't you think.

Mr. DAVIS. That is what the committee is trying to work out.

Senator MILLIKIN. I notice in the Orphan Annie strip they now have the atom bomb down to hand size, and you can tote your private demolition.

But, as a scientific man, you wouldn't know about the Little Orphan Annie strip.

Mr. DAVIS. Oh, yes; I follow all of those important matters, too, sir.

The CHAIRMAN. Are there any further questions of Mr. Davis?

If not, Mr. Davis, thank you very much indeed.

Mr. DAVIS. Thank you, Senator.

The CHAIRMAN. The next witness is Mr. Raymond Swing, a radio commentator.

Will you come forward, Mr. Swing.

I know that Mr. Swing is interested in this subject, as all of us know who have heard his broadcasts, and I am pleased that he wants to contribute to the record.

STATEMENT OF RAYMOND SWING, RADIO NEWS COMMENTATOR

Mr. SWING. Mr. Chairman, I have a prepared statement. May I read it?

Senator AUSTIN. I want to say before Mr. Swing starts that I have to leave here for an appointment at 11:15, so I want him to understand I am not disgusted with his statement if I step out in the middle of it.

The CHAIRMAN. When he is broadcasting and you do that, he doesn't know anything about it.

All right, Mr. Swing.

Mr. SWING. I have two chief points I consider it a privilege to register before this committee as worth its attention in framing legislation for atomic control. One is the tremendous importance of our atomic establishment in our international relations. One is the need of keeping atomic energy clearly under the control of the American people to whom it belongs.

The release of atomic energy was the result of a military enterprise, undertaken in the time of war for purposes of war. It was carried out through the exercise of war powers. And it has no legal status at this moment other than as a part of the war arsenal of the United States armed forces. Being possessed exclusively by the United States, in that no other nation has atomic bombs, and being the most powerful weapon ever devised by men, the atomic bomb is a powerful factor in American relations.

If I may repeat before this committee what I have said on another occasion, at this moment the United States is manufacturing atomic bombs. It will be manufacturing them next week, next month, or unless the President puts a stop to it, or the War Department does so, or Congress does so; it will be manufacturing them next year, and the year after, and as far ahead as can be seen. And by making them, the United States increases its arsenal of weapons, just as though its built battleships or tanks or rockets. For the present there is only one use for the great installations erected with the money of the American people to make the atomic bombs. It is a military use. It is under the strictest and exclusive control of the Army. And though we are at peace, the \$2,000,000,000 investment

is still functioning, and part of the installations are working on a 24-hour basis.

At the recent Moscow Conference, agreement with the Soviet Union was reached to set up an atomic commission under the UNO Security Council. It will study the possibilities of the international control of atomic energy, and when it perfects a system of inspection and control, the secret of the bomb can be shared. This is a good start toward good relations, but only a start. It does not preclude development of the bomb by other countries. It does not halt the armament race in which we now have a handsome head start. It is an affirmation of the intent to provide international control, and to outlaw the use of the bomb as an instrument of warfare. But the intent is hedged about by the necessity of perfecting a system of inspection and control.

While we wait for the atomic commission to set up and go to work, the United States continues to manufacture the bomb. And if that is not something that worries people in this country, we can be sure that it worries people in other countries. Of all the specific elements of relative power, our exclusive possession of, and continued manufacture of, the atomic bomb are an outstanding cause of worry to people abroad. We already are the strongest military nation, thanks to our Navy, our existing aircraft and our capacity to make them, and our all-around industrial productivity. We do not need to make the atomic bomb to pull our weight in the world. But we continue to manufacture it. And we manufacture it under secrecy which must be called sinister, because of the stress put on secrecy in this country, and the effect that it has on our international relations.

We should make it clear that we are not exploiting the bomb as a military factor. We should stop making it, and we should take the control of the installations for making it out of the hands of the military just as quickly as possible. That is the least we can do in furthering the work of the atomic commission of the UNO. It would demonstrate to other nations that we are back on a democratic basis. Then we should not have to be feared as a nation needs to be if its destiny is too much committed to the operations of army men working in secret.

We have made a beginning in reducing fear by accepting the policy of putting atomic energy ultimately under UNO control. But we can reduce the fear still more by taking the great atomic project altogether out of the hands of the Army. That is something for which no delay is advisable. It will do good right away. It is good that needs to be done. And it is good that will be of as great value to us domestically as it is in our foreign relations. For the Army is making only atomic bombs, and as long as the Army runs the atomic project, that is all that it will make. There can be little development of atomic energy for nonmilitary purposes as a result of the two-billion-dollar investment of the American people. That needs a new and permanent change in control.

Since the elimination of fear from international relations is essential if there is to be peace, it rarely can fall to the Congress of the United States and its organs, to do so important a task as now waits to be done in removing the atomic bomb from military control. So long as we manufacture atomic bombs, and we alone know how to do it, we issue a challenge to the rest of the world to learn the secret and to draw even with us in strength, and we serve notice that we deserve to be

feared. Whatever the justification of the use of atomic bomb in World War II, there can be no justification for continuing its manufacture now that the war is over, unless anyone is so foolish as to believe that we can serve the peace by inspiring dread and fear of the American people among our neighbors. To leave the control of the atomic bomb with the Army is to permit the continuous flow of fear from this country to all corners of the earth. But, similarly, to take the control of the atomic bomb and the atomic projects from the Army is to remove this cause of fear and to serve the interests of the American people in peace. Here is an unprecedented opportunity to aid peace quickly, and aid it basically; to do it without giving up any national asset or interest.

For the time being, the military importance of atomic energy must be considered as outweighing its use in a civilian economy, but in drafting legislation for the control of atomic energy a longer view may wisely be taken. For the moment there is no known way for the use of small quantities of fissionable materials, and there is no unlimited source of such materials, which would make it possible for the release of atomic energy to revolutionize the world's social economy. But there is far more likelihood that atomic energy will become generally available in small quantities than there was likelihood, say, 10 years ago, that atomic energy would become available in the large quantities used in the atomic bomb. And it is not undue exercise of the imagination to be drafting legislation with that possibility in mind. If atomic energy is conceivably to become the source of power of the future which will do a great part of the work of the world, we face what is perhaps one of the greatest tests of wise government that ever has confronted a democracy: For the control of the power resources of the Nation and the world means the political control of the Nation and perhaps of the world. And the possibilities at stake require the recognition of certain principles in setting up the future development of atomic energy. One is to safeguard, as one would safeguard the Nation itself, the people's sole ownership of atomic energy and control over it. It must not be delegated to individuals in any way by which individuals might use it to exploit the people or diminish their control over their destiny. Hence, there must be no private manufacture of fissionable material. And if there is private use of fissionable material it must be under the closest public safeguards.

Whatever the Congress decides as to the size and constitution of the board which controls atomic energy on behalf of the people, it must devise the most immediate responsibility of that board to the people. For that reason it appears desirable that the members of that board should serve, as proposed in the McMahon bill, at the pleasure of the President. That would make it possible for public criticism of the policy of the board to become both immediately and continually effective. To set up a board whose members serve long terms with removal only for cause, might be to establish a board not responsive to the public.

It is important, too, that the members of this board should devote their entire time to the service of controlling atomic energy, and that they be adequately remunerated so as to give the public the choice of the ablest men available.

A special word should be said on the importance of this board being composed exclusively of civilians, and the executive administrators

of the atomic project being civilians. I have stressed the importance of this provision from the standpoint of international policy. It is of equal importance that the future of atomic energy should not be committed to officers of the armed forces. If, as appears possible, atomic energy is ever to become the source of the future power of much of our economy, and control over it is to be tantamount to control over the welfare of the Nation, it is axiomatic that this power should not be vested in peacetime in a soldier. It is a characteristic of our democracy that the things that affect the people should be kept as closely as possible under the control of the people. In atomic energy we have what may become the richest heritage of our Nation. It must be kept for the people, in their capacity as citizens of a peaceful world.

In drafting the legislation for the control of atomic energy, the Congress may be tempted to slur over the necessity of maintaining social control in the interest of serving private enterprise and a competitive economy. Now, it may be that atomic energy is not going to be revolutionary in our economy. If it is not, if it is to be only a limited source of heat, and is not to grow to be much more than another public-utility industry, the danger from careless legislation would not be great. But it may be that atomic energy is going to revolutionize our economy. And in that event it becomes of the very greatest importance who is to decide what is done with atomic energy, who makes it, who uses it, and on what terms it is used. It must not be licensed in a way to give power over the people to industrialists or to corporations. We might find ourselves falling into a Fascist pattern, with industry holding the country in the palm of its hand.

Senator MILLIKIN. May I interrupt?

Mr. SWING. Yes, sir.

Senator MILLIKIN. May it not also follow a Fascist pattern if the total control of the energy were left in the Government?

Mr. SWING. It would follow a totalitarian pattern, sir, but by a Fascist pattern, I understand a pattern in which industry as such exercises the political control. I go on to say, on the other hand, we should avoid a totalitarian solution, with the control of atomic energy before the reach of the people.

There is really little reason to be thinking about competitive society and private enterprise in drawing up the basic legislation about atomic energy. What must be safeguarded is the treasure of the people. Atomic energy was released by their government, spending their money, serving their interests. It was not done by or through private enterprise, though the contribution toward success by men in private enterprise has been very great. But this was not a creative contribution which private enterprise alone could have fostered. It was a social enterprise. It had no other origin and could not well have begun otherwise. Atomic energy does not in any sense belong to anybody but to the people of the United States. It does not belong to private enterprise. And to let it slip carelessly into private control without due thought as to adequate popular controls may be to lose the public treasure, and indeed to give power over the American people to private individuals in defiance of the democratic principles of our national life. We already know that atomic energy has surpassed imagination in creating a destructive force. That being quite as possible, the legislation should be drafted with special dedication

to the public interest and to the public interest being supreme over private interest.

The CHAIRMAN. Senator Hickenlooper.

Senator HICKENLOOPER. I would like to discuss a part of this philosophy with Mr. Swing, if I may.

You have emphasized, and I think very properly, the proprietary interest of the people as a whole as differentiated from private interests in this atomic field.

I don't know whether I fully understand whether you mean that we as a people, as a whole and as a nation, should keep the whole field of atomic energy to ourselves as against the rest of the world, or whether we should give it to the rest of the world.

Mr. SWING. I wasn't discussing that phase of it. I assume that the rest of the world also will develop atomic energy, and in each of the other countries they will face then the same problem as to what is made of this power.

Senator HICKENLOOPER. I raised that question because of your special emphasis throughout this discussion that it is the property of the people and should be kept completely in the control of the people. You were not discussing the international phases of the matter?

Mr. SWING. In this regard, no.

Senator HICKENLOOPER. Would you care to express yourself as to your opinion on how far we should go at this moment in disclosing to the rest of the world the secrets, if any, that we have about the whole atomic energy field?

Mr. SWING. I have very strong views on this subject.

Senator HICKENLOOPER. We are glad to have them.

Mr. SWING. I think that we should make it very clear to the world that we do not intend to dominate it through our possession of the atomic bomb. I think we must make it very clear to the world that we wish to serve world peace.

Personally, I believe that the only safeguard of world peace will be a form of international relationship which goes beyond the present United Nations Organization, and I would advocate that we make a start on world government in a limited field with the control over all aggressive weapons vested in a central authority, a statement which is, I believe, not so far removed from one you yourself have made.

Senator HICKENLOOPER. But that situation would presuppose reliable agreements regarding the use of atomic energy, would it not?

Mr. SWING. Not until I had the organization that I believed in would I share any knowledge of atomic energy.

I would come back to your original question. I would not, at this time, for example, share the secret of the atomic bomb, but I would make it known to the world that we, as a nation, are ready to share that secret once we have reliable instrumentalities.

Senator HICKENLOOPER. Thank you. That answers the question. I think perhaps we all agree that we have a tremendous obligation in this country to do everything we can to remove the causes of fear in the rest of the world, but by the same token I wonder if you don't agree that there is an equal responsibility on other nations of the world to take equal steps to remove on their part the cause of any fear that we might have of their intentions? Isn't the obligation mutual in the world rather than resting solely upon us? I don't say that you said it rests solely upon us.

Mr. SWING. Oh, I so thoroughly agree with you that it has to be mutual. I don't see, however, that we are capable of making a contribution to the world order in changing the policies of our neighbors. Our contribution consists in making our own policy.

Senator HICKENLOOPER. We must make our position clear.

Mr. SWING. We must make those policies which do not create fear. We may well say to others, "Your policies are creating fear and we hope you will change them," but it doesn't lie within our power to make or change the policies of other countries.

Senator HICKENLOOPER. Now, Mr. Swing, assuming that we have done everything we can, leaving that aside, haven't we, as a matter of fact, made many overtures all pointing to our desire for peace and cooperation in the world?

Hasn't our Government and our people, in many ways, made overtures that should perhaps not give full guarantees in the minds of other nations but that we think ought to be indicators of our desire for peace?

Mr. SWING. I think in many ways we have. I think in many ways we have conducted a foreign policy that is in the right direction, but I think there are serious lapses in it.

I think the continued manufacture of the atomic bomb is one of those lapses.

Senator HICKENLOOPER. Well, on the broad statement I might tend to agree with you. I think there are some very practical reasons up to this moment why it would be most difficult indeed to discontinue manufacture of the atomic bomb until we know where we are going. I think we must pass a bill here and get this thing under control before we are warranted in letting the fires go out.

Mr. SWING. Well, I am interested in the bill, as you are.

The CHAIRMAN. Senator Austin.

Senator AUSTIN. I am very interested in your statement and am glad I could stay through to hear it all.

May I be excused now?

The CHAIRMAN. Certainly. I thought, Senator Austin, you might like to know that we are going to have Mr. Henry Wallace and Dr. Von Neumann, of Princeton University, who is doing the mathematics, as I understand it, on these Navy tests, to testify here tomorrow.

Senator HICKENLOOPER. May I say, Mr. Chairman, that I am especially happy that Mr. Swing is here, and I hope that others, in greater numbers, in the same situation he is, may be heard. We have had a number of special pleaders before this committee, either scientists, engineers, or construction or military people. I think generally speaking they are special pleaders for a particular line that they have been following in the active pursuit of this thing.

I think we can well listen to a great many people that have neither made the bomb nor fired it, and who have approached this from a public attitude as members of the public with opportunity to evaluate the situation.

I think from that standpoint, your testimony is very welcome indeed.

Senator MILLIKIN. Mr. Swing, don't you think that any of your key decisions—I am speaking of the decisions of the committee—must turn on this judgment as to whether the world as of today is postured for peace?

Mr. SWING. That is, in formulating your legislation, you must act on the assumption that we are going to have peace?

Senator MILLIKIN. One way or the other.

Mr. SWING. Certainly, if you don't assume that we are going to have peace, you must be assuming that we are going to have war. What you decide would then certainly not deter us from having that war.

Senator MILLIKIN. That situation would affect, in a most vital way, what we recommend to the Senate.

That brings me to this question: Would you say that we should turn this subject over to an exclusively civilian commission if we should determine also that the world as of today, is not postured for peace?

Mr. SWING. The hypothesis is one that I shrink from accepting. I cannot believe that as civilized persons we should get out at this stage, a few months after the making of peace, to prepare for another war.

Senator MILLIKIN. But it is a hypothesis that is a very unpleasant one, and I don't believe that the committee can shrink from what it may consider to be the realities of the situation. I am not suggesting for a moment that the committee thinks that the world is not postured for peace. If the committee should conclude as of this time—not 6 months from now or a year from now, and I believe you agree that we will have some interesting tests come up within the 6 months or a year—that the world is not postured for peace, won't the committee be warranted in turning the control of this energy over to an exclusively civilian commission?

Mr. SWING. Well, I should answer that question, sir, by saying that, if you are going to start on that assumption, the question of civilian control or military control is a very minor one really, and that it would be your duty as a committee to go to the American people to say that we have to take the imminence of a war into consideration and that we require therefore an entire reconstruction of our economic life so that we can survive an atomic war.

Senator MILLIKIN. Well, it might very well be that if you had reached the conclusion—I don't think the committee needs to reach the conclusion that war is imminent, for I think there are many gradations in the whole field of speculation—that the world is not postured for peace, and if therefore the committee should conclude that this subject should not be turned over at this time to a commission composed exclusively of civilians, of course the committee would have to make its position known to the public, and it would be highly desirable and essential to have public support. So let me ask you, Mr. Swing, do you think that the world of today is postured for peace?

Mr. SWING. It is a very confused world, sir, in which there are many factors working for peace and many factors working for war. It is a world in which we still have not lost the power of our own initiative and the command over our future and our destiny.

What we do now, and particularly in countries like the United States where the people have power, in creating the international structure of the next few years will go very far to determine whether peace or war will eventuate.

Senator MILLIKIN. I quite agree that there are many factors working for peace, but can we say that there are not also many factors working for war?

Mr. SWING. Oh, indeed, there are. There always have been, and assumedly there always will be.

I would say, sir, that the appointments of giving the control over atomic energy in this country in any way to the military would be creating a factor for war.

Senator MILLIKIN. Let me probe that just a little bit with you. I asked the witness who preceded you whether there was any example in history whereby a strong nation that gave up its strength as a gesture for peace thereby caused a nation with aggressive designs to put down its arms; the witness did not cite any examples, and I wonder if you can cite any examples.

Mr. SWING. I say this not irreverently. I think it is a trick question. Senator MILLIKIN. I did not so intend it.

Mr. SWING. I don't think you mean it to be, but I think it is a trick question, because obviously we have lived in a world of war and we have failed in every way to get disarmaments. Consequently, no one can cite such a case.

But one could also say, putting it another way, is there any case in history where the accumulation of power of defense has of itself provided a long interim of peace in the world?

Senator MILLIKIN. I do not like to make the argument. I shrink from that argument just as you shrank from an argument a while ago. Up to date, I believe you will agree that the only thing that has kept peace in the world is an overwhelming power residing some place, residing in Rome for a long period of time, residing in Great Britain for a long period of time. Nothing else has produced peace, measuring the period of peace.

Mr. SWING. Well, the problem of producing peace in the time of Rome obviously was somewhat different from the problem as it is today, and I would say quite frankly that I do not believe that peace is to be maintained by the single national power of any great nation any longer in the world today, that you will have to have power, but the maintenance of peace is going to rest with the use of that power on behalf of law.

Senator MILLIKIN. Let me now take my questions out of the category that you feared I was putting them in, by making it more practical.

The desire for peace after the last war, I believe, was just as vocal as it is now. You recall that. We called it a war to end wars, and to show our sincerity in the thing, you recall, we had a naval disarmament conference. We genuinely disarmed a very substantial part of our Navy but that gesture did not do any real good. It was an encouragement, in effect, to nations with aggressive designs to go ahead and build themselves and to redraft the former balance that we had had and that we probably would have used better than they did.

Then, we came along to the Kellogg Pact, and we solemnly outlawed war. We thought, as I expressed it to the previous witness, that we could talk war out of existence and could wish war out of existence. But that was just meat for a hungry lion. That again was a facade behind which aggressive nations could continue to pile up the instruments of aggression.

Now, at what point can we safely again make the gesture?

May I suggest that we cannot make it until we have reasonably satisfied ourselves that the world is postured for peace, and may I

suggest further that perhaps this is not the moment to reach that decision because from listening to you, Mr. Swing, I know that there are many war-breeding factors in the world today.

Mr. SWING. Well, I come back to my statement that it is very much up to us what kind of a world we bring into existence. To come to your analysis, I agree with your analysis that the Disarmament Conference in Washington did not produce the results wanted, but we got World War II after World War I not because the Disarmament Conference failed but because we did not make proper use of our collective power. We had collective power and we didn't make use of it.

We could have stopped the aggression in Manchuria in 1932—I mean the human race could have. The Ethiopian attack could have been stopped, and we didn't care to make proper use of our collective power.

We have got to have power to have peace, sir, and I agree with you that the question about peace is whether we are going to have just power nationally in the hands of one nation which will then dominate other nations or whether we are to have the power of the world used in the support of law. That is the basis of our domestic peace, and it must be the basis of our international peace.

Senator MILLIKIN. After the last war we didn't enter, but the major aggressive nations entered, the League of Nations, but they did not mean what they said. One of the pledges was a pledge for disarmament. They didn't mean what they said. They said it, but they did not mean it.

So, Germany quite rightly said, "One of the conditions on which we put down our arms was that there would be disarmament, and you are not disarming; so, unless you do disarm, we are going to rearm."

And what happened? One of the signatories of the League of Nations said, "Why, your position is sound. We will allow you to build up your navy to half of our strength."

Now, that was not the League of Nations. That was a notion of a participant in the League of Nations, the most powerful participant of the League of Nations, of how to disarm. So, they didn't mean what they said.

Must not we have some attention to realism and analyze by the actions of the principal powers whether they meant what they said when they went into the United Nations Organization?

Mr. SWING. Well, sir, I think the United Nations Organization is inadequate in its present form in the same way the League of Nations was inadequate in its form. It must be strengthened and perfected if we are to have peace. I agree with you there.

Senator MILLIKIN. Mr. Swing, so far as the profession is concerned, the professions of intent in the United Nations Charter are just as noble as those of the League of Nations and just as noble as any of the gestures—the verbal gestures—toward peace that have been made in the world's history, unless it is the Congress of Vienna Charter, which tied itself to God.

The CHAIRMAN. Any answer?

Mr. SWING. I think not.

The CHAIRMAN. Senator Johnson, have you anything you would like to ask Mr. Swing?

Senator JOHNSON. No; I think not. I got here a little too late to hear his prepared statement, but I am reading it, trying to catch up on it. I find several statements that he has made in which I am in complete and even enthusiastic agreement. You go ahead and perhaps I will run into something.

The CHAIRMAN. Mr. Swing, I, of course, as you know from the bill, agree with you so thoroughly in your underlying philosophy that it is contrary to our American system of government to permit the military to have control of a power that could be so tremendous as to dominate our society.

At the same time, until some international concord on the matter is reached, I presume that some attention has to be paid to military applications of the matter. Even if the actual production of the bomb itself should cease, and I agree that it should cease, experimentation and research, I presume, should go on until some agreement is had.

I want to call your attention to the fact that there is nothing in this bill—and if you have found anything, I would like to have it pointed out to me—which prevents or in any way retards that program.

In the provision of section 11 on page 21 of the bill it is provided, and I have pointed it out before, that there is a Division of Military Application. I would assume that the head of that division would be a military man. That is, not on the Commission itself, but the head of one of the divisions underneath it.

You would not have any objection to the head of that division being a military man, of course?

Mr. SWING. Certainly not. It would have to be.

The CHAIRMAN. I just wanted to get that straightened out so that neither you nor I would be held to be divorcing this matter at this particular time, if this bill is enacted into law, divorcing the military from any participation in the necessary place for them to participate.

As I take it, it is your view, as it is mine, that on the policy end of the matter—that is, where the policy is determined—you would prefer that the soldiers, the generals, and the admirals, did not serve?

Mr. SWING. Not only do I prefer that they shouldn't; I call attention to the fact that it is contrary to our system of government that they should, and the very special considerations make it important that our system of government prevail in the future control of atomic energy.

The CHAIRMAN. I believe you had some criticism to make of the bill that was introduced early in the fall because it did make possible an entire military control of this whole subject of atomic energy.

Mr. SWING. I did. It would make that possible, and in the first place it also make possible that industrialists should be put in charge of the bill without what I considered adequate public control over the manufacture and use of atomic energy.

The CHAIRMAN. I want to thank you, Mr. Swing, on behalf of the committee.

I do want to give Senator Johnson an opportunity to direct any questions that he wishes.

Senator JOHNSON. I don't find very much in the testimony with which I am in disagreement, except the common approach that we have had here in this committee to the lack of apparent desire of wit-

nesses who seem to want the people to fully control it to express the possibility that Congress might have a more direct hand in the control of both atomic energy and the military uses of atomic energy.

I will admit, as the chairman knows, I have been struggling with this problem for some time, trying to work out some way or other where the Congress, the direct representatives of the people, might have a firmer control during this interim period. I think we all must realize that whatever legislation we are providing for the present is an interim legislation. We cannot very well take the long viewpoint until we know what the international situation is to be and the extent to which atomic energy is going to be used as a military weapon.

When those two problems are settled for ourselves and for the world, then we can enact permanent legislation. Until such a time, I have been in hopes that a way would be found to keep the control of atomic energy in the hands of Congress. I will admit I haven't been able to work it out yet, but I am still trying. I think it is a worthwhile thing to try to do. I don't know that I will ever be able to work it out, because there are some very great difficulties, tradition being one and perhaps the Constitution being another.

Just the same, it does seem to me that here we have a new power, a new factor that completely revolutionizes all military tactics and perhaps completely revolutionizes all industrial processes. Until we know which way the cat is going to jump, it does seem to me that Congress should retain a firm hold. I have been disappointed that the witnesses appearing here have not stressed that point more. They are not at all satisfied to let the military agencies of the Government continue their controls, but they are perfectly willing for the President to set up a commission, and that, it seems to me, might very well be the same old military control under another approach.

That is one of the reasons why I am trying so hard to find a way out where we can keep this in complete control of the people, because after all this is the people's discovery. It is like air, and it is like fire, and we do not want anyone to get a monopoly on it.

I do appreciate your statement with respect to that, and I do appreciate your very caustic criticism of the so-called May-Johnson bill in that respect. I think that that bill was weak in its control of the peacetime uses and application.

Perhaps Senator Millikin has exhausted this phase of the subject, but it does seem to me that many of you folks who are kind enough to give us advice and help in the control of this very difficult substance are brushing aside too lightly the military aspects.

One of the questions that has been given to many of the witnesses—and unless you covered that with Senator Millikin, one that I should like to ask you—is, do you think that there ever will be another world war in which the atomic bomb is not to be used?

Mr. SWING. I cannot make a prophecy, sir, but I can say that it is up to us, to the members of this generation, to decide that. We still are free agents in making our future.

Senator JOHNSON. Well, I don't know whether we are free agents or not, when we get into war. If we get into a world war, men become very desperate and our Nation becomes very desperate.

Perhaps the atomic bomb will be outlawed to begin the war, but as soon as we get into the war our scientists will gather, our industrialists will gather, and we will produce the most efficient weapon

that has ever been devised by man up to the present time and attempt to use it.

Mr. SWING. If we have national wars, sir, I am convinced that the atomic bomb will be used. If we have the use of police power on behalf of a central world authority, I do not believe that the atomic bomb will be used.

Senator JOHNSON. Well, that brings up one other point that I have been interested in, and that is it has seemed to me that the atomic bomb might be used as a power for peace, that it might be the policeman's billy club. You seem to dismiss that idea completely.

Mr. SWING. If I may be permitted to be so rude, I think it is a dreadful idea.

Senator JOHNSON. It is a dreadful idea. War is a dreadful idea.

Mr. SWING. I don't think it is a policeman's billy club; it is the arming of a traffic officer with tear gas and machine guns to do something, giving him weapons that are not necessary for the performance of his duties. If we have a central authority in which there is adequate power to maintain order in the world, you don't need to conduct war against civilians on a mass basis.

Senator JOHNSON. No; of course; but if war should break out you are not going to be able to quell it with firecrackers or bows and arrows. You have got to use something potent, and the most potent thing that you can use is going to be the most effective thing.

Of course, it is a dreadful thing to contemplate using atomic bombs for any purpose, but modern wars are indescribably bad.

Mr. SWING. I think we agree, Senator, that if we are going to have wars, they are going to be atomic wars, whether or not you and I like it. I am merely taking the stand that if we should have a central world authority which has adequate power to perform police functions, the atomic bomb does not belong in the arsenal of that organization, and I can foresee a future.

You asked me at the outset could I foresee the possibility of the atomic bomb not being used in future conflicts. That possibility I see. If we have national wars, I believe that the atomic bomb will be used.

Senator JOHNSON. That is all, Mr. Chairman.

The CHAIRMAN. You know, Mr. Swing, I forget who it was that said that men find zest in living forever on the brink of disaster.

Now, it strikes me that the idea that men will keep peaceful, because one country, namely ours, has the power to blow them to smithereens, is without foundation; men just won't react that way. They never have in all the course of history, no matter what the overhanging danger. Do you agree with that?

Mr. SWING. I do not believe we, the American people, can frighten the world into being good.

The CHAIRMAN. We might frighten them into making more bombs themselves?

Mr. SWING. Yes, sir.

The CHAIRMAN. If there are no other questions, thank you very much, indeed, Mr. Swing. It is nice to see you.

We will meet again at 10 o'clock tomorrow morning in this room.

(Whereupon, at 11:40 a. m., a recess was taken until 10 a. m., Thursday, January 31, 1946.)

ATOMIC ENERGY ACT OF 1946

THURSDAY, JANUARY 31, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Austin, Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

Dr. von Neumann, your name was suggested to the committee by Senator Ball, and he said that he would like to have your testimony in the record. You were therefore invited to appear. You may go right ahead.

STATEMENT OF DR. JOHN VON NEUMANN, PROFESSOR, INSTITUTE FOR ADVANCED STUDY, PRINCETON, N. J.

Dr. VON NEUMANN. Senator McMahon, gentlemen, I suppose that you will wish to know my qualifications. I am a mathematician and mathematical physicist. I am a member of the Institute for Advanced Study in Princeton, N. J. I have been connected with government work on military matters for nearly 10 years: as a consultant of the Ballistic Research Laboratory of the Army Ordnance Department since 1937; as a member of its Scientific Advisory Committee since 1940. I have been a member of various divisions of the National Defense Research Committee since 1941 and a consultant of the Navy Bureau of Ordnance since 1942. I have been connected with the Manhattan District, beginning in 1943 as a consultant of the Los Alamos Laboratory, and I spent a considerable part of 1943-45 there.

I greatly appreciate the distinction of appearing before you. I realize the exceptional importance of the subject which you are considering. The developments in the field of subatomic energy release which took place in the last decades, and which culminated in 1939-45, and even more those developments which are likely to follow in the decade ahead of us, have implications in the international field which are widely appreciated. Since they have been discussed by many others, and since I do not possess any special qualifications with respect to them, I do not think that it would be useful for me to dwell upon them. I would like to emphasize instead another aspect, which is

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also of very great importance, and which is of a domestic nature—although our present efforts to handle it may well set an example of universal significance.

It is for the first time that science has produced results which require an immediate intervention of the Government. Of course, science has produced many results before which were of great importance to society, directly or indirectly. And there have been before scientific processes which required some minor policing measures by the Government. But it is for the first time that a vast area of research, right in the central part of the physical sciences, impinges on a broad front on the vital zone of society, and clearly requires rapid and general regulation. It is now that physical science has become "important" in that painful and dangerous sense which causes the State to intervene.

Considering the vastness of the ultimate objectives of science, it has been clear for a long time to thoughtful persons that this moment must come sooner or later. We now know that it has come.

The legislation on atomic energy represents the first attempt in history to regulate science in this sense. In past wartime and peacetime emergencies, governments did influence various phases of the social effort, including science, in order to promote military or economic ends. However, such efforts were always limited in time and in scope, and directed toward some ulterior, independent purpose. It is only now that science as such and for its own sake has to be regulated, that science has outgrown the age of independence from society.

Many scientists regret this, and I am one of them. Atomic physics in particular is now losing a good deal of its detachment and abstractness, and will probably never again be the same as before 1939. I repeat: From the scientists' special viewpoint, this evolution is probably not a desirable one—but nobody can change it, and we must admit that it is taking place. There is clearly a need for the Government's intervention here and now.

The problem is, then, how to effect this regulation without falling into either extreme. Regulation is needed, because nuclear physics, in combination with irresponsible or clumsy politics, could at this moment inflict terrible wounds on society. And with some more development, which could be effected—and probably will be effected by some country or other—in a moderate number of years, and the main outlines of which are perfectly discernible now to the expert, the same combination of physics and politics could render the surface of the earth uninhabitable. Regulation is therefore needed, both in politics and in science, but I will only talk of the latter, for the reasons given earlier. Regulation of science, on the other hand, must not go too far. Indeed, it should not go very far in any event, even though the risks are very great. This is the subject about which I would like to speak.

In regulating science, it is important to realize that the legislator is touching at a matter of extreme delicacy. Strict regulation, and even the threat or the anticipation of strict regulation, is perfectly able to stop the progress of science in the country where it occurs.

The CHAIRMAN. What was the last sentence?

Dr. VON NEUMANN. Strict regulation, and even just the threat or anticipation of strict regulation, can perfectly well stop the progress of science even before a very strict regulation has actually taken place.

The CHAIRMAN. Do you say why?

Dr. VON NEUMANN. No; I am asserting that.

The CHAIRMAN. Do you explain why you assert that?

Dr. VON NEUMANN. I am going to.

The CHAIRMAN. I beg your pardon.

Dr. VON NEUMANN. The fact that strict or unreasonable regulations may deter mature scientists from pursuing their vocation, or from pursuing it with that degree of enthusiasm which is necessary for success, is in itself important; but even it is not the most important fact involved. What is more fundamental is this: The numbers of new talent, which accede in any one year to a given field of science are subject to considerable oscillations. They decrease or increase in response to the emergence of new interests, to changing social valuations, to new developments in the field in question, or in neighboring scientific or applied fields. It is perfectly possible that more interest in one field which is near the one involved will scare talented men away from that field. These things have happened many times before. I am convinced that seemingly small mistakes in "regulating" science may affect the "reproduction" of scientists quite catastrophically.

Erroneous legislation on this subject may harm science in this country seriously, even irremediably. Very great intellectual values may be lost in this manner. Apart from this, damage to fundamental science would, at the present stage of industrial development, soon cause comparable damage in the technological and then in the economic sphere. Finally, since other countries may not be similarly affected, it would seriously impair the national defense.

For all these reasons I am completely convinced that it is necessary to maintain and to protect the natural modus operandi of fundamental research, and specifically two of its cornerstones: freedom in selecting the subject of fundamental research and freedom in publishing its results. Any attempt to subdivide nuclear physics is futile from the start. For instance, to make work on the fission of heavy nuclei—uranium, thorium, or similar substances—a preserve for special rules or for secrecy would be vain since the reactions of light nuclei might later assume an even greater importance. To police all work on transmutations of all atomic species would still prove inadequate. There may be still other sources of primary energy which exist in processes yet to be discovered. Science, and particularly physics, forms an indivisible unity; no attempt to compartmentalize it will produce anything but disappointment, and to put all of atomic physics, or all of physics, on the restricted or classified list would clearly kill the physical sciences.

The CHAIRMAN. Doctor, do you mind being interrupted?

Dr. VON NEUMANN. No; please do.

The CHAIRMAN. You just said that to compartmentalize it would be to destroy it?

Dr. VON NEUMANN. No; not quite. What I meant was that any attempt to regulate one part of physics—because we have recognized that that particular part can produce dangerous consequences—and to leave another part free is an uncertain affair, because I don't think anybody can judge at this moment which part of physics will be relevant in this field next year or 5 years from now.

On the other hand, to regulate everything to do with physics would certainly kill physics.

Senator HART. You gave as an example the fact that the lighter nuclei may be just as important a source in the future as the heavy nuclei are now.

Dr. VON NEUMANN. I think Dr. Bethe has talked about this subject before the committee. I can merely repeat things which he has probably said.

We have reason to think that the main source of energy in the stars are light nuclei. We think, or we suspect what conditions exist in the stars, but we don't think we can reproduce them on earth. But there may be other ways to produce such conversions.

The CHAIRMAN. We have had it pointed out to us that it would be well to change the definition which we have in the bill from "fissionable" to "reactive fissile" material—capable of producing a chain reaction to take care of the gaseous synthesized products at the top of the periodic table.

Go ahead, Doctor.

Dr. VON NEUMANN. There is the further point that of course we know still very little about nuclear physics, which is still in a state of rapid evolution and great changes. I am sure you know that the war, if anything, has held up the development of nuclear physics and the chances are that the development will be more rapid in the next 5 years than in the last 5 years.

It is entirely unpredictable what sources of energy will appear in the next 5 or 10 years. It is probably true that fission is only characteristic of the level on which we are doing business, for the order of magnitude of the energy involved, but I don't think there is any serious reason to believe that this is the only access to the very great subatomic energies. I think that it is premature to believe that we hold the key to those energies, that this is the only way in which one can get at them.

To put it another way: To make it quite universal and make rigid legislation not only for fission but all forms of physics would certainly be completely disastrous for physics. It is difficult to foresee how work in physics could go on then.

It is plausible that potential nuclear explosives and actual or potential radio poisons should be subject to safety and health regulations, and to the Government's police power. This has always been so for dangerous substances produced by the chemical industry, and it should be done even more strictly for those originating in the coming nuclear industry. This can certainly be done, and both the Ball bill and the McMahon bill indicate certain guiding principles. I assume the details will have to be worked out in the administrative practice, as usual. There must, however, be no restrictions in principle on research in any part of science, and none in nuclear physics in particular, and absolutely no secrecy or possibility of classification of the results of fundamental research.

To come to a different part of the subject, I think that any special legislation against military developments in the atomic field would not be justified at this moment, and would be exceedingly harmful. It is generally admitted that we should have an Army and a Navy and that they should be maintained at a high level of efficiency. It would therefore be inconsistent to forbid them to work on the development

of a class of weapons that is likely to be of the greatest importance—the atomic weapons—and to monopolize all atomic weapon development in the Commission. Our wartime experience produced a system for military technological development which worked. It had its shortcomings, but it worked at least as well as that of any belligerent, as far as we know, and definitely better than that of some important belligerents. It was based on the coexistence of a large civilian organization, the OSRD, and of the Army and Navy research and development establishments, plus adequate liaison. Just one of these two components, plus any amount of advisers or observers from the other party, would have been inadequate.

Besides, I do not believe that a nation would be wise in attempting to forbid to itself to do certain things. I think that the military uses of atomic energy should be in the province of each—the Commission, the Army and the Navy; that each of these three should have a right to do work in that field.

Senator MILLIKIN. Mr. Chairman, may we have that statement repeated, please?

The CHAIRMAN. Will you repeat that last statement?

Dr. VON NEUMANN. I think that the military uses of atomic energy should lie in the province of each one of the three, the Commission, the Army, and the Navy.

Regarding the makeup of the Commission, I feel somewhat inexperienced and uncertain, but I feel satisfied as to these points:

If there is to be an Administrator, he should be elected by and serve at the pleasure of the Commission.

Since the Commission is to be policy making, the Cabinet should be directly represented on it, and its character should be civilian.

I do not think that the time is now mature to connect this piece of domestic legislation with anticipated and desirable future developments in international politics. This should be done by additional legislation, I think, when and as the circumstances justify it.

The idea that the Commission should make periodic reports to the President and to Congress seems to me to be a sound one. I would like to add that I would expect that the most important modifications in what is to be done will probably emerge in such reports; in other words, that it is very difficult to predict now in every detail how the Commission should regulate.

I doubt, however, that quarterly reports are necessary or desirable. It seems unlikely that every 3 months will produce enough progress to make such reporting really valuable, and besides a certain distance from the events to be reported is essential. There is ample experience to support this. I think that yearly reporting would be more nearly right.

The CHAIRMAN. They might report that they didn't make any progress, and that might be important to know, too.

Dr. VON NEUMANN. Yes. This may be a solution. On the other hand, it is a little awkward. Experience shows that if you have to report, you report something; and it may actually be an opinion of a matter which is not yet finished, and an opinion which may change very soon. However, I admit that they could report zero.

The CHAIRMAN. Do you have some questions, Senator Austin?

Senator AUSTIN. I gather that the central point of your paper is that there should be absolute control of the science of production and

development of the theory of production of atomic energy, with absolute control of it in the Government.

Dr. VON NEUMANN. I think there should be absolute control of the materials which are produced and of the industrial aspects of it.

Senator AUSTIN. That is not my question. My question is, Do you advocate the control of the theory, of the science, the physics and the chemistry?

Dr. VON NEUMANN. No; I think it would be exceedingly difficult. I have tried to point out that it may not even be effective, even if one attempted it. One may direct it at the wrong object. One may think that one part of physics is particularly important from this point of view and one may discover afterward that one has focused one's attention to the wrong part.

Furthermore, I think that a very strict control of these subjects would probably ruin them anyway.

Senator AUSTIN. Then, on that basis your thought is that control be limited to that possession of the properties of science, the products of science, that will assure constructive rather than destructive use of those products. That is your idea?

Dr. VON NEUMANN. Yes.

Senator AUSTIN. Thank you.

Senator HART. Doctor, am I correct in assuming that you believe that there should be practically as free interchange of fundamental developments in science with scientists abroad as there is within our own country?

Dr. VON NEUMANN. I think so, because it is impossible to maintain the normal functioning of research as soon as you limit free interchange of information. In the first place, it will be very difficult to limit interchange of information with scientists abroad, without limiting it also between scientists in this country. I mean it is impossible to keep a secret if it is known to thousands of people.

The CHAIRMAN. Why do you say thousands, Doctor?

Dr. VON NEUMANN. Well, the number of members of the Physical Science Society are 2,000, or something of that order.

Dr. CONDON. Five thousand five hundred.

Mr. NEWMAN. I might point out, Senator, that Dr. Condon is president of the society.

Senator HART. I would like your opinion on one point. I assume you are remarkably closely in touch, and have been so all your life, with the upper-level scientists abroad. Do you think we have more to gain from that free interchange, or would you think that the scientists of Europe, for instance, would have more to gain in such free interchange?

Dr. VON NEUMANN. It is exceedingly difficult to tell. It is exceedingly difficult to guess ahead. However, I think the gains and losses are probably of the same order of magnitude. There is always enough of a risk that we stand to lose more in one particular case than to gain. It would be very difficult to take the responsibility for that.

Furthermore, what I would like to emphasize is this: First of all, if we try to prevent interchange of information with foreign scientists, we must also regulate it at home, and by doing this we would handicap ourselves enormously. In other words, the whole machinery which is necessary to avoid information from getting out of the country would certainly lead to compartmentalization at home, and the loss

of scientific morale at home; so, we would lose considerably beyond the loss just due to our not getting information from abroad.

There is also this: Interchange with foreign scientists is important because you get the viewpoint of people who have a somewhat different approach to your problems. You see, in one country there is always a certain inbreeding of ideas.

It is true in both directions, if two countries are interchanging information, that each gets a fresher viewpoint.

Senator HART. Thank you.

Senator MILLIKIN. Do you believe that it is practical, Doctor, to have a free interchange of scientific information between the nations of the earth without at the same time having a free interchange of all kinds of information?

Dr. VON NEUMANN. Certainly.

Senator MILLIKIN. You think it is practical or isn't practical?

Dr. VON NEUMANN. I think it is practical.

Senator MILLIKIN. This subject of nuclear energy has become one of great significance. That is why you are here, Doctor. That is why this committee is sitting.

Can you consider the subject in a vacuum of its own, or must it be related to political developments over the face of the earth?

Dr. VON NEUMANN. I think it must be related to political developments.

Senator MILLIKIN. If it must be related to political developments of the earth, we must have, then, a free exchange of political information, must we not?

Dr. VON NEUMANN. I think that is a separate matter.

Senator MILLIKIN. Well, you have made it, by your previous answers, an intermingled matter.

Dr. VON NEUMANN. Yes; but what do you exactly mean, Senator, by the interchange of political information?

Senator MILLIKIN. Well, we now have a situation where the world is ignorant of political and other developments in many spots on this earth where there is neither exchange of scientific information nor of any other kind of information, including information which might have political significance under any definition of political that you wish to make.

How, then, can they be separated?

Dr. VON NEUMANN. I think the free interchange of scientific information is necessary. The country which attempts to prevent it would probably lose more because it has to change its internal scientific machinery.

Senator MILLIKIN. I agree with you that far, but since we have agreed that this part of science has now entered the realm of politics, how can we say consistently that we will have free exchange of information on a strictly one-sided part of the subject and not have free exchange of information on the other side, which is necessary to evaluate the whole thing?

Dr. VON NEUMANN. I have no doubt it would be very desirable to have free interchange of information politically. I have no feeling, I have no intuition as to how difficult or how easy it is to achieve it.

In science, I would say the state of affairs has always existed in the past, so we know what it looks like, and we know that this is the normal way of working.

Senator MILLIKIN. But you do not have free exchange of scientific information so far as nuclear energy is concerned?

Dr. VON NEUMANN. We had it up to 1939.

Senator MILLIKIN. But at the present time you do not have it, and science itself has assumed a weapon significance. It now becomes important for us to establish policies either to exchange or not to exchange.

But for the political end of the thing, to reach proper evaluations, since the political end and the scientific end are intermingled, must we not have free exchange of political information at the same time that we have free exchange of information on nuclear energy?

Dr. VON NEUMANN. What I mean is this: I think it would be very desirable to have a free exchange of political information. However, if for any reason we cannot have it immediately or cannot have it, I don't think we would gain anything by preventing the exchange of scientific information. Of course, an important thing would be lacking, but we would harm ourselves by preventing an exchange of scientific information.

Senator MILLIKIN. I agree with you that there are perhaps greater difficulties in securing a free exchange of political information than there would be of scientific information, but is the scientific information that would be exchanged under your theory entirely dependable and can it be properly evaluated prior to the time that you have a general free exchange of information?

Dr. von NEUMANN. From the point of the fate of the world, it is, of course, not complete and cannot be completely evaluated. From the point of view of carrying on scientific work, it is complete and suffices.

Senator MILLIKIN. But you agree that the two bear on each other and therefore have an intermingled significance?

Dr. VON NEUMANN. Oh, yes.

Senator MILLIKIN. Thank you.

The CHAIRMAN. Doctor, you are a citizen of the United States?

Dr. VON NEUMANN. Yes.

The CHAIRMAN. And where were you born?

Dr. VON NEUMANN. In Budapest, Hungary.

The CHAIRMAN. When did you come to this country?

Dr. VON NEUMANN. 1930.

The CHAIRMAN. Had you engaged in your professional career in Hungary?

Dr. VON NEUMANN. Very little in Hungary, but a good deal in Germany and in Switzerland.

The CHAIRMAN. Are you now associated at Princeton, did you say?

Dr. VON NEUMANN. Yes; I was professor of mathematical physics at Princeton University from 1930 to 1933, and I have been a professor of mathematics at the Institute for Advanced Study, which is also in Princeton but which is a pure research institution, since 1933.

The CHAIRMAN. You are associated with Dr. Einstein there?

Dr. VON NEUMANN. Yes; that is the organization.

The CHAIRMAN. Are you consulting with the Navy about the tests that are proposed?

Dr. VON NEUMANN. Yes.

The CHAIRMAN. You are in consultation with the Navy on that?

Dr. VON NEUMANN. Yes.

The CHAIRMAN. I think that we will want to talk to some more, Doctor, maybe, in executive session.

Senator MILLIKIN. I should like to ask one more question, Mr. Chairman.

Do you believe that as of today, Doctor, the prospects for world peace are dependable?

Dr. VON NEUMANN. I don't know. I think the situation has its dangers.

Senator MILLIKIN. Do you think that prior to the time that we can get a better analysis of those dangers we are warranted in turning this subject over to an exclusively civilian Commission?

Dr. VON NEUMANN. Essentially; yes. I think the Cabinet should have control of the Commission; I think it would be a good thing if the Cabinet were directly represented on it.

On the other hand, it is not clear to me how long it will take before we can be reassured about the general situation of the world, whereas I think it is very urgent to have a regulation of work in nuclear physics, or those phases of it which have to be regulated. It is unquestionable that work in nuclear physics is already suffering from the absence of a final settlement.

Senator MILLIKIN. I gathered from your testimony that you do not take out of the picture a place for a military voice in the matter.

Dr. VON NEUMANN. My personal feeling is that the best thing would be to have the policy-making authority of the Commission in civilian hands, if the Army and Navy were left free to develop their own weapons.

Senator MILLIKIN. At the present time, the significance of the thing is military, isn't it?

Dr. VON NEUMANN. Of nuclear energy?

Senator MILLIKIN. You have no practical use for the energy outside of the military sphere as of this moment.

Dr. VON NEUMANN. We have been very negligent in developing the peaceful uses of atomic energy, manifestly because all of this happened under the danger of wartime.

Senator MILLIKIN. As of this moment, we have no other use for nuclear energy.

Dr. VON NEUMANN. I wouldn't go that far.

Senator MILLIKIN. Sir?

Dr. VON NEUMANN. I wouldn't go quite so far. We are producing right now radioactive substances which are exceedingly important from the medical point of view. I am not a medical man, and I don't know to how much of a medical use they are being put at this moment, but I am sure they are being used.

Senator MILLIKIN. But it is a byproduct of the military use that is being made of the energy at this time.

Dr. VON NEUMANN. It is a byproduct of running a fission pile; a fission pile is a plant to produce plutonium.

Senator MILLIKIN. And the production of plutonium at the present time is for a military purpose.

Dr. VON NEUMANN. True, but we have a byproduct which is very important from other points of view. It will certainly take a few years before nuclear energy can be used for peaceful purposes because it takes a certain amount of development. It will also take a few years before we have trained the minimum number of nuclear engineers.

Senator MILLIKIN. It would take an enormous amount of capital also, would it not?

Dr. VON NEUMANN. Considerable, but I would not say enormous. It is probably less than what is absorbed now by several major industries. It would be an important industry, but I assume that at this moment it is smaller than the automobile industry.

Senator MILLIKIN. By the same token that the automobile industry did not spring up overnight, the use of nuclear energy for peacetime purposes would not spring up overnight.

Dr. VON NEUMANN. No; I think it will take a few years, except for the radioactive aspects.

Senator MILLIKIN. And the initial plants for peaceful purposes would take very substantial money. This is not something you can do in a barn or in a bathtub.

Dr. VON NEUMANN. No; but may I mention two things: One is that a plant for military purposes and a plant for peaceful purposes—and I mean in particular plants to make plutonium—do not differ very seriously. If you want to make plutonium, you make it in the same way. A plant for peaceful purposes would have to have provisions for utilizing the energy which you produce, whereas in the military plants it was wasted; here an additional development is needed.

Senator MILLIKIN. We spent two and one-half billion to reach our present plants, and let us assume that three-fourths of it is wasted. We had to move fast.

Dr. VON NEUMANN. Surely.

Senator MILLIKIN. We had to experiment with three or four methods all at the same time, so obviously there was a waste in there. But assume that three-fourths of it was wasted, you are still talking in terms of \$500,000,000. Who is ready to put up \$500,000,000 to produce nuclear energy for peacetime purposes?

Dr. VON NEUMANN. Well, it depends on how the Government is regulating this, but I would expect that the Government would be doing well in spending sums of this magnitude on this subject. If it is to be developed by private enterprise, I would expect that there would be private entrepreneurs who would be willing to do it. This is clearly a thing which has the importance, and is likely to assume the dimensions, of the entire chemical industry, so I think it ought to be looked at on that basis.

Half a billion is an enormous capital investment, but it is not an unusual sum if you talk in terms of major industries.

Senator MILLIKIN. Well, it is a very unusual sum, I suggest, for a peacetime outlay in a field which is already covered to some extent. I am speaking of the power field. I am even speaking of the medical field.

In the case of the power that we have and can develop by normal means and in a slow evolutionary way, if you wish to call it slow—I am speaking of “politically” now—I believe that, first, there are very few nations that could put up \$500,000,000, unless we loaned it to them, and, second, I doubt whether politically you could get an appropriation for \$500,000,000 for nuclear energy from our own Government—I mean the peacetime use of nuclear energy.

Dr. VON NEUMANN. I think its importance in the power field is not that it produces cheaper power than the power you produce now.

I think coal is actually very cheap, and it is very difficult to compete with coal just as a source of calories. But in this manner you could produce power under conditions under which you cannot use coal. I am sure that you are familiar with the many possibilities of this type. It is more in the qualitative than in the quantitative sense that this is a very important new development in power. We certainly have enough tons of coal available.

Senator MILLIKIN. I do not disparage the future possibilities of the subject. I am trying to arrive at some timing factors in my own mind and what to do in the meantime.

Dr. VON NEUMANN. May I add that it is by no means clear that the processes of producing nuclear energy will always be as large and expensive as they are today. It is a general experience with industrial processes that when they are first developed they are vastly more expensive than they become later, and you don't even get a correct idea of the order of magnitude involved if you judge only these early stages.

Senator MILLIKIN. I agree completely with that. I imagine it cost \$25,000 to build the first model T Ford.

Senator AUSTIN. Isn't it true, Doctor, that we have to recognize that private capital is just as much restricted by Government monopoly as the ideas of science are restricted by it when put upon the production and absolute control by Government?

Dr. VON NEUMANN. Well, to be honest, I am less familiar with the workings of private enterprise than with the workings of scientific research; so I would not dare to make an absolute statement there.

Senator MILLIKIN. Let us do a little day-dreaming for a moment and assume a condition in the world where we have dependable assurance of continued peace so that we can put our whole mind on the development of this energy for peacetime purposes.

The suggestion that it be completely controlled by the Government under that hypothesis forms a totalitarian pattern, does it not?

Dr. VON NEUMANN. Surely. All I mean is that it should be controlled to this extent: The Government would probably interfere in some way, for instance, if somebody accumulated 10 tons of TNT in his cellar, or accumulated great amounts of poison. The fission substances are similarly dangerous and ought to be similarly under ordinary police supervision.

Senator MILLIKIN. They are dangerous from the standpoint even of protecting the people in peacetime?

Dr. VON NEUMANN. Yes, they can cause accidents.

Senator MILLIKIN. Radiation and stupid experiments with the subject might result in explosions and other forms of danger.

Dr. VON NEUMANN. Yes; but this is just the ordinary police power of the Government.

Senator MILLIKIN. That is as far as you intend to go, that the Government should exercise a sensible police power over the subject?

Dr. VON NEUMANN. Yes.

Senator MILLIKIN. Would that preclude ownership?

Dr. VON NEUMANN. That is a little difficult to tell, and I am sure it is much more for the lawyer to decide.

Whether you want to abolish ownership in a field, or maintain ownership but regulate it in such a manner that the owner is not free to use his property, is a question of legal and political convenience rather than of scientific technique.

Senator MILLIKIN. There is a serious question there, isn't there, on the assumptions that we have been dealing with?

Dr. VON NEUMANN. It is not technical in the physics sense.

Senator HICKENLOOPER. Perhaps you touched on this before I came in, Doctor, in your statement, but I would like to have your opinion as of a scientist on the matter of the tenure of any commission or board set up to control atomic energy; in other words, whether a commission should hold office at the pleasure of the President, which would be in a broad sense a political appointment subject to the changes of political ideas, or whether a board of the capability that we would hope any such board would have should be given the assurance of a definite tenure of office for a substantial period of time within which it could have some security to work out its programs.

Now, have you commented on that before?

Dr. VON NEUMANN. Just to a limited extent. I have expressed the view, sir, that I thought the Cabinet should be directly represented and the other members should be technical. I think the Cabinet members on the Commission would represent automatically the political element which can express the changes in national politics, and I think the other members should be definitely technical and should have a reasonable tenure.

I don't say they should be life positions, but something tenuous, like 5 years, 6 years, or possibly have the members come in in alternate years.

Senator HICKENLOOPER. In other words, it is your opinion that this board should at least have a security in some of its elements, anyway, of a definite tenure of office rather than to be entirely subjected, that is, all of the members entirely subjected, to holding office at the pleasure of the President or any other group that might be set up?

Dr. VON NEUMANN. I think it should be about 50 percent technical, and the technical members should have tenure.

The CHAIRMAN. Doctor, bearing upon the ability of our country to keep secrets in the scientific field and upon, as you phrase it, very bad effects of such secrecy, when Edison invented the incandescent bulb—the first bulb that he invented—do you think that there would have been the progress in the development of electricity to the point we have it today, if at that time it had been closed up and sealed off so that no one could have known about Edison's performance?

Dr. VON NEUMANN. I think that if Edison's laboratory alone had been secretive, then it probably would have only meant a loss of time. I am convinced that a few years later somebody else would have invented it.

If, however, the entire scientific community had been secretive, that I think would have been very bad for science. It just would have produced a bad group morale.

American scientists were very good about keeping secrets during the war. In fact, in the field of nuclear physics they regulated themselves to keep things secret, before the Government intervened, but everybody clearly understood that this was a transient wartime measure, and everybody did it in the absolute expectation that it would end with the war. I think it would have a bad effect on the general morale of scientists if it should turn out that the system is to be continued.

The CHAIRMAN. Why did you say the war had held back nuclear physics?

Dr. VON NEUMANN. Oh, because if you had wanted to get the maximum progress in nuclear physics—in other words, if you had wanted to produce a state of affairs 20 years from now which is as advanced as possible, then one would certainly never have concentrated as much of the best scientific talent into the few fields which had immediate military applications as one did.

Evidently much more scientific talent was concentrated on radar and short wave than the subject justified from a general scientific point of view, although these fields are important industrially and absolutely vital militarily.

Regarding the developments in nuclear physics, in atomic fission, I think one has to say that the development of the chain reaction and of the fission bomb were enormous engineering tours de force. They were enormous engineering projects carried out by scientists, because the necessary engineers did not exist.

But if nuclear physics had been left to itself, it would not have concentrated on the upper end of the periodic system to this extent. Many scientists who were working in this field claimed that they were stranded at the wrong end of the periodic system.

It is probable that lighter elements will give more important results in the coming years, so we should concentrate on them.

The CHAIRMAN. Senator Millikin pointed out that \$500,000,000 was a tremendous sum of money, with which we can all agree, and it is hard to comprehend \$500,000,000.

He also voiced to you the opinion that it would be rather difficult to get any such appropriation through the Congress for the peacetime development of this Pandora's box that we have opened.

Do you know how many days of war that represents—the cost of the war?

Dr. VON NEUMANN. Very few; \$500,000,000, I think, is about 1 day and a half.

The CHAIRMAN. I thought it was a little more than that, maybe two and a half, but you may be entirely right.

Dr. VON NEUMANN. I figure one hundred billion a year.

The CHAIRMAN. It is rather typical of us in thinking in that way.

Dr. VON NEUMANN. May I add that it was really more expensive than money expresses, because, of course, it diverted not only money—which was a relatively free commodity, but it also diverted strategic raw materials and scientific talent and a few other things which are exceedingly limited and which are much harder to produce in extraordinary quantities in wartime than any other economic services. It was actually probably even more expensive than the half billion or the two billion number indicates.

The CHAIRMAN. Do you think, Doctor, we would be warranted as a Government in going ahead and spending money on a large scale for peacetime experimentation and research in this field?

Dr. VON NEUMANN. Well, I think there are only two alternatives—either turn it over completely to private enterprise or to support it by the Government. I would think the subject is so new and the implications or the possibilities so enormous, that it would justify continued Government interest or support. It is a thing which is really on a larger scale than industrial developments usually are, and the effects on our lives are much more direct.

Senator MILLIKIN. The very challenging thought of the chairman that if we were to spend but a fraction of our money for peacetime

benefits that we do for wartime benefits has always been a challenge for a more constructive use of our peacetime money and energy, while I think there is a distinction that should be observed.

When you pour your wealth for war, you are pouring it out to save your very existence; whereas, at the present time at least, so far as the development of nuclear energy is concerned, we might in the long term have cheaper power, but we have power at the present time. Our existence is not threatened by the lack of power.

I have no doubt that the medical therapeutic value of this energy will be enormous, but as of the present moment I believe that most of those uses are covered by other available things which are most costly perhaps, or hard to get; but our very existence is not threatened.

There is another consideration. Once you go through a war and spend all of your sums—we have spent more in this war, twice over, than the value of the accumulated tangible property gathered together since the landing of the Pilgrim Fathers.

Now, there must be a stop sometime; otherwise, you get into the theory of the embezzler who says, "Well, I have stolen \$100,000; they can only put me in jail once, so I might as well steal another \$10,000," or the theory of the drunkard who goes for the hair of the dog that bit him.

Dr. VON NEUMANN. I see the point, but I would like to add this: Of course, in wartime this thing was done and had to be done very wastefully. As you have pointed out, three avenues were tried simultaneously. It was very plausible after a short time that at least one of them would work, only it wasn't clear how long it would take.

Furthermore, it was forced at a maximum tempo, and if you try to do a thing twice as fast as industry would do it normally, then you probably pay for it much more than twice as much.

However, if, as you suggested, one might double the present performance by spending another half billion, which would seem to be in the reasonable order of magnitude, I would still say that society will get more out of this than a half a billion, just on the peaceful uses if the thing is further developed.

I think it is not continuing reckless spending because one has indulged it for a while, but it is a very wise investment. This is the nucleus of a very important industry which will probably become to be worth much more than half a billion.

Senator MILLIKIN. I suggest without prolonging this, Doctor, that it is wise investment if it is wise in the light of the financial condition of the country.

The CHAIRMAN. Doctor, I am going to retain you to argue for me with Senator Millikin, because I think you have pretty well presented my viewpoint.

There is a question, Doctor, as to whether we can afford not to develop that which we have. Don't you agree with that?

Dr. VON NEUMANN. Yes. I would think that we can afford it. In other words, the things which are needed exist, and they could be used without seriously affecting the standard of living.

The CHAIRMAN. You believe, of course, that research in this field is going forward throughout the world.

Dr. VON NEUMANN. Certainly. Research has probably been slowed down throughout the world by the war, but it is probably recovering now.

The CHAIRMAN. Would you, as a citizen of this country, forgetting all military applications, want this country to be second in the matter of atomic energy?

Dr. VON NEUMANN. No; one should certainly make every effort to do one's best, and to do it just in the ordinary peaceful competitive spirit.

The CHAIRMAN. You, I take it, would not welcome the thought of country A, country B, or country C proceeding well along the road toward peacetime industrial use of atomic energy, would you?

Dr. VON NEUMANN. You mean without the United States progressing? No, I think it would be very deplorable, and I think it would not be desirable from any point of view.

The CHAIRMAN. It is conceivable that it might ruin our economy, isn't it?

Dr. VON NEUMANN. In peacetime, if you are assuming that there is no danger of war anywhere in the world, then all these things are not quite as dramatic as otherwise. In other words, if you are behind in your research and others are ahead of you, you will gradually become a second-rate industrial nation.

On the other hand, you can still buy other people's licenses and continue after a fashion. But it would be deplorable; it would be as bad as letting down in any other field of human endeavor, and we shouldn't do it.

I think it is important that the country should be first in industry and research from a purely peaceful point of view.

Senator MILLIKIN. Mr. Chairman, I believe the witness will agree with me that it is bad to become a second-rate nation in the ways outlined by our very able chairman. It is also bad to become a second-rate nation through insolvency.

Dr. VON NEUMANN. I would think the question is whether insolvency threatens or not.

Senator MILLIKIN. Yesterday we had a message from the President of the United States that shows the predicament that a nation can get into when it considers itself busted. I don't want the United States to have to pass a tin cup to other nations of the world.

The CHAIRMAN. Any further questions? Thank you very much, Doctor.

Mr. Secretary it is nice to see you here. You may proceed.

STATEMENT OF HON. HENRY A. WALLACE, SECRETARY OF COMMERCE

Secretary WALLACE. Mr. Chairman and members of the committee, you have invited me here today to discuss the several bills before your committee for the domestic control and development of atomic energy. In my judgment there is no more important problem before the Congress. The satisfactory solution of the problems created by atomic energy will have an important bearing on the future standard of living of the American people and of all the peoples of the world. It may determine whether our civilization and whether the human race itself will continue to exist.

As Secretary of Commerce, I have a particular interest in the parts of these bills which relate to the potential economic uses of atomic power and of byproduct materials. However the several aspects of

atomic energy—domestic and international, economic and military—are very closely related. Each aspect affects the others to such an extent that the whole problem has to be considered before a satisfactory policy can be worked out with respect to any particular phase. This close relationship was brought out very clearly in the testimony of the scientists who appeared before your committee last month. I shall therefore first discuss some of the general aspects of the problem as background for my specific comments on economic, industrial, and other nonmilitary applications of atomic fission.

In thinking about these several bills, we must first determine the reasons why legislation is needed on the domestic aspects of atomic fission. What are the things that need to be done now in the domestic field, and how do they relate to the question of international control to prevent the use of atomic power as a military weapon? In his message to the Congress on October 3, 1945, President Truman clearly summarized the reasons for domestic legislation which were important at that time. Those reasons were:

1. To establish a peacetime organization to take over the plants and facilities developed during the war for the production of fissionable materials and bombs.

2. To develop and direct a policy of further research on atomic fission and byproduct materials.

3. To secure control over the basic raw materials in this country.

In that message to the Congress, the President also stated that he would soon initiate international discussions for the control of atomic energy and for outlawing the use of atomic weapons. He pointed out that international arrangements for these purposes would be difficult to achieve, but that the alternative was a "desperate armament race which might well end in disaster."

Very important progress has been made in the direction of effective international cooperation since the President's message was delivered some 3 months ago. A preliminary meeting with Great Britain and Canada took place in November. A further meeting was held in December in which Russia participated; and Russia, Great Britain, and the United States agreed to sponsor the establishment of an Atomic Commission of the United Nations to make recommendations to the Security Council on the following points:

1. For extending between all nations the exchange of basic scientific information for peaceful ends;

2. For control of atomic energy to the extent necessary to ensure its use only for peaceful purposes;

3. For the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction;

4. For effective safeguards by way of inspection and other means to protect complying states against the hazards of violations and evasions.

The proposal for the establishment of an Atomic Commission was approved a few days ago at the first meeting of the Assembly of the United Nations in London.

Since the President's message of October 3, it is clear that a further very important consideration has developed with respect to domestic legislation on atomic fission—the need for consistency between our domestic policy as established in such legislation and the international policy which the United States has sponsored and which the other members of the United Nations have accepted in principle. That international policy is to bring about as soon as possible agreements

among all nations not to develop or use atomic weapons; and to insure that such agreements are effective by backing them up with an international inspection system. We do not yet have such international agreements nor an inspection system, but our domestic legislation must be designed to fit into such arrangements and must not give other nations any reason to doubt that international control is our policy and that we would support that policy wholeheartedly. For example, we would undoubtedly give the other nations of the world reason to distrust our motives if on the international front we advocate a policy designed to prevent war and to prevent the use of atomic energy for military purposes, while we simultaneously place the scientific and technological development of atomic energy in the hands of the military at home. So long as we continue without legislation on this subject, we are doing just that. In the eyes of the world, we are entrusting all of the Nation's activities in the field of atomic energy to the military.

I now turn to an examination of the bills before your committee, and especially the McMahon bill (S. 1717), the Johnson bill (S. 1463), and the Ball bill (S. 1557), in relation to the requirements for domestic legislation which I have listed. The requirement that domestic legislation conform to, and serve to carry out, the international policy to which we are committed is obviously the most important single consideration. Unless we can insure that atomic energy will not be used as a weapon, utilization of the power in the atom for peaceful purposes and for the welfare of mankind is only an academic consideration. If atomic weapons are ever again used in war, civilization as we know it will be destroyed. Those, if there are any, who survive the destruction will be concerned with the elemental problems of getting enough to eat and improvising some sort of crude shelter, and not with atomic power plants or medical applications of byproduct materials.

In order to be consistent with the international policy which we have proposed and which offers the only possible alternative to an atomic arms race and ultimate chaos, domestic legislation must be based upon the following principles:

First, it must provide for civilian control in complete harmony with our international policy.

Second, it must provide the basis for a free international exchange of basic scientific information, and for the exchange of technical information when international arrangements make that possible.

Third, it must provide for the early development of the best possible techniques for inspection, which this country can then offer and propose to the United Nations.

Perhaps some further discussion of the third point may be in order. As several scientists who appeared before your committee have testified, the United States knows so much more about the technical problems of inspection—because we are the only nation which has produced fissionable material in quantity—that we must take the lead in devising and proposing effective inspection techniques. The development of such techniques has not yet been possible because of the wartime secrecy rules which are still in force—the compartmentalization of information imposed by the military upon the scientists associated with the Manhattan project. Therefore the formulation of such techniques may need to wait upon the establishment of the Commission.

I shall now take up in turn each of the three principal bills concerned with domestic control and development and consider them in relation to the three standards of conformity with our international policy which have just been enumerated.

First, let us consider the McMahon bill (S. 1717). This bill was introduced after our policy of striving for international control of atomic energy had been formulated by the President and after the initial meeting of the President with the Prime Ministers of Canada and Great Britain. The possibility thus existed of making policy on the so-called domestic aspects of this problem conform to our international policy, and full advantage was taken of this opportunity. This bill places control of developments within the United States in a full-time, five-member civilian commission responsible to the President. Members of the Commission will be appointed with the advice and consent of the Senate, and will be removable at the discretion of the President.

These provisions are consistent with our traditions of democracy and would place control of development of this new tremendous force in the hands of agents directly responsible to representatives of the people. Such democratic control and responsibility are essential not only to prevent undesirable forms of authoritarianism or military dictatorship on the domestic front, but also to assure a domestic program consistent with our international policy. Moreover, the bill specifically provides in section 6 that—

The Commission shall not conduct any research or developmental work in the military application of atomic power if such research or developmental work is contrary to any international agreement of the United States.

The Commission is given custody of all atomic bombs, and is directed not to produce bombs nor to turn any over to the armed forces of the United States except at the express direction of the President. This is a fundamentally important provision which will assure the continuation of our traditional policy of civilian control of military matters. At no time in the history of the United States, in fact, has it been more important to follow the constitutional pattern of subordinating the armed services to civilian representatives of the people.

Secondly, S. 1717 places great emphasis on complete freedom for fundamental scientific research and on the free international exchange of basic scientific information. It provides further, in section 9, that related technical information shall be distributed—

with the utmost liberality as freely as may be consistent with the foreign and domestic policies established by the President * * *

Furthermore, the Commission is not only authorized but is directed to foster and develop economic, medical, and other peaceful uses of the process of atomic fission and byproduct materials resulting therefrom.

Finally, under the complete civilian control and with the close coordination with international policy which the bill provides, it is clear that the Atomic Energy Commission could quickly arrange for the development of the best possible techniques for use in an international inspection system by the scientists, engineers, and technicians acquainted with all phases of the Manhattan project.

The Johnson bill (S. 1463) is defective with respect to all three criteria of consistency with our international program. Since the bill was drafted and introduced before our international policy was

clearly formulated in the form of the declaration of the President and the Prime Ministers of Great Britain and Canada, it was almost inevitable that this should be the case.

The Johnson bill is essentially a bill for promoting further military developments of atomic power. It turns the entire question of domestic development and use of atomic energy, including military developments and uses, over to a nine-man, part-time Commission and to an Administrator appointed by the Commission. The Commission and the Administrator are given powers which make them largely independent of the President and of the Congress. The Commission members are appointed for 9-year terms, and cannot be removed by the President except on specific limited charges.

Under the Johnson bill, the Administrator, who is appointed by the Commission, is in fact the real power. Not only is he the top full-time official, but the bill gives directly to the Administrator practically all of the sweeping powers over persons and property which are given to the Commission itself. The Administrator cannot be removed by the President. Therefore, in any basic disagreement with the Administrator over policy the President might first have to show cause to remove a majority, or five members, of the Commission. This peculiar wording of the bill would set up the most undemocratic, dictatorial arrangements that have ever to my knowledge been proposed to the Congress in a major legislative measure. It would give to the Administrator the greatest powers that have ever been given to one man in time of peace, and yet the bill does not even provide for Senate confirmation nor for any direct means of removal by the President.

The Johnson bill is equally deficient in other respects. The entire emphasis in the bill is on the military application of atomic energy. Little positive encouragement is given to the Commission to sponsor and develop economic, medical and other peaceful uses of atomic power or its byproduct materials. The Commission is left perfectly free to manufacture, or have manufactured by private contractors as many bombs as it may see fit, and there is no specific limitation on the disposition to be made of such bombs. A yearly inventory of property, which presumably would include bombs, is required to be made to the President, but only such parts of that inventory need to be made available to the Congress as the Commission believes to be desirable.

The general statute which prohibits commissioned officers from holding civilian positions is set aside to permit military men on active duty to serve on the Commission, or as Administrator or Deputy Administrator. There is also a strange provision in section 3 of the bill which seems to indicate that the draftsman may have contemplated that the Administrator would be an Army officer and the Deputy Administrator a Navy officer. That provision reads as follows:

the Deputy Administrator shall at all times be kept fully informed by the Administrator.

These provisions potentially place the people of this Nation and even of the world at the complete mercy of a small group of men, perhaps a military clique, who could use this fearful new power to impose new and more terrible forms of authoritarianism and imperialism.

With respect to the second criterion, the bill does not provide for the free dissemination of basic scientific data, nor for the international

exchange of technical data, if and when the President finds that international arrangements have progressed to the point where such exchange would be desirable. On the contrary, there is great emphasis on security regulations—which need not even be made public. There are drastic penalties provided for even unintentional violations of the statute or of security regulations. These provisions indicate again that military applications are the prime consideration of this bill, and under it that wartime security regulation would be carried over into peacetime.

This again is a place to mention, as so many of the eminent scientists who have been associated with the development of atomic fission have pointed out, that to carry security regulations and secrecy to extremes will soon place the United States at the bottom of the scientific world in nuclear physics instead of at the top. Such regulations stifle scientific progress. They are completely counter to the teachings of the history of science. Scientific endeavor requires an atmosphere of freedom conducive to pursuing the path of truth wherever it may lead. Under conditions of military secrecy, restriction and regimentation, the best-qualified scientists would not continue to work on atomic energy. They would leave the field of atomic fission and pursue research in other fields of scientific investigation.

Lastly, under this bill I doubt whether we shall get the scientific and technical collaboration which is necessary to develop, without further delay, the inspection techniques required for effective international control of atomic energy under the United Nations.

It seems to me clear that if S. 1463 or anything like it were enacted by the Congress, it would tremendously increase the difficulties of achieving and successfully administering an international control and inspection system. We would be proposing control and peaceful uses of atomic fission to the world on the one hand, and on the other, we would be turning our domestic development and use over to a virtually independent commission. The commission provided could be dominated and controlled by the armed forces under a statute that emphasizes military developments of atomic energy. This is certainly not the way to encourage international cooperation. It is clear that this bill was not drafted to fit into a policy of international control of atomic energy. In order to conform to such a policy this bill will have to be discarded.

I now turn briefly to Senator Ball's bill, S. 1557. This bill seems to me to fall somewhere between the McMahon bill and the Johnson bill. It is clearly the intent of the bill to provide for civilian control of domestic developments and for coordination with our international policies. The nine-man Commission would consist of five Cabinet officers and four part-time public members. There is no restriction on the President's power of removal. Military officers on active duty are specifically barred from membership on the Commission or from serving as Administrator or Deputy Administrator. On the other hand, being less detailed than the other two bills, it does not provide much guidance to the Commission on many specific points of policy. It seems to me very desirable that the Congress spell out the policies to be followed by the Commission as far as that can be done at the present time, and not give to the Commission what amounts to a blank check on many questions.

I should now like to turn to the second major aspect of these so-called domestic bills—the economic, medical, and other nonmilitary applications of atomic energy. As your committee has already brought out in its hearing in December, this phase of the subject must also be considered in relation to the question of international control and inspection system. It was argued that with large-scale production of fissionable materials for economic purposes, inspection would become more difficult, and there might be more opportunity for clandestine diversion of fissionable materials to the production of bombs and other atomic weapons by a nation or groups determined to violate international controls. To my mind it would be most unfortunate if international suspicions, and the frailties and weaknesses of mankind, should force the world to forego even for a short time the benefits of the energy of the atom.

This is a matter which will have to be worked out and determined by all the nations concerned and will depend at least in part on the effectiveness of the inspection techniques which qualified scientists, engineers, and other technicians have proposed after they have had an opportunity to study all of the technical problems involved. In any event, it will probably take several years to develop practical large atomic power plants, so that the question is not immediately before us. On the other hand, qualified scientists have pointed out that some of the materials produced as byproducts of atomic fission have important and immediate medical applications, which should be put into use by the medical profession without delay. Perhaps all that is needed in the domestic legislation is a provision that no development or utilization of atomic energy for economic purposes shall be undertaken which is contrary to any international agreement or policy of the United States. We should strive in every possible way, however, to find international solutions to permit the prompt harnessing of this new source of energy for the benefit of mankind.

With such a provision, I think the domestic legislation should properly provide every possible encouragement to research and development on economic, medical, and other nonmilitary uses of the process of atomic fission and its byproduct materials. The provisions of the McMahan bill on economic uses seem to me well conceived. This bill provides positive encouragement to research on nonmilitary uses of atomic fission and directs the Commission freely to distribute fissionable material in small quantities for this purpose.

The Johnson bill seems to imply that all sources of fissionable material—the raw ores—shall be owned by the Government, and that mining extraction shall be carried on by the Government. The McMahan bill seems to me to be preferable to the Johnson bill on this point, in that it provides for private ownership and extraction of ores, but requires that the sale and distribution of ores be carried out under Government license.

With respect to patents, only the McMahan bill has any detailed provisions; the Johnson and Ball bills do not deal with this question at any length and presumably would permit private patents both on processes relating to the production of fissionable material and on devices for the use of fissionable material. Since atomic fission may ultimately form the basis of a large part of our economic activity, it is clear that private patent monopolies on critical and key processes

should not be permitted. The McMahon bill would eliminate private patent monopolies by requiring sale to the Government of patents on all production processes, and the compulsory licensing with fair royalties to the inventor, of all patents on devices for the utilization of atomic energy. I should like to suggest that with respect to devices essential to the production of fissionable materials, which will be a Government monopoly or at least carried on only under Government license and control, that another method may be preferable. It might be desirable to shortcut lengthy patent proceedings by forbidding private patents in this field and authorizing the Commission to purchase inventions directly from the inventor.

With respect to patents on devices for the utilization of atomic energy, the compulsory licensing provisions of S. 1717 seem to me to be essentially sound. However, it might be desirable for the bill to provide some definition of the devices which should be subject to compulsory licensing. As the bill is now worded, even trivial and unessential devices—such as a special stepladder or a pair of overshoes used in an atomic energy plant—would fall within the compulsory licensing provision. This seems to be unnecessary and may create a possible hardship for the inventors of such minor devices. Perhaps a criterion of broad public interest or the specification of antimonopolistic policy could be used to define and restrict the area of compulsory licensing.

Finally, on the question of patents, there is no provision in any of the three bills requiring that patents on inventions and discoveries resulting from Government-financed research on atomic fission and related subjects be dictated to the public or turned over to the Government. Such inventions may be extremely important, not only in the field of atomic fission itself, but in many ordinary industrial operations. For example, one of the Government contractors at the Oak Ridge plant of the Manhattan district has issued a memorandum, with the approval of the War Department, stating that some 5,000 such new devices and improvements capable of ordinary industrial application were developed by this one company alone. A copy of this memorandum is being submitted for the committee record.

The CHAIRMAN. What is the name of that company?

Secretary WALLACE. Dr. Condon, do you know the name of the company?

Mr. CONDON. It is the Kellex Corp., a subsidiary of M. W. Kellogg.

Senator MILLIKIN. Does that company claim ownership of these patents?

Secretary WALLACE. No; I don't think it claims ownership of the patents.

Senator MILLIKIN. I mean is it holding them as a sort of trustee for the Government?

Secretary WALLACE. The matter is raised in this document, if you care to look at it.

(The memorandum referred to reads as follows:)

[From: J. M. Mathes, Inc., 122 East Forty-second Street, New York 17, N. Y., John Black, Public Relations and Publicity Department, for release at 2 p. m., Monday, September 17, 1946]

5,000 NEW PRODUCTS, RESULTING FROM ATOMIC BOMB PROJECT, ARE WAR'S GIFT TO PEACE

The immediate benefits to American industry in new inventions, new and improved products and procedures of manufacture, resulting from the atomic

bomb project were analyzed today at a luncheon meeting of business-paper editors representing the principal processing industries, held at the Biltmore Hotel, New York, under the auspices of the M. W. Kellogg Co., chemical engineers of Jersey City, N. J., and New York N. Y. The Kellogg Co. arranged the meeting on behalf of its wartime subsidiary, the Kellex Corp., a noncommercial industry-wide unit which engineered through to construction and operation one of the major plants of the atomic bomb project at Oak Ridge, Tenn.

The keynote of the meeting was the premise based, on current estimates, that, as a result of the vast development work underlying the project, more than 5,000 new products and procedures affecting all phases of American life are available to industry. These products and procedures now await only Government release for commercial application.

Arranged on authorization of the War Department, the meeting included addresses by H. R. Austin, executive vice president of the Kellogg Co. and A. L. Baker, general manager of the Kellex Corp.

The Kellex Corp., which included in its personnel a cross-section of the Nation's scientific and engineering talent loaned for the war emergency by many companies, was formed for the purpose of developing procedure and designing equipment for volume production of uranium-235, an essential ingredient in the atomic bomb project. In this capacity the company had charge of the designing and engineering, and supervised construction of, the diffusion-process plant at Oak Ridge.

According to a memorandum distributed at the luncheon, this \$2,000,000,000 project has resulted in many scientific developments wholly apart from the fundamental factor of atomic power itself, which can be utilized immediately by a wide range of major American industries. These industries include petroleum refining, chemical processing, gas processing, manufacture of pressure and vacuum vessels, electrical, refrigeration, high vacuum, and industries employing corrosive chemicals. In petroleum refining are listed such advances as improved pumping; new type, more efficient heat exchangers; mass spectroscopy (continuous analytical control); possible new methods for separating gas mixtures and improved automatic control. Parallel advantages were specified for the other industries. In further analysis of technical progress made at Oak Ridge, the memorandum tells of "a development, aptly and simply called the leak detector, which is more sensitive than any other existing device previously utilized for the same purpose." Benefits accruing to the medical profession and public health include: (1) A low cost, more abundant source of radioactivity; (2) improved protective methods for combating toxicity in industry; and (3) extension of cancer therapy.

The history of the Kellex Corp. and the significance to industry of its work at Oak Ridge were reviewed by Mr. Baker, who disclosed many facts about this company which had lived under a strict seal of secrecy for 3 years. Two major tangible assets accruing to industry from the record of Kellex were cited by the speaker as: (1) The experience gained in handling hitherto obscure products and the development of new ways of doing business "which cannot help but result in substantial cost-savings and increased quality throughout industry"; and (2) the prestige value of the accomplishment both internationally and in making for "closer integration of our own scientific world."

Mr. Baker said that most of the advantages are still necessarily under Government ban of secrecy and he emphasized that the new developments totalled "not one or two, or an occasional isolated improvement, but literally thousands."

Himself a career veteran of the Oak Ridge project, having served on the diffusion-plant program since the Kellex Corp. was formed, Mr. Baker added:

"What really happened was that here American skill created almost overnight a new industry. A totally new type of plant was built to employ totally new processes for the production of a totally new product. The principal building of the diffusion plant, six stories high and shaped like a U of U's, houses the largest chemico-physical continuous process in the world: A single process employing more pumps, more barriers, more power, more people, more instruments, more of every process-essential than had ever been even thought of before."

Mr. Austin in his address described the character of the Kellex Corp., terming it "an all-American team of highly skilled men, drawn for the emergency from many industries, companies and professions whose patriotic motive combined to achieve the goal they had set for themselves."

Increased interest was attached to the meeting by two current developments—award of the Army-Navy E to Kellex for its excellence in war production, and the news that for the immediate future the diffusion plant is the only one of the three plants at Oak Ridge which will be continued in operation. On the latter point, it was stated that this decision was the result of a new postwar policy by

the Government in which emphasis is shifted from all-out war production at any cost to concentration on a single process which would yield maximum peacetime production consistent with efficiency and economy of operation. Wartime performance of the diffusion plant was such that the authorities selected this process for the continued separation of U-235 in the postwar period.

Approved by the War Department for general press distribution.
From: J. M. Mathes, Inc., New York 17, N. Y., John Black, Public Relations and Publicity Department, September 17, 1945.

PRESS MEMORANDUM

WAR'S GIFT TO PEACE

(As a result of the inventive, scientific, industrial, and engineering advances incident to work on the atomic bomb project, it is estimated that more than 5,000 new and improved products and procedures are now available to American industry awaiting only Government release for volume production.)

A large amount of space in our daily papers and periodicals has been devoted to glowing accounts of the painstaking, involved research by world famous nuclear physicists culminating in the splitting of the uranium atom. Interesting speculations on the possibilities and availability of atomic power have been indulged in but all too little has been said about the benefits which industry, as it is today, might expect, not from the use of atomic power, but from engineering principles, new equipment and new methods developed as a necessary prerequisite of the atomic bomb.

It is therefore the purpose of this memorandum to make available to the press some tangible assets accruing to American industry right now from knowledge gained in the successful solution of the problems faced in separating U-235 from natural uranium by gaseous diffusion methods. And incidentally, the success of that process has been underlined in two current developments: (a) The Kellogg Corp. shares with others serving at Oak Ridge, the honor—so well deserved by all of them—of the Army-Navy E award, which tribute has just been announced by the Government; and (b) even more important, from an engineering viewpoint, the technical soundness of the diffusion plant's processes and equipment are strikingly demonstrated in the current announcement that, of the three methods in use at Oak Ridge, this is the only plant which will be continued on normal operation. This decision it is stated was the result of a new postwar policy in which emphasis is shifted from all-out war production at any cost to concentration on a single process which would yield maximum peacetime production consistent with efficiency and economy of operation. Wartime performance of the diffusion plant was such that the authorities selected this process alone for the separation of U-235 in postwar use.

The development work for this method had to be transformed from a highly theoretical concept without even a laboratory process upon which to base design and performance data into an efficient, multistage, commercial, gas recycling process. And it all had to be done in a hurry. So vast was the undertaking and so enormous the cost that it is quite safe to state that no single corporation or group of corporations would even consider industrial research on this subject with such little prospect of success. The saying "necessity is the mother of invention" was never so true as in the new developments, both in apparatus and process, conceived, developed and applied under the emergency of war to bring the project to a successful conclusion.

It is doubtful if such concentrated research was ever before brought to bear on any one problem. That it was solved quickly is a tribute to the ingenuity and resourcefulness of American science and engineering and bodes well for future developments in this field. The total cost of just separating the U-235 isotope by the diffusion process in important volume reached a substantial portion of the over-all figure of \$2,000,000,000. Mistakes were made of course because decisions had to be made quickly, but progress is not achieved without mistakes. The important point is that these mistakes were capitalized on, and now that it is all over, the vast sum of money spent can be considered not only as a necessary war expenditure or as a preliminary to developing super power resources in the future, but also as our Government's contribution toward the betterment of industry as a whole.

For there is no doubt about it, industry does not have to wait for atomic power to utilize the experience of the project. Many lessons have been learned which can and will be applied to more efficient processing immediately. It can not all

be revealed in print at present but it is in the minds of engineers and firms participating in the project and will be inextricably bound up with their future thinking, engineering design, construction and processing. Some items in these fields can be mentioned and are considered below. It is hoped that they will afford to the serious thinker some idea of the enormity of the problem and the scope of its application toward the betterment of our industries.

Following are some of the industries with indications of how they will benefit from knowledge gained in the U-235 problem:

1. Petroleum refining:
 - (a) Improved pumping.
 - (b) New type, more efficient heat exchangers.
 - (c) Mass spectroscopy (continuous analytical control).
 - (d) Possible new methods of separating gasoline fractions.
 - (e) Improved automatic control.
2. General chemical and processing industries: Same as in petroleum refining.
3. Manufacture of pressure and vacuum vessels:
 - (a) Checking welds.
 - (b) Pretesting vessels for leaks before operation.
 - (c) Improved vacuum techniques.
4. High vacuum industries:
 - (a) Improved vacuum methods for vitamin distillation.
 - (b) New methods of detecting high vacua in electronic tube manufacture.
 - (c) Low-pressure, low-temperature dehydration of foodstuffs.
5. Gas processing industries:
 - (a) Diffusional separation of helium from natural gas.
 - (b) Efficient separation of hydrogen from process gases.
 - (c) Diffusional separation of oxygen and rare gases from air.
 - (d) New techniques in gas recycling.
6. Electrical industry.
 - (a) New electronic techniques in high vacua.
 - (b) Improved micro-sensitive instrumentation.
7. Medical profession:
 - (a) A low cost, more abundant source of radioactivity.
 - (b) Improved protective methods for combatting toxicity in industry.
 - (c) Extension of cancer therapy.
8. Refrigeration industry:
 - (a) Increased safety in equipment.
 - (b) Improved handling of fluorides for refrigerants.
9. Industries employing corrosive chemicals.
 - (a) New pump and valve lubricants and packing methods.
 - (b) New treatment of metal surfaces to prevent corrosion.
 - (c) Improved safety practices.
 - (d) Completely enclosed pumps operated from exterior by induction.

Corrosion factors.—Right from the start of the project staggering obstacles loomed. Uranium, being a solid, had first to be transformed into a gas for utility in the selected gas diffusion process. This meant selecting a compound of uranium with some other element which would be gaseous at nominal temperatures and from which elemental uranium could be readily regained after diffusion. After much experimentation, which included uranium hexafluoride, UF_6 , and also other gases, suitable process gases were selected. One of the big advantages of UF_6 , which brought it into special consideration was that fluorine, having only one isotope, would not complicate the separation by adding new combinations which would diffuse at varying speeds. Uranium hexafluoride is a solid at room temperature but fortunately turns into a gas at $56^\circ C$. Unfortunately, however, like most fluorine compounds, it was highly reactive, physiologically poisonous, and introduced problems of corrosion which pointed toward difficulties in production and handling. In the words of one Kellogg spokesman "uranium hexafluoride is one of the hardest things to handle in the history of mankind."

It was found that practically all the techniques and developments gained in the successful study of the problem could be carried over into a number of industries plagued by corrosion factors through improvement in equipment and processing. The results indicated a saving of millions of dollars annually in the conservation of critical equipment and materials, minimum break-down of moving parts, and also increased safety for workers.

In the process it was imperative that no material in contact with the process gas react with it since such corrosion would lead not only to plugging of the microscopic pores of the diffusion barrier and various mechanical failures but also to absorption (i. e., virtual disappearance) of enriched U-235 isotope. Obviously,

therefore, standard type valves and piping could not be used; instead, new methods of pretreating metal surfaces against corrosion were worked out, new coolants, piping, new type heat exchangers, lubricants, pumps, and packing were developed to satisfy the stringent requirements.

Application of new corrosion knowledge to industry.—Hydrogen fluoride is an important isomerization and alkylation catalyst in petroleum refining as well as an important raw material in the production of aluminum and refrigerants. It is, however, so highly active and dangerous that industry has not yet capitalized on many of its potentialities. Its handling may now be made safer and simpler without excessive maintenance costs and as a result its increased use in industry may be realized.

Other important starting materials for a host of industrial products such as sulfur dioxide, hydrogen chloride and the mineral acids (sulfuric, nitric, and phosphoric) have all presented severe problems of transfer and corrosion with particular emphasis on valve lubricants and pump packings. These difficulties can be greatly simplified by application of the knowledge gained through the extensive experimentation with UF_6 and the other related gases.

Pumps.—The story on pumps, the heart of the process and one of its most difficult problems, is particularly interesting and applicable to modern industry. Thousands of pumps operating under reduced pressure at Oak Ridge created problems in vacuum technique on an unheard-of scale. Other thousands operated at nominal pressures. But regardless of the type or service none could leak or corrode and all had to have as small a volume as possible. Many different types of centrifugal blower pumps and syphon-sealed reciprocating pumps were tried out and new types developed. For example, in one of the pumps for the larger stages the impeller was driven through a coupling containing a very novel and ingenious new seal. Another type of pump was completely enclosed, its centrifugal impeller and rotor being run from the outside by induction.

Top-flight pump designers from leading manufacturers in this country collaborated in research at the central Kellogg laboratories in Jersey City and succeeded to a remarkable degree in increasing industry's knowledge of this all-important phase of processing. For security reasons the practical applications of the new types of pumps developed cannot yet be revealed publicly. However, the engineers who participated in this phase of the project have brought to their parent companies a vastly increased lore of new techniques which cannot help but be reflected in increased service to their customers.

Perhaps the most significant advance in pump design which has been most successfully accomplished is the utilization of supersonic velocities of a very high order (Mach numbers of over 1.0).

Barrier requirements.—Literally acres of porous barriers were required for the gas diffusion plant with billions of holes smaller than 0.01 micron (about two millionths of an inch). Despite the high degree of porosity required such barriers had to be able to withstand a pressure head of one atmosphere. The pores had to be of uniform size and spacing, must not become enlarged or plugged up as the result of direct corrosion or dust coming from corrosion elsewhere in the system, and the barriers had to be amenable to manufacture in large quantities and with uniform quality.

One of the major reasons for the lack of diffusion techniques in industry today has been the barrier problem. Few, if any, corporations cared to expend the prohibitive time and money in the necessary research on this problem, until it was made necessary by the exigency of the situation. Almost at the last minute an excellent barrier was developed and today these operate successfully throughout the more than several thousand stages.

APPLICATION OF DIFFUSION PRINCIPLES TO INDUSTRY

Now that a large part of the basic research on diffusion barriers and their application to full-scale industrial separations has been completed, particularly with reference to gas recycling and instrumentation, it seems almost certain that helium will be separated from natural gas by diffusion techniques rather than by the present refrigeration method. Helium is so light in comparison to other components of natural gas that its diffusion velocity through a porous barrier is over twice as great as the next lightest compound present in the same source.

It may be even easier to isolate hydrogen by these new methods from a number of process gases now used merely as fuel because the diffusion velocity of hydrogen, the lightest of our elements, is over four times that of any compound associated with it.

The isolation of ethylene from cracked gas oil by incorporating diffusion barriers as an integral part of cracking units could conceivably supply an abundant source of this versatile chemical used for the manufacture of synthetic rubber, plastics, antifreeze, alcohol and many other products.

The preparation of oxygen and rare gases from air without resorting to refrigeration and fractional distillation is another possible application, when economic methods are developed.

The direct isolation of natural gasoline fractions from crude petroleum without resorting to distillation, and new types of fractionating columns for the petroleum-refining industry also appear feasible.

Instrumentation.—If pumping is the heart of processing, then instrumentation is the brain. No continuous process could function efficiently without adequate automatic control. In the gaseous-diffusion plant the problems of instrumentation were far greater than in any other industry because the theory involved the assumption that diffusion took place through an infinite number of stages whereas practicability dictated that such stages be limited in number.

Even so, several thousand stages were required, necessitating an intricate system of gas recycling involving abnormally large volumes of gases in relation to the finished product and continuous high precision analytical control. About half of the gas processed in each stage diffused through the porous barrier as enriched U-235 product, and after repressuring was sent on to the next higher stage for further concentration; the impoverished half was also repressured and recycled through the next lower stage. The recycling involved was enormous, over 100,000 times the volume of the final enriched gas.

There were developed to meet these needs the most precise, continuous, automatic, analytical control instruments ever produced by man. This refinement is one of the outstanding features of the gas diffusion plant and constitutes one of its most important applications to industry today. Instruments which before had existed only in research laboratories were improved upon and adapted to commercial use; completely new prototypes were conceived, developed, and put into mass production. The result is that now as never before there is available to industry a more nearly perfect system of continuous automatic control than has ever existed.

APPLICATIONS OF NEW INSTRUMENTATION TO INDUSTRY

Mass Spectroscopy.—One of the developments employed is a new type of mass spectroscopy which every petroleum refiner will welcome for control of cracking operations and transfer line analysis. The mass spectroscopy has been employed for several years in research laboratories and even within the last 2 years in certain phases of the refining industry but never on the perfected scale developed at Oak Ridge. The foremost instrument engineers and physicists in this country and England devoted their full time not only toward gearing this instrument to continuous control but also to expanding this country's capacity for its quantity output. In no other country has electronic research been applied on so grand a scale. Security considerations are not violated in revealing that the mass spectroscopy is an electronic device for analyzing gases both qualitatively and quantitatively from a mass standpoint by separating a beam of dissimilar gas molecules into separate beams according to their formula weight. Determinations are very fast, require only a thimbleful of gas and make obsolete the formerly used Orsat and chemical analyses particularly for the purposes of continuous control where instantaneous changes must be effected the moment a process swings "off the line."

Its potential uses in industry include the accurate analysis of natural gas or any process gas, the continuous automatic control of any gaseous process such as alkylation, dehydrogenation, vapor phase cracking, etc., the checking of inert gases such as nitrogen used to provide a protective atmosphere in furnaces, etc., the checking of the completeness of any evacuation process as in the manufacture of radio tubes, the detection of impurities, and many others. Industry will not have to wait for benefits from this versatile tool because production facilities have been enormously increased since the new type was created.

Leak detector.—A second development, aptly and simply called the leak detector, is more sensitive than any other existing device previously utilized for the same purpose. It played an important part in ensuring that all parts of the gaseous diffusion plant were vacuum tight. Any leaks out of or into the system would be damaging both from the standpoint of loss and contamination of an exceedingly valuable material. The leak detector is well adapted for locating annoying leaks

in industrial high-vacuum processing industries such as vitamin manufacture where even microscopic leaks undetectable by the familiar ammonia-hydrogen chloride method or Tesla coil method are still potent enough to prevent drawing the necessary high vacuum on the equipment. Other potential uses include the pretesting of pressure and vacuum apparatus before putting it in service, checking equipment in operation to ensure no wasteful loss or contamination, the testing of welds for minute pores which would otherwise escape detection and ensuring the physiological safety of refrigeration equipment employing toxic coolants.

Heat exchangers.—Of great interest to the petroleum refining industry is the development of a new type heat exchanger. Since an unavoidable concomitant to pumping gas is heating it and since enormous volumes of gas were processed, individual cooling units for each stage had to be developed. A brand-new type of heat exchanger was conceived for this purpose and developed up to the production stage. A manufacturer was then selected, shown how to make it even to the extent of redesigning his equipment so that thousands of units could be turned out quickly. They were installed and functioned very well.

Possible medical and physiological benefits.—Thanks to the variety and multiplicity of radioactive products which can be produced by means of U-235, we face the prospect of soon having available for therapeutic medicine radioactive materials possessing a wide variety of properties. It is logical to expect, therefore, that these new materials will be suitable for products offering a greater range of usefulness and at lower cost than radium.

The possibility exists of incorporating a micro quantity of a radioactive isotope in food to observe its metabolism in the body of experimental animals. Such "tagged" material could be readily traced in its passage through the organs of the body.

Money not wasted.—It should be borne in mind that the benefits mentioned above accruing to American industries as a result of knowledge gained in the development of the gas-diffusion plant represent only a small part of what is permitted to be revealed at this time. The total cost of the project, \$2,000,000,000, actually only represented 8 days of war cost to the United States.

If it be estimated that the war would have lasted another 6 months, the actual saving could be estimated at \$45,000,000,000.

Senator MILLIKIN. I certainly would agree with your intimation, if that is the intimation, that there should be no private ownership of patents developed at Government expense.

Secretary WALLACE. That is the point which I am making, Senator. I am not acquainted with the patent situation with respect to these 5,000 developments, whether patent rights were reserved to the Government or whether the company retained patent rights. Although the Department of Commerce is interested in making these developments available to American business, we have been unable to get any information on this subject. Apparently even this matter is still shrouded in military secrecy.

The CHAIRMAN. What do you mean "unable to get any information"? Have you asked for it?

Secretary WALLACE. That is my understanding—Dr. Condon?—that we have made some inquiry.

Dr. CONDON. I think that was done by Mr. Green, not myself. He said he had been unable to get any direct answer, and after making this release that they had changed their policy on the matter and decided not to say anything further on it. This document was released in September or October, I believe.

The CHAIRMAN. It bears the date of September 17, 1945.

Has the War Department been asked whether this company owned these patents or whether it didn't?

Dr. CONDON. I would have to ask Mr. Green about that.

Mr. NEWMAN. I can answer that, Senator.

The War Department was asked, I believe by Mr. Bordon, of the Publications Board under the Secretary, as to these patents. Bordon

informed Mr. Green, of the Publications Board, that he had asked General Groves for the information with respect to the patents, and Groves had instructed him that this was a closed matter on which no information could be given at this time.

The CHAIRMAN. Thank you.

Senator HART. Mr. Secretary, or anyone else who knows, is it likely that many of those 5,000 are in the class of the 15 percent of secrets which have not been disclosed by Dr. Smyth's report, and refer to the know-how?

Secretary WALLACE. My understanding is that the vast bulk of these are not in that category. As they are described in this document, the vast bulk of them are of a sort that would be used in ordinary civilian processes.

Senator HART. Are there any of them in that category?

Secretary WALLACE. I suspect there may possibly be some in that category.

Senator MILLIKIN. Mr. Chairman, I should like to suggest that we get the head of the Kellogg Corp. and that we get General Groves before the committee, in executive session if necessary, and get this thing cleared up with the utmost expedition.

The CHAIRMAN. I think that is a wise suggestion, Senator.

Secretary WALLACE. In any event, this question deserves consideration. If the patent provisions of the Kilgore bill for a National Science Foundation are adopted by the Congress, no specific provision will need to be made in the atomic energy bills because the Kilgore bill provides for public dedication of all discoveries arising in the course of Government-financed research and development. However, if that particular provision of the Kilgore bill is not enacted, I strongly urge that a similar provision be incorporated into the statute on atomic energy.

The CHAIRMAN. Mr. Secretary, do you mind if I interrupt you at this point?

Secretary WALLACE. Go ahead, sir.

The CHAIRMAN. Do you know of any other company that engaged in the Manhattan project that did take out patents or claim patents?

Secretary WALLACE. I would not care to name any company. It is my understanding that there are a number of them that did take out patents on various devices, but I know nothing of the details of that.

The CHAIRMAN. I was told that Union Carbide Co., which developed the diffusion plant at Oak Ridge, although they considered that they had invented many patentable features, did not file any patent claims.

Senator HICKENLOOPER. Didn't the du Pont Co. specifically have that as a part of their original agreement, that they would under no circumstances claim any patents or any patent rights in any devices developed in this project by them?

The CHAIRMAN. I think that was one of the statements in their contract.

Secretary WALLACE. I think there were a number of companies that did the same thing.

Senator HART. I think that was allied with the statement that they accepted \$1 as the total payment for their services under the Manhattan district.

Senator MILLIKIN. I should like to suggest, in addition, that it would be well to have somebody make a survey of these employment contracts to see what is in the contracts so far as this subject is concerned.

Secretary WALLACE. There is one further provision in the McMahon bill on economic uses of atomic energy which requires special consideration. Section 7 (d) provides that the Atomic Energy Commission shall not license any practical industrial or commercial use of fissionable materials until after a report on each such use has been prepared and submitted to the Congress by the Commission and after a 90-day waiting period has elapsed following the submission of the report. During this period the Congress would have an opportunity to enact supplementary legislation regulating such use. This provision clearly extends an invitation to vested economic interests to bring pressure upon the Congress to prohibit or delay economic progress. To take a hypothetical example, let us assume that some future Edison will invent an application of atomic power that will make all present electrical power plants obsolete. It is clear that such a development might seriously threaten many vested interests—the interests of stockholders, bondholders, workers, and others. It may well be necessary for the Congress to take cognizance of such a situation and enact such legislation as may be required to minimize transitional hardships. It would be highly undesirable, and might well place this country at the bottom of the international scale in progress toward peacetime developments of atomic energy, if we were to prevent the introduction of such a new power plant in order to protect vested interests.

The CHAIRMAN. After all, it would be the Congress of the United States that would be making that determination, wouldn't it?

Secretary WALLACE. That is undoubtedly true, but it would be making a determination in response to determined pressure groups, and the way you have it phrased is an invitation for such pressure groups to form promptly.

The CHAIRMAN. In other words, do you think that the Congress should divorce itself from the responsibility for a reviewal at least, of any determination of what might be an almost overnight transition in our economy?

Secretary WALLACE. If this section is left out of the bill Congress would not divorce itself. Congress' hands would in no way be tied.

The CHAIRMAN. Let us assume that your future peacetime Edison comes up with this proposal and a five-man Commission that we propose would say, "All right; go ahead," and immediately the market for 50,000,000 tons of coal would be gone overnight.

Do you think that Congress should not be given an invitation to review that determination?

Secretary WALLACE. Congress has the privilege, and would not in any way be prevented from stepping in, even though this section 7 (d) is eliminated.

The CHAIRMAN. I suppose it could abolish the Commission and set up another one. That would be rather a Draconian step to take.

Secretary WALLACE. You could go direct to the particular situation, if Congress so desired.

Senator MILLIKIN. Mr. Chairman, may I suggest that there are congressional precedents for keeping it in Congress.

When the air brake came along, Mr. Secretary, it of course was a very revolutionary and useful device, and Congress provided by law a certain period of time in which the transition should be made from the old-type hand brake, and so forth, to air brakes. The same thing happened in the case of couplers. I think that the same thing happened in the transition from wooden coaches to all steel coaches.

I believe we can find laws on all of those subjects which in their day were very revolutionary, imposing some congressional control over the rate of speed with which these things would come into being so as to protect the type of interest to which you refer.

Secretary WALLACE. It seems to me very important, if this country is not to fall behind certain other countries in the adoption of this power to peacetime uses, that the diminution of the hardship involved in the transition be arrived at in some other way than slowing the rate of speed of the transition.

However, that could well be discussed by Congress.

I want to urge most vigorously that we not put ourselves in the position of being forced to fall behind other nations in an economic way.

The CHAIRMAN. Mr. Secretary, Senator Johnson couldn't be here today, but at each session, practically, he is trying to work out more congressional control of this subject.

I am sure that I could speak for him that when you want to take one out it would meet with his very great disfavor.

Secretary WALLACE. With section 7 (d) in force, the Congress will have invited a campaign to restrain the introduction of such a development, a campaign which would undoubtedly magnify the immediate difficulties of present owners and workers and minimize the long-run benefits to the entire Nation which would result from the new processes. With such a provision in effect during the last 150 years, can it be doubted that our technological progress and the rise in our standard of living would have been seriously retarded? We would have had strong pressures to slow up the introduction of all major technological developments—the steam engine, the power loom, the reaper, the automobile, the telephone, and the airplane. We dare not take the responsibility in history for a slowdown in the utilization of this greatest achievement of science.

In summary, I have attempted in this statement to discuss the major principles involved in the proposed "domestic legislation." There are additional questions of technical detail and exact language which I have not mentioned, but which are covered in the formal reports on the bills which your committee requested some time ago. These reports will be submitted to the committee as soon as they have been cleared by the Bureau of the Budget.

In closing, let me summarize my views on the question of "domestic legislation":

1. Domestic legislation cannot be considered apart from our international policy on the control of atomic energy. Since international control to prevent the use of atomic weapons is by far the most important aspect of atomic energy, domestic legislation should be consistent with such control.

2. Domestic legislation should emphasize the development of peaceful uses of atomic energy.

3. Economic uses of atomic energy should to the maximum extent possible with safety and security be carried out by private enterprise rather than by Government monopoly.

The McMahon bill meets the first two of these criteria, and would require only minor modification with respect to the third. The other two bills would require complete revision to conform to these standards.

Senator AUSTIN. Does the Secretary intend to make a suggestion as to such modification in the report to be cleared by the Bureau of the Budget?

Secretary WALLACE. With regard to the third point?

Senator AUSTIN. Yes.

Secretary WALLACE. I don't remember whether that specific recommendation is there or not.

If the Senator wishes, I will endeavor to prepare such a thing.

Senator AUSTIN. I would be glad to have the Secretary's suggestion as to that.

Secretary WALLACE. I therefore wholeheartedly endorse the McMahon bill, subject to the revisions I have mentioned, in preference to any of the other bills which are now before this committee.

In coping with the problems, both international and domestic, created by the advent of atomic energy, this committee has the most awesome responsibility ever placed on a committee of Congress. In the hands of this committee, in the determinations of the Congress, rest the destinies not only of the people of the United States, but of the world. This committee has an opportunity for the exercise of vision, courage, and statesmanship which occurs only rarely in history.

No man can with clarity foresee the future developments which will stem from the harnessing of atomic energy. We are probably standing on the threshold of a new and more far-reaching economic revolution than we have ever experienced in the past. The decisions which must be made are decisions which will determine whether mankind destroys itself or whether it finds the road to new and undreamed-of mastery of the secrets of the universe in the interest of a better life for all.

We must be prepared to deal with the human as well as with the physical problems which atomic energy will create. We must anticipate social and economic changes which may be effected by this new force, a need which the McMahon bill in its provisions requiring social and economic study foresees.

We can best deal with the great problems which face us by closely adhering to the fundamental principles of freedom and democracy so firmly rooted in our Constitution and in our traditions. We must insist on maintenance of the principle of Government responsibility to the people—and avoid an atomic energy commission which is not responsible to the electorate or to its chosen representatives. We must insist on adherence to the traditional principle of civilian control over military matters—and avoid any possibility of military domination or dictatorship. We must insist on stimulating the development of peacetime uses of atomic energy through the channels of free private enterprise—and, as far as is compatible with public safety and welfare, avoid stifling and restrictive governmental operation, regulation, or control. We must assure the widespread use of atomic energy devices—and avoid the restrictive practices of monopoly. We must insist on following the fundamental precepts of scientific freedom—

and avoid secrecy, suppression, or compartmentalization of knowledge. We must insist on the most rapid peacetime development possible of atomic energy—and avoid retarding such development because of any vested interest. Most important of all, we must insist on the utilization of atomic energy for the betterment of the human race—and avoid the pitfalls which would lead to the destruction of our civilization and international suicide.

These are the principles which should be incorporated into any bill designed to cope with the development and control of atomic energy. For the sake of the peoples of these United States and of the world may you do your job wisely and well.

Senator HART. Mr. Secretary, at various points in your statement, you have mentioned inspection techniques, and you have said that it was impossible to develop those techniques for the use of the international commission so long as the present compartmentalization of scientists is concerned, and in fact as long as it is in the hands of the Manhattan district.

Now, various scientists have been before the committee and have rather played down the idea of any techniques of that sort. In fact, one said that he thought that if he were given the job of inspecting another country, the most useful tool that he could be provided with would be a screw-driver in order to open boxes.

In view of that testimony which we have received, would you care to elaborate further on your statement in order to prove your point?

Secretary WALLACE. Well, I happened to read that particular segment of Dr. Oppenheimer's testimony and couldn't help feeling that to some degree he must have been a little facetious at the moment.

I think that particular reply was made with regard to the detection of bombs that might be secreted and later set off.

Senator HART. Yes; I think that is right. But, Mr. Secretary, there were other scientists who were not facetious at all.

Secretary WALLACE. I feel the problem would best be handled by other means than the use of screw drivers. They might play a part, but if there were certain quantities of material loose in the world, the desirable method of inspection would be first to be so familiar with all of the scientists working on these problems in the world that you could know just what they were up to.

Second, to be so familiar with all the types of processes used in building plants, so familiar with the plants of the world that would produce certain key and bottleneck parts that you could trace them with certainty—and so on.

It would take someone much more familiar with all the various devices used than I am to sketch out a method of inspection, but I would be quite willing to say this:

If these scientists could emerge from their various compartments; and confer together, exchange information, they could, in my belief, quite rapidly work out effective inspection systems.

Senator HART. We have had considerable testimony, Mr. Secretary, to the effect that the technique is not at all difficult, and, as the problem appears to this committee, the difficulties are political and not technical.

I have just one further question, Mr. Secretary.

You have expressed great admiration for that part of S. 1717 which takes all bombs and bomb parts wholly out of the custody of the

military and puts them entirely under the control of the civilian commission.

Now, I call your attention to the fact that in the communique which came after the Moscow Conference, the conferees called for the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction.

Now, following your thought and following the philosophy of S. 1717, would it not also be necessary to take from the military all bombing planes, and bombs of lower power which can achieve mass destruction, and have achieved it?

Secretary WALLACE. In my testimony I only intended to speak about the military use of atomic energy, and not about any of these other matters.

Until the United Nations arrives at some agreement with regard to these other matters, I certainly would not advocate any such procedure.

Senator HICKENLOOPER. Mr. Secretary, following up that answer, until the United Nations or the respective nations individually give satisfactory assurances of the outlawing of the atomic power as a weapon, wouldn't it follow that at least our military responsibility should still exercise control over atomic energy as a weapon just as it should in battleships or bombs of lesser power?

Secretary WALLACE. Yes and no. I would advocate very strongly that at the earliest possible moment, the military, for its own sake, place the control of the atomic bomb, or the material out of which the atomic bomb is made, directly under the supervision of the President.

Unless that is done, the United States inevitably will be looked on as potentially the greatest aggressor nation in the world.

Senator HICKENLOOPER. Will we be looked on as a greater aggressor nation and still maintain the greatest Navy in the world, the greatest air fleet in the world?

Secretary WALLACE. Senator Hickenlooper, these other traditional methods of armament do not have the altogether extraordinary potentialities for destruction of the race that atomic energy has, and I wouldn't put them in the same category at all.

Senator HICKENLOOPER. If I may say, and not be misunderstood, I think I am as zealous to outlaw these things, to keep from killing people, as anybody, so I am not advocating the continuance any longer than necessary.

I admit that atomic energy is spectacular, but it would seem to me that atomic energy is a method of killing, causing death and destruction. It would seem that a 10-ton bomb is a method of causing death and destruction in mass degrees.

Now, I am wondering whether or not the military should not have a substantial, not a controlling but a substantial, voice in this field, which is now entirely devoted to national defense.

True, we have medical possibilities. We have civilian possibilities, but at the moment it is entirely a weapon for national defense, or offense is perhaps a better term.

Until we can be reasonably certain of reliable agreements, or understandings that its use will be outlawed as a weapon, doesn't possibility of its use as a weapon rather demand that we don't just discard it?

Secretary WALLACE. I feel that what you advocate, Senator, inevitably leads to the atomic armaments race which President Truman so vigorously deplored, and that it is absolutely vital to take steps to get it out of the hands of the military.

I think we ought to get it out of the hands of the military at the earliest possible moment, and that we should also press with the greatest possible vigor through the United Nations for the international control and inspection system. Otherwise, there will be suspicions in this country that certain other nations are holding out on the quantity of material which they may have been able to produce.

Undoubtedly they will not have produced more than a small fraction of what we have already produced. The ultimate result of such suspicions is the disaster of an atomic bomb race.

That stand which you advocate seems to me to lead in that direction.

Senator HICKENLOOPER. Does it lead any more in that direction than the maintenance of the greatest Navy in the World, the maintenance of a proposed substantial armed force, such as universal training, the maintenance of the greatest air fleet in the world?

Secretary WALLACE. Very much so, in my opinion; that is, I think the potentialities of atomic energy in this field are enormously greater than any of the means which you have mentioned.

Senator HICKENLOOPER. An article by Alexander de Seversky was mentioned a couple of days ago, in which he tended to depreciate the over-all net effect of atomic energy, saying that it is just another big bomb, a little bigger perhaps and more effective on certain types of targets.

I don't know whether he is wrong, for I haven't enough information on that, but that leads me to another question, if you would care to express yourself on this:

At this moment, without considering what we may or may not be able to do by way of future agreements, would you care to say how far you would go in disclosure of knowledge, both scientific and technical, in the whole field of atomic energy so far as we know up to and including the discharge of the bomb as a weapon to other nations of the world?

Secretary WALLACE. At this moment, it is obvious that we are not in a position to go very far.

Senator HICKENLOOPER. May I ask why?

Secretary WALLACE. Simply because we have pending action on the agreement proposed at Moscow between the four powers—Canada, United States, Britain, and Russia.

Senator HICKENLOOPER. Well, in other words, we haven't yet received or been able to arrive at a satisfactory mutual assurance in connection with the Atomic Energy Commission.

Secretary WALLACE. I am completely in accord with the provisions of the McMahon bill.

I think they fit in admirably with the agreement proposed at Moscow between the four powers. Of course, action hasn't yet been taken; specific action has not yet been taken on those recommendations.

Senator HICKENLOOPER. There must be some fundamental reason underlying the righteousness of the agreement. In other words, I

might assume that we are not in a position to disclose at this moment, because we haven't arrived at reliable or satisfactory understandings, and therefore we should keep this matter somewhat in abeyance and not make full disclosures.

Secretary WALLACE. Of course, what I hope is that a sufficiently satisfactory understanding and inspection system will be developed through the United Nations Organization so that there never will be disclosed any information about the making of bombs; that that will be completely out of the picture; and that there will be free scientific disclosure of the facts that lead to its peacetime use.

Senator HICKENLOOPER. I am in complete accord with that, but I also believe that that presupposes satisfactory and reliable agreements among nations.

Secretary WALLACE. I think certain other nations will want to have just as much assurance, and the same kind of assurance, we would want in their place that there is no danger of our having any of the material in a position to make atomic bombs once the agreement is arrived at.

Senator HICKENLOOPER. Here is the thing that troubles me. Let us suppose we get to the point.

It is our desire or our hope that we don't disclose the technique of the final stages of the bomb, its detonation, or any of those things. I am wondering if any other nation of this size in the world is going to be satisfied to hear us say, "We will just lock this seventh door here and we alone will have the key; the rest of the nations will stay out of there."

I wonder if they will be satisfied to let us keep and lock up, or attempt to forget the secret of the bomb, yet disclosing at least a substantial portion of the thing.

Secretary WALLACE. I think the answer to your question will be obvious if you will imagine some other nation as having done what we have done, and what we would want under those circumstances.

Senator HICKENLOOPER. I think it is a troublesome problem as to when, and the extent to which, these things should be retained or given away.

It has been testified, as you probably have read, numerous times that when we make power and go through this fission process and obtain fissionable material, we are, roughly, 75 percent down the road toward making a bomb. We have another step out of four before we can blow things up.

Secretary WALLACE. All of which gets around to an adequate inspection process.

Senator HICKENLOOPER. Of course, I think there has to be inspection. Probably the detail would have to be worked out.

My question is based on this: that we must, as you have pointed out here, acknowledge that the responsibility, at least as far as Senate legislation is concerned, is going to be upon this committee to write legislation that we at least hope has some judgment and some vision into the immediate future, anyway, and those problems are very troublesome.

That covers the point which you have in mind, and at the same time opens up the door to fruitful use of the energy for peacetime purposes with the greatest possible speed.

Senator MILLIKIN. I would like to ask you, Mr. Secretary, whether inspection as a durable and dependable measure of protection does

not in a large measure turn on whether the important nations of the earth really mean it when they say they want peace. In other words, if a nation makes pious proclamations and says it wants peace, while at the same time harbors aggressive designs, is there any inspection system that will give us complete protection?

Secretary WALLACE. I think that is a scientific problem. Obviously, there must be complete accessibility for inspection committees.

Senator MILLIKIN. But the world is a mighty large place and the aggressor nations have always found means for avoiding the restrictions that have been put upon them. I am just wondering whether we can rely on inspection unless we first have a dependable assurance that we are going to have a world at peace.

Secretary WALLACE. I think you have to have that inspection system in order to have that dependable assurance. I don't think you can have it in any other way.

Senator MILLIKIN. If you had a world in which the nations really mean what they say when they say they want peace, you would not need an inspection system.

Secretary WALLACE. I don't think there is any question about the desire of the various nations for peace. Neither do I think there is any question about the types of fears that exist in the various nations which make for war. The nations do want peace, every one of them.

Senator MILLIKIN. You believe that we are now off on a dependable course toward peace?

Secretary WALLACE. That depends in considerable measure on the action this committee takes.

Senator MILLIKIN. Would you make it "exclusively" or just as you said "in considerable measure"?

Secretary WALLACE. In considerable measure.

Senator MILLIKIN. Since we have dropped or actually used these bombs, there are symptoms around the world, Mr. Secretary, that indicate that aggression has not lost its popularity.

Secretary WALLACE. You can find symptoms of aggression everywhere, Senator. No nation has an exclusive right to harbor certain types of aggression.

Senator MILLIKIN. And no one has related those aggressions to the fact that we have the atomic bomb. They went on before, and they have been going on since.

Basic to that, does not the whole job of this committee and of the Congress swing more or less on its judgment—no matter what its judgment may be one way or the other—as to whether we have now entered a period of peace on which we can rely?

Secretary WALLACE. Well, every nation asks concerning every other nation's intention at the present time.

Senator MILLIKIN. We did that before World War I. We did that at the Disarmament Conference. We did that in connection with the Kellogg Pact, and that inquiry has not produced peace.

Secretary WALLACE. But you have now introduced into the world something altogether new, something altogether frightening, something altogether fearful that is not just another type of big bomb.

The possibilities of invention in this field are so great, and the first bombs in this field are so tiny compared with their potentialities. The leading scientists of the leading nations of the world know this

and have communicated these truths to the heads of these nations. All thoughtful people of any scientific knowledge whatsoever in positions of authority know that this is not merely a repetition of ancient history, but that we are confronting something altogether new, out of which we can make, if we use our heads and imagination, a durable peace or out of which we can make an atomic-bomb race, fear, hatred, and the destruction of humanity.

Senator MILLIKIN. I agree with the latter part of your statement, but I invite your attention to the fact that, despite our development of this new magnitude of power, some of the nations have gone on planting seeds of war in this earth.

Secretary WALLACE. Well, let him that hath complete virtue throw the first stone on that front.

Senator MILLIKIN. We have already thrown the stone; we threw the stone at Hiroshima and Nagasaki.

Senator HICKENLOOPER. Mr. Secretary, may I suggest this: We have this bomb, which is a great weapon. We may propose to demonstrate our good faith and our desire for peace with the rest of the world by even perhaps abandoning its manufacture as a weapon and placing the control of atomic energy in a civilian group.

It certainly has its arguments and its support. We would do that; we would abandon the bomb as a weapon, I take it, at this time as a gesture toward peace and as a demonstration to other nations of the world that we do not desire to go on a program of aggression or to go on a theory of enlarged war in the future.

Secretary WALLACE. That doesn't follow from the McMahon bill.

Senator HICKENLOOPER. No. I am not necessarily talking about the McMahon bill; I am talking about the philosophy of ridding ourselves, if possible, either upon agreement or otherwise, from the use of that weapon in the hope that the rest of the world will dispense with it.

Secretary WALLACE. That will depend upon the discussions in the international field.

Senator HICKENLOOPER. But it would be desirable, as I understand it, and would be a demonstration to the world if, as, and when we can adopt that philosophy of outlawing it as a weapon. That seems to have run all through the testimony of the various witnesses here. I am wondering what effect it would have on the world if today we arrived at some agreements that were satisfactory, at least satisfied us to the point where we could say we would stop making the bomb and no other nation is going to make it, and yet turn around a day or two later and establish a program of universal military training in this country which is certainly not traditional with this Nation.

What kind of a demonstration to the world would that be of our peaceful intentions?

Secretary WALLACE. I am as much concerned as the Senator with the conflict in attitude when that day comes.

Senator HICKENLOOPER. Well, it seems to me we would be putting a knife away with one hand and pulling a pistol out with the other, perhaps, if we are trying to demonstrate our peaceful intentions and our desire for a peaceful world. It would seem to me the retention or abandonment of either of those might be well argued by other nations as a demonstration either for or against a policy of war in the future as contrasted to a policy of peace.

Secretary WALLACE. It would seem to me, Senator, we should examine each of those matters on its own level according to the situation that may exist internationally at the time.

Senator HICKENLOOPER. Does it make much difference in your intention whether you shake your left fist or your right fist under a fellow's nose?

Secretary WALLACE. I say that there is a difference in the levels, and that it is not two fists.

Senator HICKENLOOPER. Well, a fellow might be able to hit harder with his right fist or his left one, but could probably still produce a bloody nose with either. It would seem to me that we are going to have to think a little bit about what our intentions really are.

Secretary WALLACE. That field is altogether minor compared with this one, it seems to me. Let us determine the priorities in our approaches; this is No. 1.

Senator HICKENLOOPER. It might be minor in the power developed. It might be minor in comparison. That is, the training of youth every year might be minor in the aggressive power that that alone could develop as compared with what you could do with 100 atomic bombs; but I am wondering if the principle is any different.

Secretary WALLACE. Principles always have to be accompanied by an examination of the facts.

Senator MILLIKIN. By inspection.

Senator HICKENLOOPER. Well, somebody said here the other day, "Are there any degrees of evil?"

The CHAIRMAN. Senator Austin.

Senator AUSTIN. I have just one question, I think, and I gather the question from your entire thesis, because you stated a postulate at the beginning which was that whatever civilian control we establish must be in complete harmony with our international policy.

Several times in state papers, and finally in a communication from our Secretary of State, our international policy has been stated to be that not until after establishment of effective security measures against the destructive use of atomic energy will the United States permit reciprocal exchange by us of knowledge relating to the constructive use.

Therefore, doesn't it follow that until that event—whether the time may be long or short between now and then—we must retain our own security measures?

Secretary WALLACE. That is true, Senator, but I would advocate even before then that the custody of the bomb be placed in some wider place than just one department of government. I would agree precisely with the Senator in his statement, with that amendment of a broader custody.

Senator AUSTIN. That is all.

The CHAIRMAN. Mr. Secretary, Senator Millikin just stated or assumed a hypothesis that there were nations in the world that might be moving toward aggression.

As I get the exchange between you and the Senator, the Senator's viewpoint was that inspection might not even be worth trying if that was the condition—that is, inspection under an international agreement.

Do you or do you not believe that even assuming that hypothesis there would not be a net gain to the United States and to other peace-

loving nations of the world if we had an inspection system, granting that hypothesis?

Secretary WALLACE. I am afraid I don't understand your hypothesis.

The CHAIRMAN. I was taking Senator Millikin's hypothesis that assuming there were nations in the world which had aggression in their national heart, my question is, would it not be to the benefit of peace-loving nations, even assuming that was true, if we could impose by international agreement an inspection system?

Secretary WALLACE. Yes; I think there would be a net gain for the United States and the world even under that assumption, provided we had a truly effective inspection system.

We would have to keep in mind, of course, that that nation would have one or several of its scientists and engineers on the inspection committee which would be visiting the United States and examining all of our plants, just as we would have several scientists and engineers on the committee which would be going to that particular country or countries, inspecting all of their plants.

The CHAIRMAN. Yes; but they would know that we had it and we would not know—in the absence of an inspection system—whether they had it or not, would we?

Secretary WALLACE. That is correct. It would seem to me that we would tend to be the net gainer under the situation you envision.

The CHAIRMAN. Even under that hypothesis?

Secretary WALLACE. Even under that hypothesis.

The CHAIRMAN. In the absence of any system for gathering information as to the state of development in the world, it would be entirely possible in the absence of the inspection system for us to be blitzed without any advance notice or knowledge, wouldn't it?

Secretary WALLACE. That is correct, sir; I agree. It seems to me the all-important thing is getting the various scientists out of their compartments in which they have been placed in the Manhattan project to work on the details of this inspection system.

The CHAIRMAN. That is now going on.

Secretary WALLACE. I am glad to know that. I didn't know it.

The CHAIRMAN. That is going on. It was developed in testimony before this committee that there was no coordinating committee that had been appointed to coordinate the various plans for inspection, and at the instance of this committee such a coordinating committee has been established and is now at work.

Secretary WALLACE. It seems to me the very fact that there are certain suspicions abroad in the world today as to motives makes it essential that the scientists of the various countries work out an inspection system that would be a real one.

The CHAIRMAN. We hope so.

Senator MILLIKIN. Mr. Chairman, I was not disparaging the usefulness of a successful inspection system. My point was that even if you have that and if at the same time there is an intent to wage war, we cannot rely for our protection on the inspection system, because I am postulating that under the most rigorous inspection there would still be opportunity for evasion.

We have a rigorous inspection system against counterfeiting, but we have counterfeiters. The point is that under this power which you have described as an extraordinary thing, which cannot be related entirely to other weapons—I have heard it described as a new

magnitude, and I think that is a very good expression—you cannot take any chances, because the fellow that shoots first wins the war. Of course, that indicates in itself inspection, but my point is that you have got to go beyond that and have at the bottom a genuine intent, by action, to have a peaceful world. If you don't have that, we cannot rely upon inspection for our protection.

Secretary WALLACE. The Senator is getting into the religious field now.

Senator MILLIKIN. I am totally unqualified to go into that field, Mr. Secretary. If I am in that field, then I quickly withdraw.

Secretary WALLACE. I think it has been said in olden times that hatred doesn't cease by hating but by love. That is an old, old saying among religious teachers.

The CHAIRMAN. If there are no further questions, I want to thank you very much, Mr. Secretary, for your appearance here today.

Tomorrow we will meet at 10 o'clock to hear Dr. Edward Teller, a very noted physicist, and Dr. Karl Compton, president of the Massachusetts Institute of Technology.

(Whereupon, at 12:20 p. m., the committee recessed until 10 a. m., Friday, February 1, 1946.)

ATOMIC ENERGY ACT OF 1946

FRIDAY, FEBRUARY 1, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Austin, Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

Gentlemen, we are privileged to have with us Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.

STATEMENT OF DR. KARL T. COMPTON, PRESIDENT, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. COMPTON. Senator McMahon and members of the special committee, I have a prepared statement from which I shall read certain parts and try to paraphrase the rest, if that is agreeable.

The CHAIRMAN. That is agreeable.

Dr. COMPTON. I believe that first I should qualify as a witness, and I do that on three points.

Senator HART. Mr. Chairman, I think we all know the doctor's qualifications.

The CHAIRMAN. Senator, I think we do, but they ought to be in the record.

Dr. COMPTON. The points that I think may be of possible significance in this testimony are, first, the fact that during the 15 years or so during which I have been president of the Massachusetts Institute of Technology, I have spent, as far as I can estimate, about one-third of the time on governmental boards or committees. That included, from 1933 to 1934, the chairmanship of the Science Advisory Board, which was appointed by the President to study the operations of scientific departments of the Government and to make recommendations regarding organization and the scientific programs of those departments.

In 1939 I was appointed a member of Mr. Stettinius' War Resources Board, which didn't operate very long. I guess it was premature.

In 1940 I was appointed to the National Defense Research Committee under the chairmanship of Dr. Bush, and I have served on that since June 1940, in that connection being primarily responsible

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on the committee for the developments in the field of physics and most importantly radar.

In the last couple of years of the war I was in charge of the Office of Field Service of OSRD, which involved efforts to assist the armed forces in the theaters in getting new weapons into use in the theaters.

I am a physicist by profession and have been at one time or another president of the American Physical Society, chairman of the American Institute of Physics, president of the American Association for the Advancement of Science.

In the field of atomic energy I had some contact with that during the time in which it had been put by the President under the jurisdiction of the National Defense Research Committee and later the Office of Scientific Research and Development. Then I dropped out of the picture until last spring, when I was appointed to the advisory committee that was set up by the Secretary of War in connection with use of the atomic bomb. I wasn't of very much service to that committee, because in the summer I went out to the far Pacific, and was in the Philippines and Japan until about the first of October. So much for the qualifications.

Senator AUSTIN. May I ask a question of you, Doctor?

Dr. COMPTON. Yes, sir.

Senator AUSTIN. Is there any systematic method of educating young men in that subject of atomic energy? That is, up to this time has there been any organization of the study so as to professionalize it in any way?

Dr. COMPTON. Well, before the war the subject of nuclear physics was the most active field of research in physics in our universities and in some of the companies, but principally in the universities. That has been the source of personnel.

During the war a great many more young men have become educated in very specialized lines as they have worked on some of these atomic energy projects, and at the present time I think perhaps the most important single thing for getting ahead in this country is to get the educational programs in the universities started and get equipment and activities going so that we can get some men trained to meet this situation.

Senator AUSTIN. The time has already arrived when young men are writing to me for information as to how to join up with some institution for some course in which they can take this specialized study. Nothing really has been organized yet, has it?

Dr. COMPTON. A large number of the universities and engineering schools are working very vigorously in trying to get the program set up. They are pretty much stymied at the present time, because I think until Congress acts and clears the air so that the institutions know what they can do and can get equipment to work with, things are more or less at a standstill; and that is one point I wanted to bring out in my testimony. I think it is very urgent that action should be just as prompt as can be taken with adequate wisdom.

Senator AUSTIN. Thank you; I shall be very interested in that aspect of your statement.

Dr. COMPTON. The first point that I bring out would be to re-emphasize this last statement, because the institutions and the groups that can work on this field are really marking time for lack of authority to exchange information, to secure the materials neces-

sary for research and development or to secure financial backing and make commitments necessary to active developments in this field.

I might interpolate just as one example from my own institution, the Massachusetts Institute of Technology. We have set up a group; we have recruited an excellent staff. Our corporation is ready to make available approximately half of all the unrestricted funds that we have in our portfolio to get started a program on atomic energy, because we think that that is the biggest thing in sight for the future, and it will need the education of men. Connected with that, it will need research and development. We are prepared to put in somewhere between one or two million dollars into a building that will be designed especially for this purpose, but we cannot very well move with these things until we know what program will be permitted and what possible types of support for carrying on that work will be available, and what the order of magnitude will be.

In the meantime the Manhattan district, of course, has this program under its jurisdiction, and I think it is doing everything that it properly can under the circumstances to carry this thing through in the interval. Obviously, there are some things that it cannot properly do. There must be some major questions of policy decided for the peacetime and civilian operations in this field. I know from talking with General Groves that he and his colleagues do not feel that they should make these policy decisions at this time and therefore set a pattern which might not be the pattern that the Atomic Energy Commission would later wish to follow.

I think the Manhattan district is doing everything it can to keep the thing going, but it is subject to that definite limitation, and that is one great reason why I hope that Congress can act as promptly as possible.

Another important reason, of course, is that in comparison with any other nations that may be throwing everything they have into getting ahead with this program, we will be losing our lead to the extent to which we delay in getting started.

I have been very much impressed, gentlemen of the committee, with the very intelligent way in which the committee has gone about the study of this question, getting a basic understanding of the technical aspects and getting competent technical advice.

I think the bill S. 1717, except in one respect which I will refer to later, is a very good bill. It is clear-cut in its definitions and in its objectives.

I have had the privilege of hearing Senator McMahon explain something of the background which your committee has had in mind, and I realize that you have been thinking far deeper than the merely superficial aspects of this program.

I should say that in general I heartily approve of this bill, S. 1717, with the exception of one point which I think is very important and with the suggestion of two or three minor details.

Taking up those minor points first, in section 5 (c), paragraph No. 1, which is on page 10 of the bill, there is a definition of byproduct materials, and then a paragraph that has to do with the consideration of those byproduct materials. I think that is excellently conceived and excellently drawn, and I have no criticism except this: I think there might be some confusion in carrying out this bill, confusion

between the types of byproduct materials that you have in mind here, and another type of byproduct material.

I think you have in mind those byproduct materials that the physicists or engineers would call "hot," hot materials that are produced in these uranium piles or in the separation, and possibly later in the industrial use of some of these fissionable materials. But there is another type of byproduct material that will be involved in the program and which should be handled differently and ought not to be confused with this type. I refer to materials that will be the byproducts of the metallurgical extraction of the basic uranium or thorium from the ores, the materials that you define in the bill as "source materials."

There is a wide variety of ores from which uranium can be extracted, and commercially it will probably be possible economically to extract ores that contain a fraction of a percent—maybe rather a small fraction of a percent of uranium, and the uranium may be associated with other materials, such as copper, and so forth.

In the process of extraction, those other materials are byproduct materials of the metallurgical process or the mining and metallurgical operation, and those, I take it, are not the byproduct materials to which your bill refers. Presumably, they could come into the atomic energy picture only to the extent that their commercial disposition would reduce the net cost of getting the uranium out of the ore.

The CHAIRMAN. What would be the names of some of those materials?

Dr. COMPTON. I am not enough of a metallurgist to know. Copper would certainly be one. There might be some nonmetallic products. I don't know what they are, but in any ore that contains, for example, two-tenths of 1 percent of uranium it means there are 99.8 percent other things, and to whatever extent those can be usefully disposed of, they are byproduct materials in the mining of uranium.

To handle that, I would make a specific suggestion that on page 10, just following the word "material," the last word in the definition of "byproduct material," there be inserted, perhaps in parentheses, this clause:

It shall not be deemed to refer to the nonradioactive substances which may be byproducts of the metallurgical processes involved in separating ordinary uranium, thorium, or similar materials from their ores.

The definition then would read:

The term "byproduct material" shall be deemed to refer to all materials (except fissionable material) yielded in the processes of producing fissionable material. It shall not be deemed to refer to the nonradioactive substances which may be byproducts of the metallurgical processes involved in separating ordinary uranium, thorium, or similar materials from their ores.

Now, the next minor point is on the preceding page, page 9, line 1, in the definition of "source materials." The definition reads:

The term "source materials" shall include any ore containing uranium, thorium, or beryllium, and such other materials peculiarly essential to the production of fissionable materials as may be determined by the Commission with the approval of the President.

Now, either fortunately or unfortunately, depending upon how we look at it, these source materials are very widely distributed, and traces of uranium or thorium are found almost everywhere. I have been told by one of the men who held one of the key positions in this

atomic energy project that, for example, if you take the average over the surface of the earth and take up a good shovelful of dirt anywhere, you will find an amount of fissionable material in that way which, if it could be got out by proper chemical methods, would yield an energy equivalent to the burning of about 3 tons of coal—any place in your backyard or any place, on the average you have got about that much fissionable material. It means in the order of 1 part in 5,000, or 1 part in 10,000.

Obviously, it would not be desirable to have under the jurisdiction of this Commission the responsibility for licensing the transfer, possession, or title to any source material after mining, extraction, or removal, if it were taken to the absurd limit of dealing with these exceedingly small traces that are not economically recoverable.

It seems to me that in the definition of "source material" it would be advantageous to insert, after the word "containing," the words "quantities deemed by the Commission to be economically recoverable of," so that that definition would read:

The term "source materials" shall include any ore containing quantities deemed by the Commission to be economically recoverable of uranium, thorium, or beryllium, and such other materials peculiarly essential to the production of fissionable materials as may be determined by the Commission with the approval of the President.

The CHAIRMAN. That would seem to be a very sensible modification.

Dr. COMPTON. Then, there is a third one to which I would just call attention, because I am not close enough to the subject to be certain of my ground on this, but I have a doubt.

That is on page 7, lines 7 to 11, which deal with the handling of existing contracts.

That paragraph reads:

The Commission is authorized to continue in effect and modify such contracts for the production of fissionable materials as may have been made prior to the effective date of this Act, except that, as rapidly as practicable, and in any event not more than one year after the effective date of this Act, the Commission shall arrange for the exclusive operation of facilities employed in the manufacture of fissionable materials by employees of the Commission.

I am not at all certain that the Commission could actually carry out that directive in a period of 1 year. I notice in the May bill, H. R. 4566, there is leeway given which makes this permissive but not directive; that is, the Commission may take over the production operations by Government agency under its own control, or may handle them by contract.

I know that in setting up these operations and getting them under way it was figured that the very great manufacturing production experience of a few of our greatest companies was the only thing that made this operation possible, and whether the Government could recruit within a period of 1 year a staff that could take over those operations, I don't know. I think I would feel happier if that were more flexible and made permissive rather than a directive.

Turning now to the point that I do feel is quite important, that is the whole of section 2 of this bill which specifies the organization of the Commission. In brief, it provides for a commission of five members with quite substantial compensation who are prohibited from engaging in any other business, vocation, or employment, and for whom there is no specified term of office. The Commission is responsible both for the determination of policies within the limit of directives

established by the Congress, and also for the administration and execution of these policies.

In my judgment, this is an inferior type of organization and is subject to serious objection. I would like to point out some of those that seem to me to be important.

In the first place, it is not good administrative practice to have the administrative and executive functions in the same hands as the policy-making function. This is illustrated in every type of significant organization in our country. Starting at the top, in our Federal Government, the policy-making function is vested in the Congress, and the executive function is vested in the President. In business corporations you have the policy-making function in the hands of a board of directors, and the president and executive staff carry out those policies.

The same thing is true in educational institutions where you have a board of trustees, and you have a president and faculty that carry out those policies. The same thing is true of the great foundations and hospitals.

I believe that there is a logical reason for that separation, and also it seems proved by the fact that it has survived, because it is the universal type of organization.

I think it would be much wiser to have a policy-making commission or board which would be subject in over-all matters to the President and the Congress, but which, within their directives, would be in a position to make the subordinate policies and to evaluate the way in which those policies were carried out by an administrator.

The second point is that while the Commission, as set up in section 2, could command the services of good men, I don't believe it could command the services of the best men, and that is in spite of the fact that the compensation is a generous compensation for Government officials. I believe that in a thing as important as this atomic energy is going to be, there ought not to be serious limitations on the type of men that could be brought in on the policy-making side. To speak of men that are not living, I would think of men of the caliber, for example, of Newton Baker and Elihu Root as men of a type that it would be important to have represented on this Commission.

Furthermore, it might be advantageous to have the heads of certain of the most concerned Government departments represented on this Commission. I think it should be possible to have one or two of the top scientists represented on this Commission; but as the bill is now drafted, none of those men would be available.

The CHAIRMAN. Doctor, if you applied the same test that you are now speaking about, I wonder what the Senate of the United States would be composed of.

Dr. COMPTON. Sir, I am going to come to that in my next point. I can justify the Senate.

Senator HICKENLOOPER. May I ask the doctor a question, Mr. Chairman?

The CHAIRMAN. Yes, sir.

Senator HICKENLOOPER. I presume, Doctor, that there might be underlying your comment on this No. 1, the fact that the best men undoubtedly will have and demand to have some other interests or some other field of interest in addition to this; that it would be difficult to get the best men who could confine their energies and their entire

abilities to the particular field of administration or handling of this atomic energy.

Dr. COMPTON. That is the point exactly. The thing is so important and so interesting that I think you could probably get anybody you would want to put in a very considerable amount of time. But if you say that he would have to resign as Secretary of War or have to resign as head of a great law firm or have to give up his job as a director of research of some great laboratory or something of that sort, to put in full time on this, then I don't think he would be available.

Senator HICKENLOOPER. May I ask you this: Do you believe that the policy-making group composed of such men would be amply able, giving part-time attention, to properly formulate the policies and properly evaluate this field and get the proper perspective in the entire field so that the Administrator could carry out the policy and keep a sufficient check on it to know that it was done?

Dr. COMPTON. I think it would be possible.

Of course, it would mean that the Administrator would have to have a good strong administrative staff, and as in every such organization the Administrator would probably in most cases take a great deal of initiative.

But any of these groups that I have known about take their jobs very conscientiously and very seriously, and I think the combined wisdom that you could get would be worth having.

Senator HICKENLOOPER. Thank you.

Senator MILLIKIN. I should like to suggest, Doctor, that one way you can get these top men to disassociate themselves from all other interests in life, and perhaps the only way, is life tenure; but that would probably be too inflexible for this sort of organization.

Dr. COMPTON. Yes; sir, I believe so; and that was the third point I was going to bring up. The implication of indefinite tenure for membership on the Commission, I think is unwise. For one thing, it is a new and very active developing field and it should be possible from time to time to bring in fresh blood and fresh ideas. I would be afraid that without a term of appointment, and with the great power that this Commission will have, there will be the danger of its falling into a bureaucratic rut, and I don't think—for a thing as new and proceeding as rapidly as this is—that risk ought to be taken.

The CHAIRMAN. Doctor, you haven't overlooked, I am sure, the provision in section 11 on page 21 of the bill which provides that in the performance of its function the Commission is authorized to—

(1) establish advisory boards to advise with and make recommendations to the Commission on legislation, policies, administration, and research.

Dr. COMPTON. Yes, sir.

The CHAIRMAN. Do you not envisage, assuming that this was the type of commission that was set up, the setting up of the kind of part-time advisory board that you have been talking about?

Dr. COMPTON. Yes, Senator McMahon. I think that is a wise provision. I think there should be advisory boards probably in various fields—in the geological field, for example, or the engineering or production field, and so forth.

The CHAIRMAN. In other words, the full-time five-man Commission, composed of men who had no other interests of any kind, would be able to set up an advisory board composed of the type of men that you

suggest, who could be quarterly, or as the necessity demanded, in the position to consult with the board and advise the board on policies.

Now, this board would be a public board. It would have access to media for the dissemination of its views, and it would seem to me to exercise a great influence in the matter without at the same time being able to control the workings of the project.

I just wanted to make sure you had not overlooked that provision.

Dr. COMPTON. I haven't overlooked that, and I think it is a good provision. I think there should be advisory boards in any case. However, as the Commission is established, I think the Commission will need special technical expert advice in various fields, and it can get that in the manner that you suggested. I have not overlooked that.

My only point is that I think the other method of defining membership in the Commission is the better method, independently of this other point.

The CHAIRMAN. In other words, instead of having the advisory board advise the Commission, you would want the advisory board to be advising the Administrator?

Dr. COMPTON. Well, it could be either way; but I should think the Commission might want to have the advisory board advising it or the Administrator. I don't see that this provision for these advisory committees would not be applicable however the Commission is constituted; I think in any case there should be the possibility of advisory boards.

Senator MILLIKIN. I should like to suggest, Doctor, it couldn't be any other way unless the Commission itself, within itself, had a personnel that embraced all of the sciences and all of the human knowledges.

Dr. COMPTON. Right.

Now, I don't believe it is necessary to provide this substantial compensation for the members of the policy-making commission, as distinct from the administrative staff. The salaries proposed in this bill of \$20,000 and \$15,000 are generous for governmental employees, but for the type of individual that seems to me to be called for, that monetary reward would not be the principal inducement, or even a major inducement.

If it were the inducement to the job, then I don't think he is the man that ought to be on the commission. The right type of person, I think, would be the man that took the job as a public duty because of its interest and importance. I would much rather see this amount of money go into providing as strong as possible a staff for the Administrator.

The CHAIRMAN. I read in the paper where Louis Mayer's salary was \$960,000, and the President of the United States gets \$75,000. I doubt whether the average American citizen today, if given his choice, would hesitate long about which job he would prefer to get.

Dr. COMPTON. I think that is right, but the incentive should be the interest and importance of the job.

Senator HART. Doctor, may I ask you what you think of this: Throwing back to what you have said about the control of large industrial organizations, and also of educational institutions being in the hands of a board of directors or trustees, have you given any thought to the idea of having the Commission composed of men in

both categories, some full time chosen by the President at the best salaries that can be supplied to get the best men, but which, as you say, will not attract all the men of the caliber which this committee should represent in certain respects.

How would it be, then, to have the board of directors of the Commission composed of men in both categories, some part time and some full time?

Dr. COMPTON. If that didn't make any difficulties within the group, I should think that might be workable. That would be equivalent to having, we will say, some professional members and some public members, or however you want to call them. I think that would be feasible.

Senator HART. It would be somewhat akin to a board of directors in which the president of the company and certain of the vice presidents also sit as directors.

Dr. COMPTON. Or ex officio members.

Senator HART. And they are at the same time the executives of the concern.

Dr. COMPTON. Yes; I think that would be workable.

Senator HART. Would you think that that thought is serious enough for us to pay a good bit of attention to?

Dr. COMPTON. Well, if you ask my preference as to this sort of thing, I would recommend a commission in which the members were appointed without salary to serve part time, but any administrator and probably a deputy administrator ex officio also members of the board.

Senator HART. Well, to carry it a little further, one very excellent feature of Senator McMahon's bill is setting up certain compartments. We may not have them just right, but presently there are four, and the heads of those departments would be, reverting to the industrial, parallel to the vice presidents of the concern. There would be several of them. Would their inclusion in the Commission look to be a good thing to you?

Dr. COMPTON. Yes, sir; I should think that would be a good solution. That might make a fairly large Commission with the Administrator and the heads of the four divisions. You would have five men there who are full time. Then I should think there should be at least an equal number of public members serving part time.

Senator HART. Thank you, Doctor.

Dr. COMPTON. I don't have any one pattern that seems to me the best thing, but the thing I want to argue for is that the bill not be passed in its present form, in which it would exclude from membership on the board some types of persons that I think would be very helpful; it is that, as presently drawn, it would exclude some people that I think would be very helpful on the board.

Senator HICKENLOOPER. Let me ask you this, Doctor: It is probably of little consequence at the moment, but these part-time members—would it be desirable to provide that as to part-time members they should get the equivalent of the same per diem pay that the full-time members got when they were performing the duties?

Dr. COMPTON. I should think so; yes; as far as the meeting of expenses is concerned. I believe any man serving on a voluntary basis should have a fairly generous expense account, and should not be required to itemize down to the last cent in an expense account;

that is, a per diem, as we did, for example, in our OSRD organization throughout the war. All of us who served without compensation received a \$10 per diem. I am a member of one or two other boards in which there is a \$25 per diem, and in which I confess I make money; which I am a bit ashamed of. But \$10 is a little skimpy if you are too busy to try to save money on taxicabs, and so forth.

Senator HICKENLOOPER. If you live for \$10, you have to look around a little as to where to eat.

Dr. COMPTON. There is one point that was raised in regard to membership on the Senate, and I promised to try to defend the Senate. In some quarters I think there is a feeling that the affairs of government can only be safely entrusted to men that are on the Government pay roll. I think in many cases this is necessary and inevitable because of the nature of the job and its responsibilities, and I would say certainly the Senate, knowing the full time has to be put in on the Senate, is one of those. There is just no other possible way of handling its business. But in other cases it is not necessary or, in my judgment, even desirable to have paid career men in the office, and I think that this is one of those cases.

Now, one of the best illustrations I think of in the Government of an organization that is somewhat similar to this atomic energy, although less important, and that has worked very well by the type of commission that I would advocate, is the National Advisory Committee for Aeronautics. It is similar in this sense: It has to do with a pretty highly technical subject, and it was created at a time when that subject was pretty much in its infancy. The Government recognized that it was important for the national interest to get ahead in the development of that field. This National Advisory Committee for Aeronautics has been operating since the time of the first World War, and has done a most excellent job. The chairmen—present and past chairmen—of that commission have been extraordinarily able men, devoted to the job. Those men were President Ames, of Johns Hopkins, then Dr. Bush before he went on to the OSRD, and presently Dr. Hunsaker. I am certain that none of those three men could have been secured to serve on the National Advisory Committee for Aeronautics if there had been the specification that he had to give up all other employment and interests. But I know all those three men personally, and I know that they did their jobs well and very devotedly, and put in from time to time pretty close to full time on that job when it was needed. That is true of their other colleagues. That Commission has some ex officio members, representatives of various Government positions, and then it also has the public members that are appointed by the President, I believe, with the consent of the Senate.

Those are some of the reasons why I believe that this section 2 of S. 1717 is inferior to the alternative type of organization that is proposed in the May-Johnson bills which provide for an unpaid, part-time policy-making commission, with members serving a definite term, a 9-year term, and with a paid, full-time administrative organization under an Administrator appointed by the Commission, or it might alternatively be nominated by the Commission and appointed by the President with the approval of the Senate.

Senator HICKENLOOPER. Doctor, may I ask you about this 9-year term? Would it be wise, under a part-time proposal such as you make, to make the original appointments for that substantial length

of time, or would it be better to start a part-time service on this board for perhaps a shorter period until we know a little more about where we are going with this atomic energy?

In other words, my point is that 9 years freezes it for quite a long time in its inception. Five years from now we might be willing to make it 15 years, or might want to make it 2.

Dr. COMPTON. There is a balance of advantages and disadvantages that has to be weighed. In the May-Johnson bills there are three appointed each year for a 9-year term, so there is some turnover. The danger of a long-term appointment is that if you get the wrong man in there, he may not be so bad that you can impeach him or throw him off, but he may not be helpful and it may be desirable to make a substitution.

Senator HICKENLOOPER. I think history has shown that practically without exception there are ways and means of securing the resignation of an undesirable person.

Dr. COMPTON. But history has also shown that those ways are not always followed out when they should be. I should think a shorter term, with the possibility of reappointment on a second term, but not more than a second term, perhaps would be a safe provision. There is the advantage in not making it too short, because it takes a little while to learn the job.

Senator HICKENLOOPER. Of course any term appointment must be an arbitrary term. We must center on 5 years, 4 years, 9 years, or some other term.

Dr. COMPTON. If I had just the power to draft a thing of this sort, I wouldn't make the term as long as 9 years; I would make it a shorter term—3, 5, or something of that sort, with the possibility of reappointment. I would probably choose the longer term, say 5 years, with the possibility of reappointment.

Senator MILLIKIN. Don't you think, Doctor, that all turns on whether you adopt the theory of a tenure which carries with it the exclusion of all other business interests?

Dr. COMPTON. Yes, sir; if it excludes all other business interests, then I think it has got to be a long term, preferably life. It should be so that the man can think he holds that job as long as he is competent.

Senator MILLIKIN. That is the turning point one way or the other?

Dr. COMPTON. Yes, sir. If there is the exclusion of all other business, then I don't see anything other than letting this be a career job, because the man would be "out on his ear" otherwise.

The CHAIRMAN. Doctor, Cabinet officers hold at the pleasure of the President, do they not?

Dr. COMPTON. I think so.

The CHAIRMAN. I can tell you they do. The difficulty many times, particularly in a change of administration, is to keep them out instead of getting them in.

Dr. COMPTON. If I might go on, gentlemen, to a conclusion, I am not sure whether I am supposed, Senator McMahon, to comment on any of the other bills or just this S. 1717.

The CHAIRMAN. We want any comment you wish to make.

Dr. COMPTON. I have a couple of comments on the May bill and the Johnson bill—that is, H. R. 4566 and S. 1463.

I understand that these in their original forms were identical, or essentially identical. The May bill has been revised and very much

improved. So far as I know, the Johnson bill was not correspondingly revised because, I believe, that thing was then turned into the hands of your committee, as far as the Senate was concerned.

I believe that H. R. 4566 is a good and acceptable bill as it now stands except for one feature, and this criticism applies also to a somewhat greater extent to the corresponding portion of the Johnson bill. In the Johnson bill on page 12, lines 14 to 20, there occurs this statement:

The Commission is authorized to extend the provision of this subsection (b) to any deposits from which there can be refined or produced other metals or substances determined by the Commission to be readily capable of or directly connected with the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy.

Now, when you come to the transmutation of atomic species, you have got a very big program. My scientific friends, who have been closer to this in the laboratory in recent years than I have, tell me there is only 1 of the 92 chemical elements of which the earth is composed that has not in one way or another, with the cyclotron or otherwise, been involved in the transmutation of atomic species, and that one probably will soon come into the picture.

Just literally, as this bill is drafted, it gives the Commission authorization over all of the elements of which the earth is composed, and as I said one time facetiously, that would leave only contemplation and religion outside the jurisdiction of this Commission; that obviously is not intended.

The point there is that scientifically in the laboratory ways have been found of transmuting a very large majority of the chemical elements, transforming them from one element to some different element, and probably ultimately all of them. There are very few of these transmutations that have anything except a purely scientific interest, and it is only a very few—at the present time only the fission of uranium-235 and plutonium and their attendant processes—which involve atomic energy in a foreseeably useful or dangerous form.

Senator HICKENLOOPER. May I interrupt at that point and say that the matter of definition has been discussed by the committee, and it has been suggested by some of those who know a lot about it that some restriction on the definition along this line be made: Products that are capable of releasing atomic energy and a self-sustaining chain reaction.

Dr. COMPTON. That would make it all right as far as I am concerned.

Senator HICKENLOOPER. That verbiage is not perhaps scientifically accurate, but that was the sense of the suggestion.

The CHAIRMAN. Would that definition cover synthesis as well as fission?

Dr. COMPTON. No; that wouldn't. I think that would cover only the fission. You are thinking of the synthesis of producing plutonium, for example?

The CHAIRMAN. I am thinking of the gaseous elements at the high point of the periodic table inasmuch as there is, as I understand it, a prospect of development of atomic energy through a combination of lighter elements.

Dr. COMPTON. Yes; there may be possibilities there.

Senator HICKENLOOPER. I didn't intend to be technically accurate on the statement; I was merely suggesting the idea that it had been

suggested as "products capable of releasing atomic energy or quantities of atomic energy in an explosive manner in a self-sustaining chain reaction."

Now, I presume that synthesis may, although I don't know, involve a chain reaction.

Dr. COMPTON. Well, I think something along that line would cover what Senator McMahon has in mind, because the synthesis in this case is a process that is carried out as part of the program for getting this self-sustaining chain reaction.

I had suggested something here which is along the same line; that is, in the May bill, H. R. 4566, which makes an attempt to meet this, but a pretty weak attempt, I am afraid, by introducing the words "peculiarly related to," which limits the broader statement of the original May-Johnson bill to "substances readily capable of or peculiarly related to the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy."

But "peculiarly related to" is still pretty indefinite, and it seemed to me there might be introduced in the May bill, H. R. 4566, on page 30 an additional definition under that list of definitions, as follows:

The term "peculiarly related to" means essentially involved in the production of fissionable material or release of atomic energy in processes capable of producing materials or energies in such appreciable quantities as to be commercially or militarily significant, or to constitute a national hazard.

That is perhaps a little clumsy but you had essentially the same idea. I think something of that sort should go in if a bill of the type of the May bill is passed.

I think in S. 1717 that is satisfactorily taken care of.

The CHAIRMAN. Doctor, in the May bill it is provided, of course, that there shall be an advisory commission. Now, you have a representative from MIT on the Aeronautical Commission, have you not?

Dr. COMPTON. Well, at the present time Dr. Hunsaker is the Chairman of it.

The CHAIRMAN. What department does he head?

Dr. COMPTON. He heads our aeronautical engineering department, and also our mechanical engineering department.

The CHAIRMAN. Would it be a violation of good faith to tell us what his salary is?

Dr. COMPTON. Off the record.

The CHAIRMAN. Do you think that the type of men, such as the good doctor is, might not be perhaps eager to take a place at \$20,000 on this Commission?

Dr. COMPTON. Off the record.

The CHAIRMAN. Doctor, in ordinary peacetime, how many hours a month do you think you could get from part-time Commissioners?

Dr. COMPTON. I think that depends very largely on the importance of the job. Now, I have told you a little bit about my circumstances. I have put in, in 15 years, as far as I can estimate, the equivalent of 5 full years of time on these Government commissions.

The CHAIRMAN. Most of that has been in wartime, has it not?

Dr. COMPTON. Either war or prewar. It has been in an emergency, that is true.

The CHAIRMAN. And of course the same considerations would not apply in times of peace?

Dr. COMPTON. They would not, sir, completely. The National Advisory Committee for Aeronautics is the best example I know, be-

cause it is most nearly along the line I am thinking of, and I know there in peacetime that the men I have known on that Commission who have been either chairmen or on the executive committees, have put in very considerable amounts of time, at times putting in weeks or months continuously on the job.

The CHAIRMAN. Off the record.

Dr. COMPTON. On the other hand, you might want to interest people such as Donald Douglas, Glenn Martin, Lindbergh, Orville Wright, or people of that sort.

The CHAIRMAN. But they would still be available as members of the advisory committee to the full-time workers, as you might call them.

Dr. COMPTON. That advisory committee could be an exceedingly useful committee if its advice were taken.

Now, I have had a little experience on governmental advisory boards when it was pretty clear that those advisory boards were window dressing, and that is not a satisfactory situation to be in. It all depends on whether the agency that you are trying to advise really wants your advice and is willing to take it or not, and there is danger in that.

The CHAIRMAN. On the other hand, Doctor, you of course have this consideration, haven't you: On this we can agree, it is going to be a very powerful Commission, extremely powerful?

Dr. COMPTON. Yes, sir.

The CHAIRMAN. Don't you think it is of some importance that the people of the country believe that they have people serving but one interest, not open to the charge that they have other conflicting interests in their private lives which might subconsciously guide them in their decisions?

Dr. COMPTON. I think that is important, and for that reason I, for example, would immediately write myself off if anybody were to think of me for this sort of job. For fear anybody might get the idea I might be on such a commission, I would write myself off, because I have too much conflict of interest. We have too much of a group at MIT that wants to get into this thing.

The CHAIRMAN. That is the point. Here you are, one of the leading men in the field, and so acknowledged all over the country, and you write yourself off an advisory committee. Now, it is men of your type—you wouldn't phrase it that way, but I will, because you are too modest—that you are urging for appointment to this Commission. The very reasons that you give as to why you would feel disqualified, or would not accept appointment to an advisory committee, would be applicable to many others who perhaps would not be as sensitive to the situation so as to decline to serve.

Dr. COMPTON. I have tried to think of a good many individuals that I think would be good for this job, and I can think of some very good men who would not have this handicap and whom I don't believe would be available on a full-time basis.

Senator HICKENLOOPER. Doctor, isn't it reasonable to think that men or women, people of the type and ability that you have been referring to as possible appointees on this part-time Commission, would be of the type that if they undertook the responsibility of this part time job would not only undertake it with the intention to devote all the necessary time to it that the situation demanded, but

they would also have sufficient grasp of their other responsibilities and be able to evaluate them, and when they accepted the job it would be a well considered acceptance of a highly important job, and it would receive the attention of their abilities?

Dr. COMPTON. I believe so; yes. Perhaps this thing we are talking about can be broken down into two: One is how the Commission should be appointed, and the other is the point that I brought out in my testimony, the question as to whether it is advisable to have the same body charged with the administration as is charged with the determination of policies and the criticism of the administration.

Now, if there were provided in S. 1717 a provision for an administrator and an administrative staff which you now have provided in your four divisions—an over-all administrative staff—and the Commission became primarily a policy-making commission and did not also themselves head those divisions, then I think it would be a sounder organization.

The CHAIRMAN. If I were in the Department of Justice—as I was for some years—in charge of the Criminal Division, it would strike me that my usefulness might be decidedly impaired if in setting policies, as I was called upon to do, in criminal prosecution, I also ran a law office on the side. You run into that conflict at every turn of government.

The Interstate Commerce Commission members would hardly be thought to be appropriate if one of them was a railroad president.

Dr. COMPTON. You run into that, of course, in every place, and if you ruled out everybody that had a conflict of interest, you never could get anything done, if you carry it to the limit.

Take, for example, operations on some of these foundations—the Rockefeller Foundation, for example. I happen to be a member of their board of trustees. I raised the question when I was asked to become a member—I said, “I don’t want to get into a situation in which I cannot bring before this foundation any fine project that the Massachusetts Institute of Technology may want to have considered.”

They said, “That is fine; we will take care of that. You need have no embarrassment at all.” And they did take care of it in this way. At any time, under that foundation, when any grant is under consideration or any project under consideration that concerns an institution of which a man is either a member or a trustee, or anything of that sort, he leaves the room and he hears nothing whatsoever of the decision. All members are honor-bound to give him no information of what went on in the discussion. All he learns about is the final action that they take.

That is universally followed. This conflict of interest is a thing that comes in very generally, and has to be handled. The difficulty is that unless you can find some way of working so as to permit people that might have a conflict of interest to participate in the program, you immediately cut out a lot of the most effective people you could have.

The problem seems to me to be to set the thing up in such a way that the man who has the conflict of interest is on the one hand never personally embarrassed, and, on the other hand, is never in a position where he can exert influence on his own show. I think that is a policy scheme that has to be set up within the organization, but I would hate to see a thing like atomic energy, as important as that,

set up in such a way that you would say that everybody who was concerned in the field of atomic energy in his other affairs was automatically ruled out.

The CHAIRMAN. Of course, they would be eligible for the advisory board that is provided for under the bill.

Dr. COMPTON. Well, I have given my best judgment. I may not be right on this.

The CHAIRMAN. It is just a disagreement as to the philosophy of the thing between you and myself.

Senator MILLIKIN. May I suggest in that connection that this conflict of interest is a matter of degree. In the Senate, for example, we have many farmers, men who own farms, who do not consider that there is any conflict of interest when they legislate on farm problems, and legislate in a way that may affect them importantly so far as their own farms are concerned.

It is a common practice in the Supreme Court of the United States for a man to disqualify himself if he has had some conflicting interest in the litigation before him.

I respectfully suggest that unless you can find a man from Mars or the moon, or some place, he has had some connection with the rest of the world and is found to run into conflict of interest in remote degree. When he comes into conflict of interest in close degree, then as any other honorable man would do, he disqualifies himself. Isn't that correct?

Dr. COMPTON. Yes, sir; it is.

Senator MILLIKIN. If you assume, Doctor, that you are going to have a top commission with the benefit of instruction from specialists, it doesn't particularly matter who is on that, what profession the men on the top commission may belong to, if they are honorable men to start with, if they are intelligent men, if they have a sensitivity to progress in science, if they have a sensitivity to our economic situation and to the problems of industry, if they have a sensitivity to our national defense. You might find that any place, if those are good qualifications for membership on that sort of commission. Would you disagree?

Dr. COMPTON. No; I agree with that, sir.

The CHAIRMAN. Doctor, Senator Millikin used the example of the Supreme Court Justice disqualifying himself. It is my hope that membership on this Commission, if set up as proposed in the bill, would be considered of equal dignity, on account of the life-and-death potentialities of the decisions of such a commission, to be on a par with justiceship on the Supreme Court.

Certainly I am sure that neither you nor I would want Justice Burton or Justice Stone or any other justice to be operating a private law office in Washington, New York or any place else, would we?

Dr. COMPTON. No, sir; we would not.

Senator MILLIKIN. I want to say that I quite agree, Mr. Chairman. For example, there certainly would be a red lantern on the appointment of the head of a great power concern, let us say, to this Commission; for obviously he would be exercising judgment in his job that might very easily bring up a very clear conflict between his private interests as the head of a great power concern and his public interest in relation to this energy.

Dr. COMPTON. I think my testimony on this, of course, is colored by my own experience; my own experience has been that those jobs

that have been handled by the method that I advocate have been handled in a manner that has been both efficient and honorable.

I would also say this: In the experience of this Science Advisory Board in 1933 and 1934, it was not a very romantic job that was done. That was at a time when the scientific budget had been cut to the bone, and the question was how to carry on. Our job was at the request of the Secretaries of the Departments, or the Director of the Budget, to go into some of these scientific bureaus to see how they could be salvaged and what best could be done. We had a board, and quite a number of subcommittees, and we never asked a single man to serve on that board or one of the subcommittees who turned it down. I think there must have been 50 or 75 men engaged in those studies, and everyone dropped everything he did or was doing for a period of a year or 2 years.

Senator MILLIKIN. Were they scientific men?

Dr. COMPTON. They were, sir.

Senator MILLIKIN. Do you believe this is a correct statement: that probably of all of the professions in the world, the scientist is less interested in monetary gain—I am speaking of the pure scientist?

Dr. COMPTON. I don't know of any other group that has less interest in monetary gain, and I have had enough experience in seeing scientists get jobs one place or another to know that the interest and importance of the job far outweigh a differential of 25 or 50 percent in the salary they get from it. That is always true.

Senator MILLIKIN. I think you will agree that we all have egotistical motivations. The motivation of some is to have the biggest car in town or the most money in town.

Is not one of the egotistic motivations of scientists to have his name on a sound paper to receive the kudos of his fellow scientists, and to build up his reputation with papers and contributions, and to be known among his fellow scientists as a good man in the field? Is that not the main ego satisfaction that the scientist gets?

Dr. COMPTON. Yes, sir.

The CHAIRMAN. Wouldn't the same considerations, Doctor, that Senator Millikin has just graphically expressed be present in the drawing power of a full-time, well-paid commissionership on this Commission?

Dr. COMPTON. It would have a drawing power; I don't deny that at all. But there are some people that it would not draw who would be very useful. As you say, you can get help from them on the advisory commission.

Senator HICKENLOOPER. I wish to explore one thought for just a moment on the question of the executive and administrative set-up of this Commission. I think it is a difficult problem and a most important problem as to how it is constituted, but I have in mind, Doctor, a particular board at this moment which is very important—and I won't say where it is—which has tremendous authority in a technical field.

I am quite sure that the membership of that board that exercises final authority is very mediocre. The capacity of the members to evaluate recommendations that are given to them by experts is not great. That board consequently has been buffeted from one side to another on decisions due to the lack of the ability of those who control the policy to evaluate the expert advice on one side or the other that is given them.

I think we have sometimes run that danger on arbitrary appointments in controlling positions, and then rely upon really highly technical advice at the lower levels to keep the board straight.

In other words, it would seem to me that in a matter as important as this, and with the implications and ramifications as great as we think this is, those who control the policy or the last word on it should have at least as great a mental capacity for analyzing and arriving at conclusions—whether they are expert in a particular field of advice or not—as the experts who advise them. If they are a shade below that capacity, then we are apt to get an uncertain course, and we are apt to get into a position where the policies of that board, because of the very conflicting advice they may get and their lack of ability to evaluate, may be not what it should be.

Dr. COMPTON. You have expressed very well, I think, better than I have expressed, one part of the concern I have here; because it seems to me that the advisory boards primarily should be experts, advising as experts, and not advising as national policy makers. The commission itself has got to be the one that makes the policy, subject to Congress.

As you say, it has got to have a caliber that will command the respect of the public and the respect of these advisory groups.

Furthermore, I think that one very important safeguard in a position of this sort is that the man should not be under influence in his decision by the fact that his \$20,000 or \$50,000 a year may depend on the decision that he makes. When you get in as high a position as that, I think that is pretty important, and you cannot always get it. There are some types of situations where that cannot be done; for example, the Supreme Court is one of those.

The CHAIRMAN. And the Senate, Doctor.

Dr. COMPTON. And the Senate; yes.

The CHAIRMAN. And the House.

Dr. COMPTON. But I believe that the thing can be done here—not as far as the work of the administration is concerned, but as to the decision on the major policies and the evaluation—as one stage between the administrator and the Senate, for example, as to how the thing is going on, and there should be a group there that is more independent than a group would be set up under this bill.

Senator HART. Mr. Chairman, if you have finished that particular angle of it, I would like to ask President Compton to turn back to what he said about the 1-year termination of all contracts, and so forth, after which, as the words of the bill now provide, the Commission shall arrange for the exclusive operation of facilities employed in the manufacture of fissionable materials.

My question is, viewing the possible magnitude of such production for peacetime purposes, do you think that the Government can ever arrive at a point where they can as efficiently operate those plants as they have very likely been able to do under private management, under contracts, or for gain?

Dr. COMPTON. I don't believe so. How big the differential would be, I wouldn't know, or whether the differential is worth paying; but I don't believe they can be handled as efficiently, and I think at the present stage where the thing is in so much flux—as, for example, will these production methods be rendered obsolete within a limited period of time by a method of enriching the piles, or some other material, or

something of that sort?—the matter might become a problem that would take the finest engineering talent that could be found to handle the modifications. I don't know any place inside the Government where that is found.

I suppose the Army engineers come closest to it, and they have done a magnificent job; but they have had to get the outside help to do this type of construction, because there is no background of experience for that. To make that shift by law—say that that shift has to be made within a period of 1 year—it seems to me is running a big risk.

Senator HART. I was attempting to carry you a little further than that, Doctor. There are arguments on both sides, and very good arguments for confining this absolutely to the Government; and there are other considerations. Now, if this does grow into a really big business for the production of power or other peacetime purposes, as it may, I just wonder if you think that the Congress should at this time lay down a law that private business never can engage in it except under very tight licenses which would allow not too much private industry?

Dr. COMPTON. I think one thing we all agree on is that this is so important for national safety and international relations, that the control has got to be a tight control anyway you work it so far as the control goes. It seems to me there is no question but that the Government has to retain tight control over this thing because of its nature and significance. When it comes to how that control is maintained, whether it is by actually doing all the work itself or by allowing it to be done under contracts or under license, I think it is too early at the present stage to say what ought to be done. I think the thing should be left flexible, and I can quite easily see that it might be desirable that the Government operate at least some of these plants and sell the byproduct power, or something of that sort.

I think it may be a big enough thing so that in the long run it has got to be Government-operated, but I would hate to make the decision in the legislation right now. I would rather see that left flexible, and see how that thing develops. The legislation could be made later after we find out how it goes.

Senator MILLIKIN. I believe you have answered a question I wanted to ask you, Doctor, pursuing Senator Hart's theme. What we can do with this energy and how we are going to do it depends largely on the state of the world. If we were to reach a period where we have dependable assurance of world peace—and I mean dependable assurance of world peace—we could have an entirely different viewpoint toward the controls the field require at the present time. Is that not correct?

Dr. COMPTON. Oh, yes.

Senator MILLIKIN. Is it not also correct that at the present time this is a field that requires some Government subsidy if we are going to go ahead with it? To put it another way, do you know of any private industry that is willing to spend the money necessary to carry on from where we are now?

Dr. COMPTON. No, sir.

Senator MILLIKIN. And there is precedent for that. I think we have appropriated \$30,000,000 for research on the use of coal and oil, because private industry would not interest itself in the subject. I think an argument could be made that this is something that, if you want to go ahead with it, has to have some Government subsidy.

Dr. COMPTON. I agree with that, sir.

Senator HART. But you still do agree that we should not be too inflexible in that respect in any law we put on the books at this time?

Dr. COMPTON. Yes, sir.

Senator MILLIKIN. But you do visualize that the time might come when the public safety factors were no longer predominant, and at that time it might be advisable to turn the whole thing loose into private enterprise?

Dr. COMPTON. Perhaps, under adequate control. I think the thing is inherently so dangerous, there are so many dangerous things that can happen if it is not properly handled, that it will always have to be a thing that is under very close Government supervision. I think the time might come when there would be large industrial use.

Of course, I think this bill is well drawn on that point as regards industrial use of the product, because, if I understand it correctly, the bill is drafted in such a way that a license can be given, a nonexclusive license for industrial use on appropriate terms; so that as far as using the product is concerned, I think the bill is all right.

The only place where this question arose was on the actual job of manufacturing the fissionable materials in the first place.

Senator MILLIKIN. Mr. Chairman, I would like to ask one more question, and then I promise to desist.

Do you feel that an inspection system is feasible which, at the same time, will not violate the necessary secrets in laboratories of private industry that are not engaged in producing atomic energy?

Dr. COMPTON. I think so; yes. We have had some minor experience to back that. We know that the fire-insurance companies have inspection of plants, and they go into the plants of one company and its competitors, and so forth. I have never heard of any scandal in that connection.

Senator MILLIKIN. Of course, you could stand a fire. The whole theory of a fire-insurance company is to be able to stand the fire; whereas, we cannot stand an attack of atomic bombs.

Dr. COMPTON. But the inspection you are thinking of is the inspection to find out the conditions under which this material is being used—first, whether it is being worked with at all, and second, the conditions under which it is being handled.

Senator MILLIKIN. And whether there is a clandestine development of the energy for an improper purpose.

Dr. COMPTON. It will be a difficult problem, but I think the difficulties of not doing it are so much greater than the difficulties of doing it that there can be only one answer to that.

The CHAIRMAN. Doctor, you said that you were in Japan at the time the interim committee was functioning?

Dr. COMPTON. Yes, sir.

The CHAIRMAN. Did you view those Japanese cyclotrons while you were there?

Dr. COMPTON. I saw the two of them that were in Tokyo. I think there were three others in Japan that were completed, and one other in the course of construction; but I saw only the two that were in Tokyo.

The CHAIRMAN. Did you approve of their destruction?

Dr. COMPTON. No, sir; I did not.

The CHAIRMAN. Were you consulted about that?

Dr. COMPTON. I was consulted in Japan with reference to the conditions under which they should be allowed to operate, and the scientific mission of which I was a member drafted the regulations which were put into effect under MacArthur's order, under which they were operating at the time when I left.

That is, conditions were that in the first place we recognized that the cyclotron is not a military tool. I think Dr. Langmuir, before your committee, said "It produces knowledge; it doesn't produce bombs," and we recognize that. We set up the regulations wherein all Japanese nuclear scientists should be required—who were doing any laboratory work—to report the objectives and nature of their work at such periodic intervals as the commanding general might order. Second, of course, they should be open for inspection at any time; and third, they should engage in no work that could conceivably produce quantities of uranium-235, plutonium, or similar elements which would be capable of being weighed with the most sensitive chemical balance. Finally a later order went in that limited their work to production of tracer materials for use in biological and medical research.

The CHAIRMAN. Did the commanding general approve of that report that the scientific mission made?

Dr. COMPTON. Yes, sir; it was the official order, the official ruling under which that work was going on at the time when I left Japan at the end of September.

The CHAIRMAN. Were you surprised to see that they had been destroyed?

Dr. COMPTON. I was.

The CHAIRMAN. Do you know who caused their destruction?

Dr. COMPTON. Nothing except what I have read in the papers, no. I know the Secretary of War, to whom I wrote a letter of protest, accepted full responsibility. He said the order had gone out over his name. He said that he personally had known nothing about it, and I can well understand that.

The CHAIRMAN. Did he tell you who was responsible in the War Department for this reversal of the scientific mission's advice?

Dr. COMPTON. No, sir; I don't know that, and the War Department here may have known nothing about the scientific mission's advice, and probably didn't. I don't know that, and I have not tried to find out.

The CHAIRMAN. It might be well for this committee to find out.

Dr. COMPTON. Well, I think it was unfortunate. It is a dead issue; the thing won't happen again. I think it was unfortunate and it disturbed a good many people.

Senator MILLIKIN. Was it a good cyclotron?

Dr. COMPTON. It was a good cyclotron. It was operated by a Japanese scientist named Nishina who was a personal friend of Ernest Lawrence, and when Lawrence built his next-to-the-largest cyclotron—or perhaps one just before that—he ordered duplicate parts, magnets, and coils, for his friend Nishina. That was the basis of Nishina's cyclotron. As far as the major construction parts were concerned, it was identical with one of these at the University of California.

Senator HICKENLOOPER. Are there other cyclotrons operating in Japan now?

Dr. COMPTON. I believe not.

Senator HICKENLOOPER. Were all the cyclotrons destroyed in Japan, or just one?

Dr. COMPTON. I cannot answer that question; I don't know. I have just seen the pictures of this big one of Nishina's being destroyed, and I have had no report from Japan. If I recall the newspaper reports, it was that they had all been destroyed.

Now, Nishina had two cyclotrons. There was one smaller one, and it was completely destroyed in one of our incendiary bombing raids. I never would have believed that an incendiary raid could do what was done to that mass of iron and copper, but it certainly was completely wrecked. The big one that was later destroyed by the Army was not damaged in the raid.

Senator AUSTIN. Was it melted?

Dr. COMPTON. The iron was not melted; the copper was melted down. The iron warped, but not melted.

Senator MILLIKIN. What is the size of one of those big ones, how many tons?

Dr. COMPTON. I can not remember the tonnage. The instrument was one that would have pretty well filled this section of the room here, giving space enough to get around it. I forget the tonnage.

Senator HART. I have one question which the Doctor may not wish to answer.

I don't know, Doctor, whether or not you have touched upon security of secrets very much in these manifold duties you have been carrying on for the Government; but if you have, I would like to ask if you think the provisions of S. 1717 for security as of now are sufficient. They fall back upon the Espionage Act, with the possibility of administrative softening or hardening, but nothing else. The question is whether you think that as of now that would be sufficient?

Dr. COMPTON. Yes, sir; I thoroughly approve of those provisions here. I think they are sufficient, and I think they are very wise, because as I see the situation, we are not worried about what happens in the next 2 or 3 years; we are worried about what may happen over a longer period than that. The most important single thing for us to be in a strong position is to develop this field of atomic energy and all the scientific and engineering background just as fast as we can. That cannot be done under security restrictions.

It seems to me that from a standpoint—speaking solely now of national defense—the wisest thing we can do is throw these restrictions to the winds as regards the scientific facts, the facts of nature. I am not referring now to the industrial technique and know-how.

As far as the scientific facts are concerned, I think security restrictions should be completely removed and we should go ahead just as fast as we can possibly get ahead in the development in that field.

If at any time the country gets under the storm clouds, or something of that sort, then things can be tightened up as they would in time of emergency. If war should break out, then of course the restrictions would be put on again.

I have used this illustration, I think, once before. I think our national security factor in this thing is analogous to something like this: Suppose that back when most of you were children and I was a young man, about the time the automobile came in, the War and Navy Departments had said, "Well, this internal-combustion engine

looks as if it ought to have a very great military significance, and we will classify that information and develop it for our military purposes in trucks, tanks, and maybe airplanes"—if they were envisaged at that time.

I think it is clear to everybody that under those conditions our great automotive industry never could have been developed to anything like the strength that it is now. Then, when we got into this war, we might have had some secrets on our shelves, but we would have had an absolutely inferior product and wouldn't have had the productive capacity which was far more important than any secrets we had in winning the war.

I think we should look at this atomic energy thing in the same way at this stage.

Senator HART. Just one other thing, Doctor. I don't think that you mean that such production secrets as we still retain should be disclosed any further than they have been?

Dr. COMPTON. Yes; I agree. I think they should not be disclosed and I think we should keep that industrial know-how at least until such time as our country, our Congress, is convinced that an international arrangement has been arrived at which we can go along with.

When that time has come then I think our country should take the lead in its generosity in cooperating with that organization; but until that time, I think we should keep this know-how.

Senator HART. Would there ever be any good in our telling the rest of the world how to make a bomb?

Dr. COMPTON. I cannot see any good in the world in that; no.

The CHAIRMAN. Doctor, if, at the time Rutherford split the nitrogen atom back in 1919, restrictions such as now are exercised by the War Department on the whole field of nuclear energy were imposed, do you think there would have been the advance that occurred between 1919 and 1939?

Dr. COMPTON. Certainly not; no, sir. As you gentlemen know perfectly well, this knowledge of nuclear physics just advanced by leaps and bounds in the late 1920's and 1930's. This fission idea came in, in about 1939. I think it will go ahead by leaps and bounds again if the thing can be set free to go. It will go much faster in the future than it has in the past, if conditions are right.

Senator HICKENLOOPER. Our intensive activity in the investigation in this field in the last 4 or 5 years has been in the presence of war to develop exclusively a weapon of war.

Dr. COMPTON. That is right.

Senator HICKENLOOPER. And that was the sole and only immediate object that we had in mind.

Dr. COMPTON. That is right.

Senator HICKENLOOPER. Therefore, do you think—whether compartmentalization was the answer, or some other matter—we should have retained strict secrecy so far as the military activity, objectives, and methods were concerned during that period?

Dr. COMPTON. During the war period, I think the thing has been handled just right. I think we can regret that out of all the work these scientists were doing there wasn't more work done in science to develop the art; but that was inevitable. It was cast aside.

Senator HICKENLOOPER. Our object wasn't to advance the art but to produce a weapon of war as quickly as possible, I believe.

Dr. COMPTON. I have no criticism at all of the way it was handled during the war. My comment is only as to what we do next, throwing the scientific side of the thing open.

Senator HICKENLOOPER. So far as I have been able to observe, Doctor, it seems universal that the intention of everyone that I know, including the Army, is that scientific information should be given when, as, and if Congress sets up a civil body to take charge of this. I think the secrecy at the present moment which is being maintained is merely a carry-over from the military responsibility which probably they would like to divest themselves of.

Dr. COMPTON. I am sure they would. I have heard various ones say they would.

The point is, as I mentioned earlier, knowing that this Federal Atomic Energy Commission is going to be appointed, the War Department doesn't feel free, as I gather it, to make decisions on security, on availability of materials, on setting up or making facilities available to universities, for example, or to industry, or things of that sort, because that would be doing something that the Congress intends this Commission to supervise.

Senator HICKENLOOPER. They accepted the responsibility under the military secrecy and the military objective, as I understand it.

Dr. COMPTON. Yes. Incidentally, I would like to say this: It is going to take some time to get this Atomic Energy Commission set up and educated and operating, and I have already made a plea for as prompt action as can be taken. In fact, I would go further in my plea and say that most of these minor details of definitions and things of that sort I wouldn't waste time on at this stage, if it is going to delay the passage of the Act. I would wait for those things to be corrected in supplementary legislation if they cause a delay.

In the meantime, I think it is most important that the Manhattan district retains the authority and the support necessary to do what it can in the interim until the Atomic Energy Commission is ready to take over.

Otherwise, everything stops.

Senator HICKENLOOPER. It is the only authority we have now.

Dr. COMPTON. Yes, sir.

The CHAIRMAN. Thank you very much, indeed, Doctor.

(The prepared statement submitted by Dr. Compton is as follows:)

PREPARED STATEMENT OF DR. KARL T. COMPTON

Senator McMahon, members of the Special Committee of the Senate on Atomic Energy, I appreciate the privilege of submitting to you my views on the proposed legislation for the development and control of atomic energy. I scarcely need to say that I consider this subject to be one of very great national importance. It is also a subject on which it is highly desirable to reach wise decisions and to pass legislation as promptly as possible because, until such legislation is passed, the scientists and engineers who should be pushing forward to secure more complete scientific knowledge of nuclear processes and to develop useful peacetime applications are to a considerable degree "marking time" for lack of authority to exchange information, to secure the materials necessary for research and development, or to secure the financial backing and make the commitments necessary to active development of this field. The Manhattan district engineers are doing what they properly can to bridge the gap until authoritative legislation is passed, but for obvious reasons the program cannot go ahead at anything like full speed until the Congress acts. If such action is very long delayed the United States will lose much of its head start in comparison to such other nations as may already be throwing their full resources into the project.

I have noted with interest and approval the very intelligent manner in which your committee has tackled this problem by informing itself as fully as possible regarding the technical aspects of atomic energy and securing competent technical advice. Benefiting by this approach and by the previous studies and legislative drafts, you have drawn, in S. 1717, a bill which is clear-cut in its definitions and objectives, all of which I approve. In view of the long study which you have made and the extensive testimony which you have already heard, there would seem to be no reason for my further amplification of this statement of approval.

I would, therefore, confine my discussion of S. 1717 to just three points, the first two of which are of rather minor importance and are simply the suggestion of further definitions to avoid possible later confusion. The third point, however, which has to do with the constitution of the Commission, I believe to be of very great importance.

My first point is a technical one, having to do with the definition of byproduct materials in section 5 (c), paragraph (1), on page 10. From the context of (c) I believe that you have in mind by "byproduct materials" those materials mostly "hot" in the sense of being radioactive isotopes, which are produced in the action of a pile or other device in the process of producing or separating such desired end products as uranium-235 and plutonium. As to such byproduct materials I believe that their handling as provided for in (c) is wise and adequate.

However, there is another type of byproduct material which will be involved in the atomic energy program which should be handled differently and which should not be confused with the type of byproducts which I have just mentioned. I refer to the materials which will be byproducts in the process of metallurgical extraction of the basic uranium or thorium from the ores which you define as "source materials" in section 5 (b) paragraph (1).

For example, there is a wide variety of ores from which uranium may be extracted. In some of these the uranium content may be only a few percent or even a few tenths of a percent, but it may be technically and economically feasible to get uranium even from low-grade ores. In the process of extracting the uranium, many other materials will also come out as byproducts, as, for example, copper. Such byproducts would of course be commercially disposable and should be handled in the usual commercial manner, and would come into the atomic-energy picture only insofar as their commercial disposition should reduce the cost of the uranium or similar metal of interest for atomic energy.

I suggest, therefore, that any confusion between the byproduct material which the committee has in mind in this section and the type of byproduct occurring in the extraction of the metal from the original ore could be taken care of by introducing a sentence in parenthesis immediately following the word "material" in line 5, page 10, as follows: "(It shall not be deemed to refer to the non-radioactive substances which may be byproducts of the metallurgical processes involved in separating ordinary uranium, thorium, or similar materials from their ores.)"

My second point refers to the definition of "source materials" in section 5 (b), page 9, line 1. Fortunately or unfortunately, depending on how we look at it, these source materials are very widely distributed and traces of them can be found almost anywhere. I understand, for example, that on the average over the surface of the earth if you take up a good shovelful of dirt it will on the average contain sufficient traces of fissionable materials so that, if they were extracted, purified and properly used, they could supply an amount of energy equivalent to the burning of about 3 tons of coal. Literally speaking, therefore, the definition of "source materials" as now written would require a license from the commission in almost every mining operation. This absurd extreme is of course not the intention of the bill, but it would seem to me desirable to modify the definition of "source materials" to make it conform more accurately to what your committee has in mind.

I would therefore suggest the insertion, after the word "containing" on page 9, line 2, the words "quantities deemed by the commission to be economically recoverable of." Thus this definition would read:

"The term 'source materials' shall include any ore containing quantities deemed by the Commission to be economically recoverable of uranium, thorium, or beryllium, and such other materials peculiarly essential to the production of fissionable materials as may be determined by the Commission with the approval of the President."

Turn now to my third point which I consider to be a very serious objection to S. 1717 in comparison to the corresponding provisions in the May-Johnson bills. I refer to the constitution of the Atomic Energy Commission as provided in section 2 on pages 3 and 4.

This section provides for a commission of five members with quite substantial compensation, who are prohibited from engaging in any other business, vocation, or employment, and for whom there is no specified term of office. This Commission is responsible both for the determination of policies, within the limits and directives established by the Congress, and also for the administration and execution of these policies. In my judgment this is an inferior type of organization and subject to serious objections, of which the following are important.

1. It is not good administrative practice to have the administrative and executive functions in the same hands as the policy-making function. This is illustrated in every type of significant organization in our country. Starting at the top, in our Federal Government the policy-making function is vested in the Congress and the executive function is vested in the President. In every business organization the policies are ultimately set by the board of directors and carried out by the president and his subordinate officers. In every university the ultimate policy decisions are made by a board of trustees and executed by the president and his faculty. The same organizational pattern is found in the great altruistic foundations, like the Rockefeller Foundation, the Carnegie Corp., the Brookings Institution, and the larger hospitals. It is not an accident or mere tradition that the policy-making and executive functions have been so universally separated. It is a result of experience and of the survival of the form which in the long run has proven most advantageous. It is therefore running contrary to all the background of experience to entrust so important an enterprise as the development of atomic energy to one small body of men responsible for their administrative acts and executive efficiency to themselves as policy makers, subject only to the ultimate control of the Congress. It would be much wiser I believe to have a policy-making commission or board subject in over-all matters to the President and the Congress, but, within their directives, determining the policies and in a position to evaluate the carrying out of these policies by an administrator.

2. While the Commission as set up in section 2 could command the services of good men it could not command the services of the best men, and certainly the best wisdom and competence anywhere available will be required to direct and develop the potentialities of a program of such importance to our nation and to civilization. I believe it should be made possible to bring in the policy-making function men of such wisdom and statesmanship, for example, as Elihu Root and Newton D. Baker, if they were now alive. It should be possible to draw on the services of some of the most expert and mature scientists and engineers. It should be possible to bring into the Commission the heads of some of the most important departments of the Federal Government intimately concerned with atomic energy. If the Atomic Energy Commission were established in accordance with section 2, it would immediately rule out from membership all men of this type, yet I feel sure that it is most important that men of such qualifications should be eligible for appointment to the policy-making commission.

3. I believe that the implication of indefinite tenure of membership on the commission is unwise because, in such a new and actively developing field as atomic energy it should be possible from time to time to bring in new blood and new ideas, and for this reason I believe that there should be a term of appointment long enough to insure experience and full competence but not so long as to permit the Commission to fall into a bureaucratic rut.

4. I do not believe that the policy-making function of the Commission should require full time, although it certainly would require very substantial time; in fact I do not believe that the policy-making function could long be very effectively carried out by men who are restricted, as in this bill, from participating in other business, vocation or employment. This objection of course does not carry over to the administrative and executive functions because here certainly there must be a full-time staff for whom this job becomes a career.

5. I believe it undesirable and also unnecessary to provide substantial compensation for the members of a policy-making commission, as distinct from the administrative staff. The salaries proposed in this bill of \$20,000 or \$15,000 per year are generous for governmental employees. However, for the type of individual who seems to me to be called for in establishing our national policies on atomic energy, this monetary reward would not be an inducement. If it were the inducement he would not be the right type of person for the job. This right type of person should be one who took the job as a public duty because of its interest and importance, and there is plenty of past experience to indicate that such men will be available. I would furthermore point out that these proposed salaries are sufficiently attractive to create strong pressures for appointment by men seeking good governmental berths. This is not the type of man to whom

the policies in so important an enterprise should be entrusted. I should interpolate here by saying that I would have very considerable faith in the President and the Congress in their desire to make the best possible appointments to such an important post, but I simply point out that in my judgment the set-up described in section 2 would be a severe handicap.

6. I realize that in some quarters there appears to be a feeling that the affairs of government can only be safely entrusted to men on the Government pay roll. In a great many cases this is necessary and inevitable in view of the nature of the job and its responsibilities. In other cases, however, it is not necessary, or in my judgment even desirable, and I think that this is one of such cases.

The fact that voluntary services to the Nation can be secured and efficiently rendered is amply demonstrated by the performance of the Office of Scientific Research and Development during the past war. Perhaps the best long-term example is that of the National Advisory Committee for Aeronautics, which has operated for over 25 years in a very distinguished and fruitful manner under the direction of a committee serving part-time and without salary, yet devoting a combination of time, energy, and talent because of the interest and importance of the job. No full-time paid commission, for example, could have commanded the services of the three past chairmen of the NACA, President Ames, Dr. Bush, or Professor Hunsaker. At the time of the last war, recognizing the great importance and technical character of aviation, the Congress established the National Advisory Committee for Aeronautics in a manner to command the services of the most competent personnel in the country, and to operate in a manner as fully as possible free from political pressures. It is the same kind of action which I believe is now called for to make the best progress in this similar situation of atomic energy, namely, a situation of great national importance and of highly technical character.

For reasons such as the above, therefore, I believe that section 2 of S. 1717 is unwise and is inferior to the alternative type of organization proposed in the May-Johnson bills which provide for an unpaid, part-time policy-making commission, with members serving a definite (9-year) term, and with a paid, full-time administrative organization under an administrator appointed by the Commission (or it might alternatively be nominated by the Commission and appointed by the President with the approval of the Senate).

I believe that this issue is so important that, if I had to express a preference between the two bills as now written, I should state my preference for the May bill, in spite of the fact that I like the clarity and emphasis of S. 1717 in other respects.

Permit me to conclude this statement with brief comments on the May bill, H. R. 4566, and the Johnson bill, S. 1463. I believe that in their original forms these two bills were essentially identical. The revised May bill, H. R. 4566, is a decided improvement over the original May bill and in my judgment is preferable to S. 1463 in those portions in which they now differ.

I believe that H. R. 4566 is a good and acceptable bill as it now stands, except for one feature, the criticism of which also applies to a slightly greater extent to the corresponding portion of the Johnson bill.

In the Johnson bill, S. 1463, page 12, lines 14 to 20, there occurs this statement:

"The Commission is authorized to extend the provision of this subsection (b) to any deposits from which there can be refined or produced other metals or substances determined by the Commission to be readily capable of or directly connected with the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy."

I suspect that in drafting this bill it was not realized that this phraseology would give the Commission jurisdiction over probably every material of which the earth is composed. My physicist friends who are closer to the new developments than I am, tell me that there is probably only one of the entire group of 92 chemical elements of which the earth is composed which has not been proven in one way or another to be "directly connected with the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy." It was certainly not the intent, nor would it be the desire of the Congress, to place under the Atomic Energy Commission jurisdiction over all the materials of which the earth is composed. As I once remarked, this would leave very few human activities except contemplation and religion outside the jurisdiction of the Commission.

The point is that modern science has found ways of transmuting a very large majority of the chemical elements, transforming them from one element to some different element, and in the process of nuclear fission quite a variety of common

chemical elements are produced as uranium-235 or plutonium (explode) by fission. However, all but a very few of these transmutations are of only scientific interest. It is only a very few, notably the fission of uranium-235 and of plutonium and their attendant processes which involve atomic energy in foreseeable useful or dangerous form. Consequently the above wording in this bill should be re-drafted so as to include only those aspects of nuclear processes which are significant from the standpoint of usefulness or hazard.

The May bill, H. R. 4566, attempts to specify more exactly the desired objective by inserting the word "peculiarly," as for example on page 14, line 9, and page 15, line 10, and specifies the substances with which the bill is concerned as those which the Commission determines to be "readily capable of or peculiarly related to the transmutation of atomic species, the production of nuclear fission, or the release of atomic energy." This would leave it to the Commission to interpret the significance of the word "peculiarly."

While this is an improvement over the original phraseology, I believe that it would be still further improved by the insertion of an additional definition in H. R. 4566, page 30, immediately following paragraph (g), somewhat along the following lines:

"(b) The term 'peculiarly related to' means essentially involved in the production of fissionable material or release of atomic energy in processes capable of producing materials or energies in such appreciable quantities as to be commercially or militarily significant, or to constitute a national hazard."

In conclusion, therefore, I would summarize my testimony on these bills as follows. As they now stand I believe that the interests of the Nation would be better served by the May bill, H. R. 4566, than by the McMahon bill, S. 1717. If section 2 of S. 1717 should be modified to adopt essentially the type of Commission and Administrator provided in H. R. 4566, I then believe that S. 1717 would be the more advantageous of the two bills. If a bill like the Johnson bill, S. 1463, is to be followed by the Senate, I believe that it should be revised to conform with the May bill, H. R. 4566, and that both bills should define what is meant by "peculiarly related to" along the lines suggested above. Finally I would again emphasize, as I did in the beginning, the importance of prompt action. I deem prompt action so important that I would advocate passage of the May bill without changes, or of the McMahon bill with only the change in the constitution of the Commission, if by so doing a month or more of delay could be avoided. The desirable minor improvements could be made later in supplementary legislation.

Until the legislation is passed, and no time allowed to organize and educate the Atomic Energy Commission, it is essential that the Manhattan district be authorized and financed to continue its work vigorously.

The CHAIRMAN. Mr. Edward Teller.

STATEMENT OF EDWARD TELLER, PROFESSOR OF PHYSICS, UNIVERSITY OF CHICAGO

Professor TELLER. Mr. Chairman, members of the committee, my name is Edward Teller. I am professor of physics at the University of Chicago. During the last 7 years I have been working on the problem of atomic power. In the period leading up to Hiroshima and Nagasaki, I witnessed a strikingly fast and successful development. The main fact which I want to call to the attention of the Senate Special Committee on Atomic Energy is this: Since the surrender of Japan the scientific and technical development of atomic energy has practically come to a standstill.

Many feel that with the successful conclusion of the war there is no further need to develop atomic bombs. Development of bombs must depend on the international situation. As a scientist I do not think that I am in a better position than the average citizen to make a recommendation on the desirability of production of weapons. But many people will agree that peacetime work should proceed.

In the following, I shall attempt to give a crude outline of possible future developments of atomic power. I shall then discuss the

reasons which have been responsible for the lack of progress in the past months and which threaten to frustrate any vigorous development in the future. Finally, I shall outline the conditions which, in my opinion, must be established if successful work on atomic power is to be resumed.

Among the fields of future work, I should like to mention first the defense against the atomic bomb. Such defense may not utilize atomic power. Yet in connection with the atomic bomb the feasibility of defense must be uppermost in our minds.

It has been stated repeatedly that a satisfactory defense is impossible. I share this belief. Nevertheless, the difference between an unsatisfactory defense and no defense may be decisive.

Devices may be constructed which destroy a considerable fraction of atomic missiles directed against us. It is extremely difficult but not impossible to develop fast-moving defense missiles which are automatically steered toward approaching projectiles. To accomplish this end, scientific and technical developments similar in magnitude and success to recent work in radar and jet propulsion would be necessary.

In recent years development of aggressive weapons has outstripped the development of defense. The V-2 rocket and the atomic bomb are two instances of weapons against which, at present, no defense exists. The atomic bomb is in its earliest infancy and even a moderate amount of work may improve it considerably. Future bombs may become less expensive, may be easier to handle, and they may have a much greater destructive power. I am convinced that it will not be very difficult to construct atomic bombs which will dwarf the Hiroshima bomb in the same way that that bomb has dwarfed high explosives. In the near future, we can hardly expect that defensive measures will catch up with the means of aggression. Our present military advantage seems great. But the events of the last years show how quickly this situation may change. Only 3½ years of intensive effort were needed to make an atomic bomb. Unless the possibility of a future war can be eliminated, we are going to live in a world in which safety no longer exists.

I do not know whether international developments will make further work on atomic bombs necessary. I share the hope that the atomic bomb, together with other weapons of aggression, will be eliminated. But if it should be decided that we renew work on the development of the atomic bomb, it must be pointed out that, under present conditions, we are not prepared to do so.

Among the peacetime applications, extraction of useful power from chain reacting structures is first in economic significance. One must not expect any profound effects on our economic life in the near future, but specific applications may soon become important. One is production of energy in places which at present lack cheap power. Another is construction of smaller energy-producing units which will function for a very long period of time. It must be stated, however, that even these smaller units cannot be installed without a considerable weight of shielding, and they therefore cannot be used in cars or airplanes but only in fairly large-sized vessels. Progress toward all these ends has been, in the recent past, slow.

Use of radio elements which are byproducts of atomic power plants will have an extremely great influence in science, particularly in

medical science. Work with these byproducts will lead to a better understanding of living organisms, and the knowledge so gained will, in the end, help to save human lives. Progress in this direction has been practically negligible so far. In the past this was due to necessary wartime secrecy which made it impossible to distribute the radio elements among the men who could have made use of them. The publication of the Smyth report has changed this situation. The distribution of many radio elements would disclose now no important secret and would result in no real danger since, in appropriately small quantities, these byproducts are harmless. That the byproducts have not been distributed and used in the last months is due, to a considerable extent, to the inertia of the administrative apparatus required for the distribution. I believe that these materials should be made available not only to scientists in this country but to scientists throughout the world. This would be a gesture which would cost us little and would bring us great returns in good will as well as in the advancement of scientific knowledge.

Scientific use of byproducts will probably not be long delayed. All other phases of work on atomic power present a much more serious problem. This is so because scientists are returning to their academic work and the great majority of them have stopped being actively interested in work on war projects. There are several reasons for this.

Scientists are men who have chosen as their work the free investigation of nature. For this freedom they have sacrificed the expectation of a greater income which industrial or commercial jobs offer. They will not give up this freedom except for the most compelling reasons.

In times of peace many feel an understandable reluctance to work on weapons of destruction.

The present interim arrangements do not permit any long-range planning. No long-term contracts can be offered since the authorities are reluctant to make commitments prior to the passage of legislation.

Even if a person does decide to continue work on atomic power, he is hampered by the fact that long-range planning is ruled out. He feels, therefore, that his efforts are wasted.

With the success of the atomic bomb, a number of routine operations have become part of the program. In Los Alamos, N. Mex., which was, up to the present date, my place of residence, these routine operations threaten to crowd out research and development. Under such conditions it is extremely difficult to secure the cooperation of scientific personnel.

All of the security regulations are irksome. Some seem to be unnecessary, particularly since hostilities have ended, and some rules of secrecy are a serious hindrance to progress.

The development of atomic power and the construction of the atomic bomb were possible only because individual scientists working on these problems were willing to take the initiative and to assume responsibility. According to the nature of the organization in which we were working, and which continues to be in force, such individual actions were not encouraged and often met with resistance. Since the emergency has passed, few scientists are willing to act with such vigor unless they are both asked and encouraged to do so.

What can be done to induce a reasonable number of scientists to work on the further development of atomic power?

First, it is important that legislation should be passed to make long-term planning possible and thus remove some of the present handicaps. But the wrong kind of legislation will merely cause the present stagnant conditions to continue.

It must be clear that no pressure can bring about real progress in science or development. It is impossible to force a person to be inventive and resourceful.

More financial inducements will not suffice either, and Congress cannot insure progress by simply appropriating great sums of money. One of my young friends has recently accepted a stipend of \$150 per month because this stipend permits him to continue his studies and his research. In doing so he turned down a job with a salary almost six times greater. A certain amount of money will, of course, be necessary to give scientific workers enough leisure to go ahead with their task. But other conditions are not less important.

One of these is the removal of certain parts of secrecy regulations. Purely scientific data—that is, facts concerning natural phenomena—must not be kept secret. If such secrecy is continued, it will warp the entire research activity of any man who is involved in work on atomic power. He either has to sever relations with the scientific world not involved in the development of atomic power or he has to acquire a split personality, remembering in certain parts of his work only certain parts of the information available to him.

Furthermore, scientific facts cannot be kept secret for any length of time. They are readily re-discovered. If we attempt to keep scientific facts secret, it will certainly hinder us, but will hardly interfere with the work of a potential competitor.

The only secrets which can remain effective for a reasonable length of time are technical details of construction and industrial know-how. Indeed, these things cannot be easily communicated except by actual collaboration. As an example, I may mention the construction of cyclotrons. In spite of the fact that full details have been published, everyone had the greatest difficulties in reproducing these instruments except those men who had a chance to learn directly from the original inventors.

Another part of security which will impede progress is compartmentalization. During the work on the atomic bomb, an attempt was made to give each person only so much information as he needed to perform his specific task. Thus the field of vision of each individual was artificially narrowed down. He could not use his full imagination. He could not be fully useful. One great drawback in this system is that in scientific work no person can judge what information another man will need. Scientific progress results from a continued search for surprise. It cannot be planned or directed. Compartmentalization is the principle that your right hand must not know what your left hand is doing. In the long run this principle makes effective research impossible.

I believe that even if some secrecy must be maintained, it should be restricted to a few subjects on technical details. Secrecy regulations should be in a large measure entrusted to the people who themselves engage in the work.

Perhaps the most important requirement for successful scientific work is the encouragement of individual initiative. In organizing work on atomic power there exists the grave danger of too much

planning, of too great centralization. Thus a mistaken idea, a single scientific prejudice in the minds of the planners, may render the whole program barren. Such rigorous planning will, furthermore, repel the best scientific talent.

This danger cannot be avoided by good legislation but only by a reasonable administration of the law. But legislation may counteract overcentralization by earmarking a yearly sum for small projects, carried out at universities. These projects should not be under the direction of the central administration of atomic power. They should be responsible to the faculties of the respective universities. Their success should be judged after 3 or 5 years. If even 1 percent of the money spent on atomic power would be set aside for such long-range investments, we could be assured of valuable returns.

To obtain a systematic picture of the desirable relations of scientists to future work on atomic power, I shall consider the problem under five headings.

(1) WORK ON GENERAL SCIENTIFIC BACKGROUND AND ON EDUCATION

Scientists are most eager to engage in this work. If the traditional freedom of research is preserved and if some financial aid is given, this type of work will flourish.

(2) WORK ON TECHNICAL PEACETIME DEVELOPMENTS

One should attempt to carry out a considerable part of such work at universities but only under the condition that the work need not be kept secret. In the few cases where secrecy is necessary, the work should be carried out in special laboratories. In this way universities will remain institutions of free learning and enquiry. The special laboratories will have to employ some scientists and will use additional scientific workers as consultants.

The two fields of activity just mentioned contribute most in building up the technical and scientific potential of the country. Therefore, in the long run, these endeavors are the most important for national defense. If, however, short-range preparedness is necessary, other types of development become important.

(3) DEVELOPMENT OF WEAPONS

If this activity is judged necessary, it should be carried out in the most effective way. This means that secrecy should be reduced to a minimum. As much as possible of the work not subject to secrecy should also be carried out at universities. The rest must be done at special civilian laboratories with full-time and part-time participation of scientists. To secure the necessary scientific personnel for this work in peacetime will be difficult. The special laboratories must have, therefore, an exceptionally wise and liberal leadership. In my opinion, one need not, and should not, exclude participation by the armed forces.

(4) PRODUCTION OF WEAPONS

This work will never attract scientists and in the long run scientists are not needed in this work. The work should be transferred to the

armed forces or to a Government-controlled corporation, and, in either case, placed under the direct authority of the President of the United States.

(5) TESTING OF WEAPONS

This activity is of great interest to the armed forces and for the scientists as well. An atomic bomb may be regarded as a scientific tool. It allows us to find out facts of nature which cannot be found out in any other way. These tests cannot be effectively performed either by the scientists alone, who lack manpower, nor by the armed forces alone, who lack detailed information. Therefore, tests should be planned mainly by scientists, but, in the actual execution, the armed forces should participate to the greatest possible extent.

In my testimony I have repeatedly spoken of the further development of atomic bombs. I should like to say, in conclusion, that such development may lead to war, that a future war will be horrible beyond imagination, that none of the combatants will be spared, and, what is worst, that such a war may destroy the decency of those who survive it.

But I do not know by what measures the danger of war may be reduced. I have therefore restricted my testimony to the discussion of the one question: If any aspect of atomic power is to be developed, by what means can the necessary cooperation of scientists be obtained?

The CHAIRMAN. Thank you very much indeed, Doctor. There will be a future announcement as to the next session.

(Whereupon, at 12:20 p. m. the committee adjourned.)

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ATOMIC ENERGY ACT OF 1946

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

SECOND SESSION

ON

S. 1717

A BILL FOR THE DEVELOPMENT AND CONTROL
OF ATOMIC ENERGY

PART 3

FEBRUARY 7, 8, 11, 13, AND 14, 1946

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III

ATOMIC ENERGY ACT OF 1946

THURSDAY, FEBRUARY 7, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 457, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Tydings, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. Mr. Rafferty, I believe you are vice president of the Union Carbide & Carbon Corp.

Mr. RAFFERTY. I am a vice president and director of the Union Carbide & Carbon Corp.

The CHAIRMAN. We have asked you to come here this morning primarily to give us any views that you may have on the domestic legislation that is pending, that is, for the domestic problem.

However, I imagine we would like to have for the record a description of your company's part in this project as far as you can go with it within the requirements of secrecy. So would you give us a description of your company's part in this project?

STATEMENT OF J. A. RAFFERTY, VICE PRESIDENT, UNION CARBIDE & CARBON CORP.

Mr. RAFFERTY. Senator, I am glad to be here in response to your request to appear before this committee and to outline the activities of the Union Carbide & Carbon Corp. in this Manhattan project.

There were about six of the units of the Union Carbide & Carbon Corp. that participated actively in this work. There were the United States Vanadium Corp., the Linde Air Products Co., the National Carbon Co., the Electro Metallurgical Co., the Bakelite Co., and the Carbide & Carbon Chemicals Corp.

Over the last 20 years the United States Vanadium Co. has been occupied in the prospecting, mining, and milling of carnotite ores. These carnotite ores contain vanadium oxide to the extent of about 40 pounds per ton of ore, and these same ores contain about 5 pounds of uranium oxide, or a quarter of 1 percent of uranium oxide in the ore.

The region of production of these carnotite ores lies mostly in Colorado, Utah, New Mexico, and Arizona.

The extraction of vanadium oxide is a readily accomplished process, and the gang or tailings after the extraction of vanadium oxide contain the uranium oxide, which we piled up in our plant.

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I don't know how much you want to go into now, Senator, the different activities of the company.

The Linde Air Products Co. did its work mostly in Tonawanda, N. Y. The Electro Metallurgical Co. did its work in Niagara Falls. The Bakelite Corp. did its work in Bound Brook, N. J. The Carbide & Carbon Chemicals Corp. operated the Oak Ridge plant. That plant in Oak Ridge has been operating, as you know, and is operating today. I don't suppose I could go into any of the details, for security reasons, of the operation of that plant. I don't know what has been declassified particularly, and I would be rather reluctant to speak much about that.

Senator HART. I suggest, Mr. Chairman, that Mr. Rafferty give us some most useful information as to the use of the company's engineers, physicists, and chemists in the developmental work, with a view to indicating the magnitude of the company's work in the entire project.

Mr. RAFFERTY. Due to the experience that we had in all these different activities—for instance, the know-how of which I spoke in the prospecting, mining, and milling of ore—we had everything pretty much ready for the use of the Government when this project was launched, and we built and enlarged our facilities for supplying the project with the increased demands that the project required.

We dealt a great deal, of course, in a research way, and placed the facilities of our research laboratories, construction crews, and operating crews entirely in the hands of the Government.

If I were to go into the activities of the research laboratories, I am afraid I would again get into regions where I don't know whether I am at liberty to speak or not.

In the Oak Ridge plant, we not only cooperated in its design and construction, but we had to man that whole plant, which is probably the largest continuous operation in the world. Its operations were very similar to those of a large chemical operation, and we took plentifully from the operating personnel of the Carbide & Carbon Chemicals Corp. The Linde Co. likewise, in running their big plant up at Tonawanda, took several hundred of their personnel to operate it. That goes pretty much for the Electro Metallurgical Co. in Niagara Falls, who prepared the pure uranium metal for use by the Hanford plant in Washington.

We had to work out those processes in great detail, which we did by our technical forces, both the engineers and the research scientists that the Senator speaks of.

The Bakelite Corp. had to supplement all the work that had been done by the Columbia University in the researching of some of the most critical parts of the Oak Ridge plant.

The CHAIRMAN. You feel somewhat bound by security restrictions from giving a more complete description of the detail of the work, Mr. Rafferty?

Mr. RAFFERTY. In all this work, of course, we have participated in a very major way, but our company has pretty much shunned the limelight that has gone with this whole thing, very much because we took seriously the injunctions of the Government in connection with the security regulations.

The CHAIRMAN. Do you recollect how many men you had on your payroll in carrying out this over-all activity?

Mr. RAFFERTY: Oh, Senator, I would say perhaps a rough guess of 20,000 men. In the Oak Ridge plant alone, we have 10,000 men. I would imagine we had another 10,000 in all the other activities of our corporation.

The CHAIRMAN. When we were down there, Mr. Rafferty, we did not see so many men. That was one of the minor secrets of the occasion, the fact that there didn't seem to be such a large personnel in evidence as we went through the gas-diffusion plant which your company operates.

Mr. RAFFERTY. Of course the operations themselves in the gas-diffusion plant are very highly instrumented, and it doesn't require very many operators right at the scene of operations. But there are a great deal of auxiliary operations for conditioning and maintaining the equipment. We have a power plant down there alone, I think, that generates about 300,000 kilowatts to run that plant.

The CHAIRMAN. Did you erect that power plant?

Mr. RAFFERTY. We helped in the whole project. The power plant itself was built by the Jones Construction Co. The Oak Ridge plant was designed by the Kellex Corp., but we collaborated all the way through in the design and engineering of the job. The operation of the plant itself is entirely in our jurisdiction.

The CHAIRMAN. That is the entire gas-diffusion plant, as well as the electromagnetic process?

Mr. RAFFERTY. No; the electromagnetic process is operated by the Tennessee Eastman Co. We produce up to a certain purity of material, and then they take it on. The Tennessee Eastman plant, our plant—the gas-diffusion plant, plus the electromagnetic plant are pretty much classified as the Oak Ridge development.

The CHAIRMAN. During your work, I presume that you developed some new processes?

Mr. RAFFERTY. Yes, sir.

The CHAIRMAN. Did you develop any new gadgets or new inventions?

Mr. RAFFERTY. Yes, Senator, we would in that capacity in which we were serving—yes; quite a few.

The CHAIRMAN. Do you think that anything that your company or personnel has developed has any peacetime prospects for use?

Mr. RAFFERTY. Yes, sir.

The CHAIRMAN. Are there any of them that you could tell us about without, in your opinion, violating the security regulations? I leave that entirely to you.

Mr. RAFFERTY. I would say that, for instance, in our mining operations we have effected improvements that might be applicable in some degree to the mining industry in general in this country. In the Tonawanda plant, we have done some quite good work in effecting separating methods that we have developed which could be applied generally to industry. I wish I could expand more on that.

The Bakelite Corp. has done a very good job in some of their work. Carbide & Carbon Chemicals Corp., of course, has done quite an outstanding job in the operation of that plant. When you get several hundred outstanding chemical operators, the best improvements, I have found in my experience are after the project leaves the research laboratory and gets into the hands of the operators. There is a lot,

I think, that will develop to bring about industrial improvements in this country when this whole thing can be released.

The CHAIRMAN. Now, in the contract that you have with the Manhattan district or with the War Department—I believe it was with the War Department that you have your contracts?

Mr. RAFFERTY. Yes, sir.

The CHAIRMAN. Do you have any provision in there for treatment of patents of new inventions made during the course of this work?

Mr. RAFFERTY. Well, just what was specified in those contracts, Senator, I cannot state definitely. I think I might sum up that whole thing by saying that we assumed that all this work that was financed by the Government was certainly not our property, and I don't think we made any effort at all to cover the thing by patents. We even threw in our own know-how in these different operations, and we weren't specific as to how much publicity might be given by the Manhattan district to those patents of our own.

We were under such strain and stress in this whole work that the question of where the proprietary ownership lay was a purely academic one with us. I assumed that the Government would keep control of those improvements or patents that were effected by the Government money.

The CHAIRMAN. Was that your belief as to what should be done on all patents or all inventions that were made, and improvements that were made in the course of this project?

Mr. RAFFERTY. Well, my general conclusion in that direction would be that if the Government has financed this work, they employed private industry to go ahead and carry out the job. Now, I don't think that industry has got any proprietary interest in that sort of thing. There will be, of course, disputed zones wherein the previous know-how of industry probably has made the major contribution to certain improvements that were effected in the course of the work, and I think in that disputatious zone it certainly could be compromised in some fair-minded manner.

The CHAIRMAN. As far as you know, your company has filed no claims for patents on anything developed by your company in the project?

Mr. RAFFERTY. And financed by the Government?

The CHAIRMAN. That is right.

Mr. RAFFERTY. I don't recall any, and I would be surprised if there are any, Senator.

The CHAIRMAN. Do you know anything about the patent situation of other companies that had to do with the project, whether they have filed or not?

Mr. RAFFERTY. Only by roundabout hearsay, and I don't know whether there is anything to it or not. I understand some of the companies did file patents, but I didn't get that from the principals of the companies themselves; I got it more or less by hearsay.

The CHAIRMAN. Have you, Mr. Rafferty, given any consideration to S. 1717, or any of the other legislation?

Senator HART. May I ask him one question to clear up before you begin that?

The CHAIRMAN. Surely.

Senator HART. Mr. Rafferty, this zone of dispute as to whether the inception of an idea which would be patentable and was carried

on incident to the development work of the Manhattan district—in the case of your company, is that a zone of considerable area?

And also, as another part of my question, what is the position of the individual who was an employee of your company, who had an idea before he began to be paid by the Government indirectly that he may have developed incident to his work with the project?

Mr. RAFFERTY. Well, the zone of possible dispute between ourselves and the Government is so slim, Senator Hart, that we would not give it much heavy thinking at all. I don't imagine that anything in this disputed zone would be momentous enough for us to do any more than give it to the Government, if they made much of an issue about it.

Now, in the case of employees who may have developed some previous know-how, that would be a company matter, and I think that ought also to lie in the same limitations of my first statement.

Senator HART. The individual who was one of your employees would not acquire patent rights in his own right?

Mr. RAFFERTY. No, that would be a company right, Senator.

The CHAIRMAN. Mr. Rafferty, I presume you have given some consideration, because of your deep interest in the project and the extent to which you have been engaged in it, to our present proposal for handling the Manhattan district.

Do you believe that there should be a Government monopoly of the making of fissionable materials, or do you think it permissible to farm it out to private contractors?

Mr. RAFFERTY. Senator, I have read the McMahon bill. I think in the main it is a very good bill. I have a deep appreciation of the fact that the success of this effort up to now has been due to a group effort of Government, industry, and science, and I think it was the best way to effect that success in the emergency in which we were working.

But I do think now that the McMahon bill outlines very well a system of carrying on that we should work under. I have only had one thing in mind to debate about, which was the question as to whether three or five men could carry on the tremendous ramifications that their duties are going to involve. I noticed the other day that the Commission was suggested to be cut down from five to three.

The CHAIRMAN. The President suggested that.

Mr. RAFFERTY. I think the people should have pretty much control of it. I think that considerable farming out might well be followed. I am at a loss to see that the Commission can have 100 percent success in this thing unless we tap and utilize the tremendous knowledge that industry has in this thing.

There is no doubt in my mind—and I suppose I speak clumsily—that industry did the heavy part of this job, and I think it would be a great loss to the country and to this Commission, who is acting for the country, if they are not in a position to, and do, utilize that information. I would hope that industry's contribution would be pretty much eleemosynary as far as the Commission goes.

The CHAIRMAN. Well, of course, there is nothing in the bill that would prevent the Commission from drawing upon industry for anything it could possibly get. You realize that?

Mr. RAFFERTY. Yes, I realize that, Senator.

I suppose the composition of the Commission will be the determining factor as to how much of that tapping of industry's know-how will

be effected. After all, the success of anything depends upon the personnel and the management of it.

At one time I thought that a commission of that kind could have representation from industry, science, and Government, the Government being represented by Congressmen and Senators, a representative of the Chief Executive, and a representative from the Supreme Court. I don't know whether it could be done or not, but I do feel this, too: Naturally the military, I suppose, is more or less in bad with everybody because they have necessarily been shoving everybody around because they had to in the war, but I do realize that the military always has utilized the achievements of research in industry in the possible applications of improvements for military uses, and I do think that the military should have access to the progress that is effected in atomic energy over the years—although I certainly don't think they should be in control of it.

If it looks as though, in order to effect civilian control, we should just have this three- or five-man Commission, it is perfectly all right with me. I have made the point that that Commission should have ready access to and be welcomed by industry to help them out wherever they could, and farm out this work, farm out jobs to the industrial research laboratories, as well as the university laboratories.

The CHAIRMAN. There is a provision for that.

Mr. RAFFERTY. I realize that.

The CHAIRMAN. And there is also a provision in the bill providing for a Division of Military Application set up under the Commission.

Mr. RAFFERTY. Yes.

The CHAIRMAN. You stated that you believed we ought to have civilian control in the matter?

Mr. RAFFERTY. Oh, yes; I think it should be in civilian control. I suppose industrialists are civilians, and university scientists are civilians. I just would hope that the composition of that Commission would be such that men who have been through the whole project could be on that Commission. Otherwise, it is going to take them a great deal of time to learn it.

The CHAIRMAN. You will recollect that in the bill there is a provision permitting the Commission to appoint an advisory board, or boards, as it may see fit. I presume on any advisory board that was set up that industry, science, and Government might well be liberally represented.

Senator HART. Following up the chairman's last question, what is your conception of the status of an advisory board under those conditions, in case their advice is not accepted, or there is too much disagreement? Would you have any fears that the ability to advise of such a board would not be fully utilized under those conditions?

Mr. RAFFERTY. Yes, that would be my fear, Senator Hart. I would rather reverse it and have the advisory board put over the Commission. I suppose that is not practical.

Senator HART. You said in response to the chairman, as I understood you, that you rather preferred the board of director over the management system which obtains in industry; is that correct?

Mr. RAFFERTY. That is correct, sir.

Senator HART. Now, would you carry that a little further and give us your ideas, just off the cuff, of how you would today constitute that board of directors?

*Atomic Energy
+ Control*

Mr. RAFFERTY. Well, I would have science represented on that board of directors, and by science I mean perhaps some university scientists, someone in academic circles, one or two. I would have one or two industrialists. I would have, if possible, somebody in Government—maybe a member from the House and a member from the Senate. You might take the representatives from the Military Affairs Committees from those two bodies, if you would, and could combine some military flavor with the governmental end. I would hope to get somebody from the State Department, and if we could get one of the busy Justices of the Supreme Court, I would imagine that kind of a board would appeal to the people as one which would not be in the control of the military, and would be represented a lot by the branches of the Government itself.

My whole thought in this thing, Senator, is to instill confidence in the people that this atomic energy program would be carried out in the hands of the people. I am afraid sometimes that a commission—whether you call them civilians or not—might turn into a sort of bureaucratic body, and wouldn't have the vision necessary to carry this thing on. I am just wondering whether you can get the personnel on a commission like that that would carry this thing on in the all-embracing way it ought to be done.

I guess that is about all I could say.

Senator HART. The chairman of a board of directors in industry is a very important person who actually works full time, is he not?

Mr. RAFFERTY. The chairman of the board of directors, yes; he is generally a full-time employee.

Senator HART. Would you use that same idea if you were setting up the Commission, and make the chairman a full-time man highly paid—that is, as highly paid as the Government could pay?

Mr. RAFFERTY. Well, I had visualized this advisory board, Senator Hart, as not a full-time body. I had visualized that board as a board that would meet at appropriate periods.

Senator HART. I was not talking about the advisory board, but the board of directors idea and the chairman of the board.

Mr. RAFFERTY. Well, if that board was going to meet—you are emphasizing now the question of the chairman of the board being full time?

Senator HART. Yes; I am speaking of the chairman only.

Mr. RAFFERTY. Well, of course, I would imagine that the chairman of that board would not have to be a full-time employee, Senator. He would preside over the board meetings, but that board, as I see it, would supervise as directors do, the workings of this Commission, and they would see that the programs that were outlined perhaps by the Commission and concurred in by the advisory board, or amplified by the advisory board, would be carried out.

Now, I would imagine those meetings could be carried on by men who are not putting in full time. If you were to get industrialists and men of science on that board, I think there are men that probably wouldn't want to give their full time to this thing. It was merely to carry out my thought of the short-comings, maybe, of the personnel that you will have on the Commission, that you could put on maybe men of a little larger viewpoint and more broad experience. It will be very difficult to get qualified industrialists to spend their whole time on a Commission like this. The industrialists I know of that

have been occupied on this project would be difficult, if not impossible, to get full time; but you could get them on a part-time basis where they would be serving maybe 1 or 2 days a month, or something of that length of time.

Senator HART. Then, Mr. Rafferty, you would not in this instance think that the chairman of the board—call him that for the present—would be so highly important and would find so much to do that he at least would have to devote his full time to it?

Mr. RAFFERTY. No, sir; I do not.

Senator HART. One other thing. It is usual to have management—that is, the president and certain vice presidents—members of the board of directors, is it not?

Mr. RAFFERTY. Yes.

Senator HART. Would you follow that idea if you were setting up this Commission, or board of directors, whichever you call it for the present?

Mr. RAFFERTY. I think, Senator, that I wouldn't have anybody in the Commission on the board. Is that what you meant?

Senator HART. No; I am rather drawing an analogy between the board of directors to become really the Commission, with management being full time and separate from that.

Perhaps you can talk straighter on this if I throw you back to the bill that is in the House. Now, are you familiar with the May bill?

Mr. RAFFERTY. Not very, Senator; no.

Senator HART. That has a different approach, a different solution to the problem of the top-line management. You have not studied that bill?

Mr. RAFFERTY. No; I was out of the city on a protracted visit to our plants in the West when that bill came out, and I did not have a chance to go over it thoroughly. I didn't study it as I have the McMahan bill.

Senator HART. I have no further questions.

The CHAIRMAN. In that May-Johnson bill, which Senator Hart has referred to, the provision is for a board of directors—not by that name, but that is the idea—and then the board appoints the Administrator, who is not subject to Senate confirmation. All of the very wide powers that are given to the part-time Commission are also given to the Administrator. The Administrator is not removable by the President, and in order to get rid of him you would have to remove, I think, five of the nine commissioners in order to get at him. He also has the power to determine—true enough, in consultation with the part-time Commission which would meet one or two days a month—how much fissionable material was made and how many bombs could be made.

There is also a provision in the bill which waives the prohibition against a member of the Military Establishment serving in a civilian job, so obviously the intention was to have the Administrator a military man.

Secretary Wallace, when he was up the other day, suggested that perhaps the intention was to make the Assistant Administrator a Navy man, inasmuch as there was a requirement that the Administrator must tell the Assistant Administrator everything.

Now, what would you think of that set-up?

Mr. RAFFERTY. Well, the future I visualize for atomic energy is an entirely peacetime one to make people's lives better and better all the time. I am not looking at this thing from a military standpoint at all. I am praying that the efforts of the world to maintain permanent peace are going to win out, and I wouldn't want to be in favor of a set-up like that.

I believe that the appointees of this Commission should be under the jurisdiction of Congress and the President.

Senator HART. Of the Commission?

Mr. RAFFERTY. Of the Commission. At the same time, as I say, we expect our military to defend us in time of crisis, and I would expect the military to have their eye on the developments that are to come out in atomic energy, and utilize them to the limit, if conditions warrant.

I presume that there is going to be a strong liaison between this Commission and any commission that the UNO sets up, and that is why I thought that on this board of directors the State Department might be represented. I would perhaps be in favor of the Secretary of State to be the chairman of the board of this body I speak of, so that the people engaged in this country will be closer in touch with the advice of a man in his position. He is the man that is going to have to take care of the foreign affairs.

That is why I also outlined a board that would, by no stretch of the imagination, be under the control of the military. I assumed that the congressional representatives, if they were the heads of the Military Affairs Committees, would still be Congressmen.

From what I hear you say about this set-up, I wouldn't be in favor of that; no.

The CHAIRMAN. This project, it has been estimated to us, may cost the people of the United States as much as a half a billion dollars a year. I am hopeful myself that it can be done much more reasonably than that.

Do you know of any business or private business of a comparable size that would operate with an administrative staff which would only meet around 1 or 2 days a month?

Mr. RAFFERTY. That would cost —

The CHAIRMAN. That much money. We have this tremendous cost, you see. Now, as I understand your thought, you are proposing more or less an absentee board of directors that would set the policies for this half-billion dollar expenditure of Government funds.

Does it strike you that that is a control a little too far away from the source of the power to make you a little wary of a proposition like that?

Mr. RAFFERTY. You are not speaking now of the May bill, Senator?

The CHAIRMAN. No; I am talking about your suggestion.

Mr. RAFFERTY. About my suggestion—if I may say "my," for I think perhaps some others have thought of it, and maybe I was not the first one to think of it.

Of course, a half billion dollars you speak of involves also the expenses entailed in running these plants?

The CHAIRMAN. That is right.

Mr. RAFFERTY. Oak Ridge, Hanford, and Los Alamos, and wherever else they operate.

The board of directors that I am visualizing would to be a working board of directors. I am familiar with working boards of directors, and I have heard a lot about those that deal more or less in absentee attendance.

These men that I would suggest on this board, however, would be workingmen and would stay in close touch with the program that the Commission outlines, and which the board would approve.

The CHAIRMAN. In other words, you are for a full-time commission?

Mr. RAFFERTY. A full-time commission.

The CHAIRMAN. To operate the plants?

Mr. RAFFERTY. That is right.

The CHAIRMAN. Your thought is that over and above them, and subject to their approval or rejection, there ought to be a part-time advisory board of directors?

Mr. RAFFERTY. That is right.

The CHAIRMAN. That is your thought?

Mr. RAFFERTY. That is right.

The CHAIRMAN. Rather than having the board of directors of outside men who would give 1 or 2 days underneath the Commission advising the Commission, but not binding upon them?

Mr. RAFFERTY. I think that the advisory committee ought to have some—whether it is confirmation, at least concurrence with the Commission. The Commission ought to concur. I think that if you just have an advisory board whose advice might be pretty much not concurred in by the Commission, after a while you wouldn't get very ready response and ideas from this board.

Senator HART. Then, Mr. Rafferty, in which—either the Commission or the board of directors—would you place, under the direction of Congress, the final power of decision?

Mr. RAFFERTY. Of the Commission and the board?

Senator HART. I am confused now as to which you mean, whether you would have the board of directors have the final power of decision, or the Commission, which the chairman has just mentioned, of three or five members. Which would it be?

Mr. RAFFERTY. Well, I believe that at least we ought to go so far as to say that the Commission's recommendations would have to be concurred in by the advisory board, and if there is any stalemate arrived at in that sort of a set-up, maybe Congress ought to decide it.

I wouldn't be loath to put the Commission under the board of directors as far as confirmation of their findings is concerned, because I think that board will have broader experience, and I would imagine that the scientific and industrial men there would be fortified with an awful lot of background in their own spheres of influence, and could probably take a broader aspect than the caliber of men of that Commission. If you knew what the caliber of that Commission was, I could say probably what the final say of the advisory board would be.

Senator HART. Under any salary which the Federal Government can pay, what is your estimate of the caliber that we would get for men who would devote full time to the work? Federal salaries are relatively low. Would we be able to get men who were sufficiently high grade to have the full power of decision under Congress and the President?

Mr. RAFFERTY. As to the type of men I have in mind, I question, Senator Hart, whether you could get them for that money. At the

same time, I think that the provision for the salary is not niggardly; but the men of industry that might help to back up that Commission on an advisory board are men who would probably not want to leave industry at the present time either because they might be getting more than that salary today, or because they see the future holding out for them higher rewards than that.

Senator HART. Whereas, with an advisory board you would rather apprehend that their status might become not too good?

Mr. RAFFERTY. I had in mind perhaps a different caliber of men on the advisory board than you would get on the Commission and, as I say, these men, on the advisory board then would fortify that Commission with judgment and experience which the Commission hasn't got.

I would imagine that these men on the advisory board would be the type of men who would only want their carfare paid, their transportation, if the Government saw fit and wanted them to take it. I am not looking forward to any salaried men on that board strictly from Government money.

Senator HART. You are speaking now of the advisory board as provided for in Senator McMahon's bill, for which you have, quite properly, expressed an admiration. That is what you are speaking of now, and not the board of directors idea which would really control?

Mr. RAFFERTY. Well, I first was talking about the advisory board and I think the Senator had pointed out that a provision was made in the bill for an advisory board to be selected under the Commission. I think I did say to the Senator that I would prefer, if I had my way, to make the advisory board over the Commission, and I still think so.

The CHAIRMAN. That is, your basic thought in that is your doubt as to the caliber of men who would be appointed on a five-man commission, or whatever number Congress finally decides; and underlying that is, of course, a belief that you cannot get the best men to serve on a full-time commission of this kind.

I might say to you, Mr. Rafferty, that I envisage membership on this Commission as being on a comparable basis, a comparable position of honor, with membership on the Supreme Court.

I think you, who are so imbued with the importance of this after working on it, and I, knowing much less about it, realize the tremendous force expended and let loose on the world, and the great power any body of administrators will have in administering a bill for its control.

Do you not feel that there would be a considerable appeal on the basis of honor, on the basis of public service, to bring the proper men to the Commission to operate this on a full-time basis, the same inducement that goes out to a Senator of the United States who might make \$150,000 a year but who is willing to come to the Senate and devote 14-hour days to his work, or to the Supreme Court Justice who gives up \$150,000 a year in private practice, as Charles Evans Hughes did, as Owen Roberts did, as Chief Justice Stone and Robert Jackson did, or to men of the caliber of Stimson and Forrestal? Have you given any thought to those considerations?

Mr. RAFFERTY. Yes, I have, Senator; and, as I said, if that Commission of the type of men you speak of is bulwarked with understudies who can talk to industry and to the scientists and who can see that the deals that are made with the scientists are understandable to all these

people. I agree with you that you can get that type of man. But this thing is so involved; every day there is some new development in connection with this atomic energy, and I question whether civilians can stay with it. Heaven knows it is giving a lot of us who have a little smattering of the thing a difficult time to stay in touch with it. But if you take three or five of the men you are talking about, men of the caliber in Government work today, and they have a host of scientists, industrialists, and engineers around them to advise them, that will aid them in making the proper steps to develop this thing to its utmost so that we will not be behind the flag in comparison with other nations—and that is very important—then I think that is all right.

The CHAIRMAN. A commission composed of men of the caliber that I have suggested, with an advisory board composed of some of the best minds of the country in the field would certainly be, in your opinion, conducive to fair operation and a good and progressive operation of this project, would it not?

Mr. RAFFERTY. Yes, sir.

The CHAIRMAN. So it comes right down to this basic fact: Are we so morally bankrupt in this country that we cannot get five citizens to come and serve their country, and to serve the future of the world and the future of their country with honor and dignity, at a \$15,000 salary? That is really what it comes down to, isn't it?

Mr. RAFFERTY. That is correct, Senator. I don't doubt you can get five men of that kind, and that is why I supplemented my first remarks by saying I hoped they had a good advisory board, because the type of men you outline are the type of men who should make this Commission very successful.

But if you don't get that type of men, again going back to my remark that the composition of the personnel of the Commission is going to have a lot to do with its success, I cannot see where an inferior type of personnel is going to get the type of men I have in mind for an advisory board.

Senator HART. Mr. Rafferty, this parallel to the Supreme Court—and I don't wish to embarrass you in any way with this question—but does that weigh so heavily with you in view of some appointments which have actually been made to the Supreme Court?

Are you so fully satisfied with all the appointments that have been made to the Supreme Court over the last 50 years, let us say, that you feel that is an apt parallel to draw?

Mr. RAFFERTY. You mean to appoint one man from the Supreme Court on this board?

Senator HART. No; the composition of the Commission, the caliber of the men.

Mr. RAFFERTY. Oh, I would say that that would be a pretty marvelous commission if it approached the caliber of the Supreme Court appointees.

Senator HART. That is, you in your own experience and your present status as a citizen of broad experience, would have no particular fears as to the composition of that Commission under the terms of the McMahon bill as it now stands?

Mr. RAFFERTY. That is right, Senator. I would have no fears whatsoever.

Senator HART. You think that adequate men would be chosen and would accept?

Mr. RAFFERTY. I had not conceived, frankly, of that type of man accepting this job because it is so completely out of his former lines. I conceive that perhaps an outstanding physicist, and outstanding fellow who knew engineering, and maybe some outstanding fellow in the mining fraternity would have to be on this Commission. Now, if you are going ahead and selecting men of that kind, and have these men fortified with the technical fellows, I think that is fine.

Perhaps not enough emphasis in the bill, Senator McMahon, has been placed upon the type of men who would be on this advisory committee.

The CHAIRMAN. Except that they are confirmable by the Senate, and the framers of our Constitution wisely put that provision in there.

I have a little difficulty in following your thought that it would be impossible to get the proper caliber of men. I just don't agree with you on that. After all, it would be a pretty poor way if we had to weight our own Army and Navy with a board of directors vetoing the action of the Secretary of War or the Secretary of the Navy.

Mr. RAFFERTY. Well, perhaps the reason why I was anxious to suggest this board of directors or advisory committee is because we will be dealing with foreign nations, for one thing, and I visualize the Secretary of State or one of his assistants on this Commission. I visualize plenty of congressional action on appropriations, and what not, and I thought perhaps that could be more intelligibly put before Congress if the Senate and House had representatives thereon.

Senator TYDINGS. Let me ask you a question here, if I don't interrupt the chairman.

You want the advisory committee because you assume in your statement that the membership of the advisory committee—all things considered—will have a superior and more detached point of view for the welfare of this enterprise than the Commission itself?

Mr. RAFFERTY. That is right.

Senator TYDINGS. And you want the advisory committee to be a policy-making committee, and the Commission to be in the position of executing and carrying out that policy; and your feeling is that if you have this detachment that is based primarily not on salary, but on knowledge, that the better policy will prevail than if that is put under the Commission?

Mr. RAFFERTY. That is right.

Senator TYDINGS. So that the compensation of the advisory committee is secondary.

Mr. RAFFERTY. It is immaterial, sir.

Senator TYDINGS. Now, wouldn't you accomplish the same thing if you made the advisory committee the Commission, and put under it the executives to carry out the policies of the advisory Commission?

Mr. RAFFERTY. That is right.

Senator TYDINGS. In other words, let's assume that we name the advisory Commission with no salary except a modicum to take care of expenses, travel, and what not?

Mr. RAFFERTY. That is right.

Senator TYDINGS. And then under that there was a permanent staff carrying out those policies.

In that contingency, how many meetings do you visualize the advisory committee—I am going to keep that old nomenclature—

would have to have a year in order to direct the executives who would carry out its policy?

Mr. RAFFERTY. Oh, I would say, perhaps as a suggestion, 1 day a month.

Senator TYDINGS. One day a month?

Mr. RAFFERTY. Yes.

Senator TYDINGS. It is only fair to assume that at the beginning they would probably have to meet more frequently?

Mr. RAFFERTY. That is right.

Senator TYDINGS. So I am assuming you are looking at it after it has been in operation for 6 months.

Mr. RAFFERTY. Yes.

Senator TYDINGS. Then you visualize that after that, if they would come once a month to a meeting, how long would they stay in session?

Mr. RAFFERTY. I would say all day.

Senator TYDINGS. Do you think they could do it 1 day a month?

Mr. RAFFERTY. I think if they attack the thing early enough in the morning, and stay a little late in the afternoon, they could do it.

Senator TYDINGS. A great deal of the thinking would be done, I suppose, prior to their convening?

Mr. RAFFERTY. That is right.

Senator TYDINGS. Do you visualize that there would be such a meeting of the minds on general policy that they could transact business in a single day?

Mr. RAFFERTY. Well, as I visualize this advisory board, they would have an opportunity between meetings to discuss the weighty problems with their associates in these different companies that have been occupied in this enterprise, and I should think every organization would lay itself ready to co-operate.

~~Senator TYDINGS. Let me pursue that just one step further. Do you estimate that it would be possible to attract the caliber of men to the advisory Commission which you have described here if it were necessary for them to come 1 or 2 days a month with no salary except expenses for the high honor involved therein?~~

~~Mr. RAFFERTY. I certainly do.~~

~~Senator TYDINGS. You do?~~

~~Mr. RAFFERTY. Yes, sir.~~

Senator TYDINGS. And you are somewhat fearful that if that policy of honor, you might say, or service without compensation is discarded, that the job may become a political one wherein some people may be put on there without that high degree of approach which your testimony seems to imply, and so you are fearful that the regular commissioners, whom you have heretofore described, will be of an inferior type to the advisory Commission.

Mr. RAFFERTY. When Senator McMahon puts up men of the caliber of the Supreme Court appointees, or Senators of the United States, he is changing my viewpoint as to what I had visualized as the composition of this committee.

Senator TYDINGS. How about making the salary larger than \$15,000 a year? Do you think that would attract these exceptionally fine men who are well qualified in their line?

Mr. RAFFERTY. It wasn't perhaps so much the salary that I had in mind as the fact that industry today, which has had these men in this job, has a lot of men which I know would serve on this advisory

committee for nothing, because they are making more than \$15,000 or \$20,000, and they have no ambition to leave their company and industry. There are a lot of men that don't get as much as \$15,000 or \$20,000, but who hope some day to get beyond that and have cast their lots with industry.

Senator TYDINGS. If there was a conflict between the policy laid down by the advisory committee and the permanent Commission, to differentiate between the two, you would want the bill so drawn that the advisory committee was the directing force and the subsidiary permanent Commission couldn't overrule its proclaimed policy, or deviate from it?

Mr. RAFFERTY. Yes, I would say that there ought to be at least a concurrence between the two bodies.

Senator TYDINGS. And if there is a disagreement, the advisory committee's decision would be paramount?

Mr. RAFFERTY. I would say that would be a good way to leave it; yes, sir.

Senator TYDINGS. So what it comes down to is that you make the advisory committee the Commission, and make the permanent staff—which we designate as the Commission—really executives under the advisory Commission?

Mr. RAFFERTY. That is right.

Senator TYDINGS. What you are arguing is that instead of having a commission which sits all the time, you would have a commission that was assembled from time to time, at least once a month, to proclaim policies; then you would have a chief executive under it and other assistants who would carry out that policy?

Mr. RAFFERTY. That is right.

Senator TYDINGS. So you are really arguing for a nonpaid commission of the highest type?

Mr. RAFFERTY. That is right.

Senator TYDINGS. With executives under it?

Mr. RAFFERTY. That is right.

Senator TYDINGS. As preferable to a permanent commission that would meet all the time?

Mr. RAFFERTY. That is right.

The CHAIRMAN. Mr. Rafferty, it is of course one of the principles of the law, in recognition of the Biblical injunction, that a man cannot serve two masters. It is embodied in our law that one who has an official position with the Government must not enter into contractual relations with the Government when he passes on the amount of compensation for the Government. It is a very wise provision.

Now, it is envisaged that industry will be called upon in an advisory way for advice. Naturally the men on the advisory Commission would be drawn from that portion of industry which knows most about this problem.

Do you see any conflict that might well develop between a member of the advisory Commission on the one hand advising the Government, and on the other hand taking contracts from the Government?

Mr. RAFFERTY. Well, I would say that that man would have to be very particular. I naturally, being associated in industry as I am, have always wondered how industry became so severely criticized in the past; in the press at any rate, in certain public circles. I don't think there is a higher-minded lot of men than the men in industry, and I think they have showed that in this war.

I would say that any member of the advisory Commission who was employed by a concern with which the Commission or the Government, as a result of the Commission's recommendation, might enter into a contract, could and should disqualify himself from taking any action pertaining to such a contract.

I would rather trust an industrialist to seek out the proper schools or proper personnel to make these contracts with in behalf of the Government, because industry is using that type of man all the time, and industry reinforces its research laboratories from all these schools. That is the kind of thing I am making a plea for, that the Government would get the best value for any money it spends in these things.

The outstanding things done in science are done in industrial laboratories, outside of the fundamental things that the university laboratories are organized for. But, as I said before, the outstanding things that were brought out in this bomb project were brought out by the type of men that industry has—the technical engineers plus the research men they employ.

That is the thing I am urging. I would like to see that placed at the service of the Government. I think, as to the thing you were talking about, that these industrialists would be watched pretty closely, and I would say that proper action could be taken by Congress to provide punitive measures in case a member of the advisory Commission should show partiality to some particular company or some particular group.

The thing I am hoping for is that an adequately qualified commission will be set up that can handle this almost overwhelming task.

The CHAIRMAN. Really what it comes down to is the type of men that we appoint on the Commission.

Mr. RAFFERTY. That is right.

The CHAIRMAN. If we appointed a commission that was of low grade, your belief is that the best interests of the country would better be protected by having an advisory commission that could veto the acts of such a low-grade commission?

Mr. RAFFERTY. Yes.

The CHAIRMAN. On the other hand, I take it if a high-type commission was appointed, of the caliber of the men that I have indicated, you would be perfectly content to leave the final determination of policy with a commission of that kind, composed of that kind of men, to be advised, but not to be run, by an advisory board?

Mr. RAFFERTY. That is right.

The CHAIRMAN. So the basis of your fear is the caliber of men who would be appointed on the full-time Commission. Speaking only for myself, and assuming that the confirmatory powers are kept in the bill, as I assume they will be, I can assure you that I would examine, as a Senator, the qualities and credentials of any candidate who was proposed for appointment most carefully with those standards in mind. I hope that that is the kind of commission we would get.

Mr. RAFFERTY. Well, I will be very happy if you get that kind of commission. I was visualizing maybe a commission of less experienced and qualified men than what you have just outlined, Senator.

The CHAIRMAN. Thank you very much, Mr. Rafferty.

Mr. RAFFERTY. Thank you, Senator. I enjoyed it very much.

The CHAIRMAN. The committee will meet tomorrow at 10 o'clock in room 324.

(Thereupon, at 11:30 a. m. an adjournment was taken by the committee until Friday, February 8, 1946, at 10 a. m. in room 324.)

ATOMIC ENERGY ACT OF 1946

FRIDAY, FEBRUARY 8, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 324, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.
Mr. Folk.

STATEMENT OF GEORGE E. FOLK, PATENT ADVISER TO THE NATIONAL ASSOCIATION OF MANUFACTURERS

Mr. FOLK. Mr. Chairman, my name is George E. Folk. Since my retirement from the practice of patent law, I have for the past 7 years acted as patent adviser to the National Association of Manufacturers. Its committee on patents and research has given careful consideration to proposals for the establishment of an Atomic Energy Commission as outlined in the Senate bill, S. 1717, and other similar bills introduced in Congress. The patent and research committee's recommendations, as later set forth, have been approved by the board of directors of the National Association of Manufacturers. I am speaking today for the National Association of Manufacturers, a voluntary organization of about 13,000 manufacturers, 70 percent of whose members have less than 500 employees each.

The CHAIRMAN. Are you restricting your comments to the patent sections of the bill, Mr. Folk?

Mr. FOLK. No; because they are tied up so that one necessarily involves the other.

The National Association of Manufacturers is alive to the fact that, in order "to protect the national security and to insure the broadest possible exploitation of the field" of atomic energy (p. 2, lines 22 to 24, of the McMahon bill, S. 1717), it is necessary and desirable that the Government regulate and police the production and use of fissionable materials. We believe, however, that it is not necessary or advantageous to institute a "program for Government control of the production, ownership, and use of fissionable materials" (p. 2, lines 21 to 22).

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In short, we are in full accord with the statement in the President's message to Congress of October 3, 1945, that—

our science and industry owe their strength to the spirit of free inquiry and the spirit of free enterprise that characterized our country. * * * The observance of this policy is our best guaranty of maintaining the preeminence in science and industry upon which our national well-being depends.

It is important, however, to keep in mind what "free enterprise" really is. The American idea of free enterprise is not that a person should be free to disregard the property rights of others. It is obvious that the right of one person in any form of private property limits the freedom of others to exploit that property. "Free enterprise" merely means that so long as a person respects the property rights of others, whether it be in physical property or in patent property, he shall be as free as is consistent with public interest to conduct his own business enterprise, and especially that he shall be as free as possible from Government control. Accepting this interpretation, the American interpretation, of free enterprise, we wholeheartedly endorse the maintenance of free enterprise in the development and exploitation of atomic energy for industrial purposes.

We therefore take the position that the Commission should be given only such authority as is, or may become, conducive to public safety and public health, with the least possible Government interference.

We, therefore, venture to criticize certain features of the McMahon bill, S. 1717, trusting that such criticisms may be deemed to be constructive and helpful to the committee in its difficult task of formulating a bill that will protect the national security and insure the broadest possible exploitation of the field of atomic energy—the declared purpose of the act—and at the same time will not run contrary to the American system of free enterprise.

GENERAL AUTHORITY OF THE COMMISSION

Assuming that the Commission be given, as it should be, authority to establish regulations adequate for the public safety, it would then seem wholly unnecessary that the Commission shall be the exclusive producer of fissionable materials for industrial purposes (p. 5, line 24); and that it shall be "unlawful for any person to produce any fissionable material except as may be incident to the conduct of research or development activities" (p. 6, line 5).

It would seem unduly harsh to give authority to the Commission by which it may "require any person to permit the inspection and copying of any records or other documents" (p. 22, line 9). This would seem, furthermore, to violate the constitutional provision guaranteeing the—

right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures—

The CHAIRMAN. Now, let us examine that, Mr. Folk. I presume that you have more or less followed the discussions about inspection that have been proposed for international application.

Mr. FOLK. Yes, I have followed that rather closely in the newspapers.

The CHAIRMAN. And you realize that any effective inspection system that is evolved will necessarily have to be applied with equal force and effect in our own country, as well as in the other countries of the world?

Mr. FOLK. That will undoubtedly have to be the case.

The CHAIRMAN. You, of course, are acquainted with the terrible potential destructive possibilities of atomic energy.

Mr. FOLK. Such as we get from the newspapers and talks with some who have some scientific knowledge of it.

The CHAIRMAN. I don't know that I have any scientific knowledge, but from what I know of it I think I can assure you that is accurate.

Mr. FOLK. Yes; it is potentially a dangerous matter.

The CHAIRMAN. Now, of course we have to weigh the potential dangers of its use and we must, in the light of that, judge what we are going to do to prevent it from being used as a weapon of war. You would say that that was a highly desirable objective, would you not?

Mr. FOLK. Oh, yes.

The CHAIRMAN. Might it not be, therefore, that we would have to suffer certain restrictions that perhaps we would not even think of suffering if it were not for this terrible danger that we might be under?

Mr. FOLK. That is undoubtedly true.

The CHAIRMAN. So that assuming that an inspection system is developed which could only be effective providing there was free inspection, and assuming that as the hypothesis, would you still object to the provision that requires a person to submit to inspection?

Mr. FOLK. There would be a great deal that would be required under this inspection that would have no real relation to the danger from use of the material, I should think. It should be carefully safeguarded, but I think the language is too broad here. If that language should be changed, I think it would be all right, and it could be changed.

The CHAIRMAN. How do you suggest changing it?

Mr. FOLK. I haven't given any particular thought to that. I cannot think for the moment of how to change that language, but I would be glad to think it over, if you wish me to, and let you know my views on it.

I object to papers being subject to examination which may not have any direct bearing on the use of fissionable material. The bill is broader than the uses of fissionable materials, as I will point out later.

The CHAIRMAN. I wish that you would give that further consideration and submit a suggestion for a change that you think will accomplish the objectives that we must accomplish, it seems so me, in view of what we are dealing with, and still not unwarrantedly harass our people, because that is not the intent of the bill.

Mr. FOLK. I know it is not, and that is the reason I called attention to the broad language here.

The CHAIRMAN. The intent of the bill is to protect our people, and it perhaps is some indication of what might be necessary in our inspection system.

Mr. FOLK. I want you to understand that we are entirely in accord with the objectives of this bill, to protect the public against danger. We think the bill is drawn somewhat broader than is necessary.

As to materials under control of the Commission, the bill is designed to give unlimited control to the Commission over "source materials," "fissionable materials," the "production of fissionable materials," "byproduct materials," and "atomic energy." It is also designed to control the use of fissionable materials (1) in research and development

activities, (2) in industrial uses of fissionable materials, and (3) in military application of fissionable materials. Even for regulatory powers, it is, of course, important that the definitions of the above terms shall not be broader than are necessary to give the Commission authority to regulate for public safety.

DEFINITION OF TERMS USED

The definition of "source materials" (p. 9, line 1) is such as to "include any ore containing uranium, thorium, or beryllium." This definition is so broad it would include ores in which only minute quantities of such elements are found. Undoubtedly ores abound which contain little radioactive material but are nevertheless now used and are useful for other industrial purposes. Such industrial uses should not be under the control of the Commission. The latter part of the definition also includes—

such other materials peculiarly essential to the production of fissionable materials
* * *

This is broad enough to include many devices and substances which now have varied industrial applications entirely apart from the production of fissionable materials. For example, it would include electrical apparatus, electromagnetic devices, blowers, turbines for generating power, fuels, etc. I doubt that it was intended that the definition should be so broad, but it is capable of that construction. Surely it is not intended, as the definition would seem to imply, that the Commission shall have control over all industries employing for any purposes such devices or substances. Attention is also called to the fact that there are now in existence many industries utilizing uranium, thorium, and beryllium. These industries, not in any sense a public menace, would under this bill as drawn come under the dominance and control of the Commission even though such industries are not now engaged nor likely to become engaged in the production of fissionable materials.

The definition of "fissionable materials" (p. 7, line 14), in addition to including plutonium and uranium-235, includes—

such other materials as the Commission may from time to time determine to be capable of releasing substantial quantities of energy through nuclear fission of the material.

It is quite probable that additional fissionable materials may be discovered in the future in which the release of substantial quantities of energy through nuclear fission may be so sluggish as not to endanger the public safety. The definition should be changed to include only such other materials as the Commission from time to time may determine to be likely by their fission to endanger the public safety.

The CHAIRMAN. I take it, Mr. Folk, that the point you make and your underlying philosophy here is that the public safety is the sole criterion of the Government's authority in the field?

Mr. FOLK. I have gone a little further than that later and I may have said here—"or the misuse of such materials." That is, if the material is very scarce, we don't want it squandered; I recognize that.

The CHAIRMAN. But you take the position that fissionable material should be permitted to be manufactured by any industrialists?

Mr. FOLK. Provided it is under police regulation, so that it will not endanger the public.

The CHAIRMAN. What compensation do you envisage, or do you suggest any, from private industry to the Government for the use of the process?

Mr. FOLK. I see no reason why they should be any different from any new enterprise. For example, the beryllium enterprise is a very important new industry that has arisen in the last 9 or 10 years, and that would come, it seems to me, under the control of this Commission.

The CHAIRMAN. But that wasn't developed from Government funds, was it?

Mr. FOLK. So far as Government funds are concerned, I should say definitely any invention made by an employee of the Government should be owned by the Government, and should be open to license by anyone.

The CHAIRMAN. The Government has spent \$2,250,000,000 on the Manhattan project and has brought this to mass production—loosely speaking—of the material.

Of course, that was the taxpayers' money and added to the debt. Do you advocate that the result be turned over to private industry, that the processes be turned over to private industry, without compensation?

Mr. FOLK. I don't know the terms under which the people are working for the Government, what the contract provided. Of course, something would depend on that.

If it is Government property—and it could be Government property by reason of the contractual relations, in that the Government employed these people and paid them for the time to do this work—of course the results belong to the Government.

Now, insofar as it is safe to let the public have the advantage of that, the taxpayers who paid for that development should have the free use of it; that is, a nonexclusive license.

It is very difficult to answer your question without knowing the details.

The CHAIRMAN. In other words, under the contracts, as I understand them, certainly the basic processes that produce fissionable material are the property of the Government and have been paid for by the people. Now, if I understand you correctly, what the Government would get would be a shop right, and everybody else would be allowed to produce the fissionable material based upon the Government processes without any royalty or payment of any kind to the Government.

Mr. FOLK. Well, the Government would get more than a shop right; it would get ownership of the patents under the conditions you have mentioned.

Now, what should they do with them? We have various theories regarding what should be done with Government patents, some taking the view that, since the Government would be acquiring the patent for the public, the public should be allowed to use it freely without further payment, having already paid for it; others have the view that it should be sold for compensation, and others exclusive license given.

We haven't attempted to deal with it in this statement, but in my personal view I think when the Government owns a patent it should be free for use by anybody that is capable of using it without any compensation.

The CHAIRMAN. Therefore, the Jones or Smith Manufacturing Co. of New Jersey or New York should be permitted, under that theory, to start up a uranium-producing plant?

Mr. FOLK. Provided it is safe to do so, because we should have competition in dealing with uranium. You will get it that way, if everybody is given a chance.

The CHAIRMAN. Do you see any possibility of adding difficulty to the international control of fissionable materials through the dissemination of it on a private basis all over the country?

Mr. FOLK. I haven't thought of any. I don't see any. Of course, we don't know what the international situation will be. What I am very much afraid of is that, if we put severe restrictions on it that are not put on in other countries, the other countries will undoubtedly have the advantage in that case, and I would dislike very much to see that happen.

There should, of course, be some provision by which the authority of the Commission is not so limited that it couldn't act sensibly. I agree with that.

Whether it is the material we are talking about now, or any other patents owned by the Government, there should be free use by the public because they have paid for it ultimately by taxes or otherwise, and why should they have to pay for it again?

I am glad you ask me these questions, because it gives me an opportunity to discuss them.

The definition of "production of fissionable materials" (p. 5, line 17) is likewise too broad in view of the definition given to "fissionable materials" and in view of the reasons above set forth.

The term "atomic energy" is defined as including "all forms of energy liberated in the artificial transmutation of atomic species." This, of course, does not include spontaneous transmutation, such, for example, as occurs in radium and other radioactive materials. But it is probable that even in the artificial transmutation of atomic species, such transmutation can also occur with many elements without any danger to the public in general. I should be disappointed if that does not prove to be the case. Therefore, the definition of atomic energy, in view of the control given to the Commission, is much too broad, broader than is necessary or desirable.

As the art develops, it is almost certain that harmless fissionable materials may be discovered, not now known to be capable of fission, but which can be extensively utilized for industrial purposes without creating a public hazard, and for the use of which there will be no need even for regulation.

Thus the bill, in providing, as we shall presently point out, Government control of source materials, the production and use of fissionable materials, byproduct materials, and atomic energy, would give to the Government enormous and increasing economic control of private enterprise not only as it exists today but as it will probably develop in the contemplated atomic age. It would increasingly wipe out our boasted American system of free enterprise.

The CHAIRMAN. Has it occurred to you, Mr. Folk, that if sudden and widespread industrial use—call it peacetime use—of atomic energy were made, that it might have some impact upon our economic system?

Mr. FOLK. I should think it would, definitely; of course, I don't know. We have had guesses, and I have listened to a lot of guesses

from people who know, some who figure that in 5 or 10 years we will be using it extensively, and others think possibly never. But I am not sufficiently informed on the scientific aspect of it.

The CHAIRMAN. If it came indiscriminately and more rapidly than we think, which is quite possible, it might have some impact upon our economic system, might it not?

Mr. FOLK. Absolutely, it would, and that is the reason I don't want to change it from free enterprise to Government-controlled enterprise.

The CHAIRMAN. Let us assume that Westinghouse and General Electric, du Pont, or any one of the great concerns which made such great contributions to this project, were to develop very quickly an atomic furnace. Do you see any difficulty in putting that into our economy over night?

Mr. FOLK. No more than in any new development. My experience is that new developments take years before they get into commercial use.

The CHAIRMAN. Well, let us assume, though, that they do, through a combination of fortunate circumstances, develop an atomic furnace which would overnight displace 500,000 coal miners from work. Do you see any threat to our free-enterprise system in such an immediate transmutation?

Mr. FOLK. No; no more than has been threatened in the past with new developments, like the railroads driving the cabs out of existence, and so forth, in various other industries. There is always a displacement for the time being, but always to the advantage of the public in a very short time.

The CHAIRMAN. You see no difference in the situation as it might develop with atomic energy?

Mr. FOLK. No; I do not.

The CHAIRMAN. Even though it displaced all other forms of energy?

Mr. FOLK. I think it is very unlikely that that problem would arise, but if it does arise, it is just like any other new invention that came in to displace something that had gone before. Of course, there have been people who advocated not allowing labor-saving machines to be patented on the theory that it displaced labor. We now know it was a blessing to have labor-saving machines when we needed them.

CONTROL OF SOURCE MATERIALS

Now we get to the control of source materials. In view of the broad definition of source materials, it is unjustifiable to provide that no person "may transfer possession or title to any source material after mining, extraction, or removal from its place of origin," and no person may receive such material without a license from the Commission (p. 9, line 6). This provision would not be nearly so objectionable, though apparently unnecessary and harmful, if the definition of source material is restricted, as above suggested, so as to include only dangerous-to-process ores, and not to include such material, for example, as ores which it may be found can be processed and used without any danger to the public. The search for undiscovered ores should not be discouraged, as the above prohibition would undoubtedly tend to do. Regulation is all that is necessary. Further control would be harmful.

CONTROL OF THE PRODUCTION OF FISSIONABLE MATERIALS

We believe that it is unnecessary and undesirable to have the Commission be the exclusive producer of fissionable materials, except where such production is incident to research or developmental activities by those licensed by the Commission to do so (p. 5, line 24); or for the Commission to "arrange for the exclusive operation of facilities employed in the manufacture of fissionable materials by employees of the Commission" (p. 7, line 9). It would be sufficient that the Commission shall have the authority to regulate and police the production of fissionable materials in such way as to guard the public safety.

CONTROL OF FISSIONABLE MATERIALS

The provision by which any person owning any right in fissionable material shall forthwith transfer the same to the Commission is an unnecessary interference with free enterprise (p. 7, line 19). It would be sufficient that only such fissionable materials, the possession of which by an individual may endanger the public safety, should be under the regulation of the Commission. Ownership of the material by the Commission is not necessary for regulation of its possession and use.

The CHAIRMAN. You, of course, realize that after the Government produced the fissionable materials, assuming that they could be used industrially, there is no provision in the bill which would bar the Commission from permitting this to be used by private industry under a suitable payment to the Government.

Mr. FOLK. That is true, and yet there are one or two objectionable phases of that which I will come to in just a moment, and which I think should be corrected.

The CHAIRMAN. In other words, there is no intention under this bill for the Government to operate atomic-energy furnaces in every house in the country.

Mr. FOLK. No, it is to produce material which would be used in such furnaces.

The CHAIRMAN. That is right.

Mr. FOLK. I think that is wholly unnecessary and is undesirable.

The CHAIRMAN. But I wanted to make certain that you understood that it ended with the production of fissionable materials themselves.

Mr. FOLK. I understand perfectly.

The CHAIRMAN. And did not contemplate that the Government would go in the business of heating every house in the country, or of taking any of the fissionable materials and running locomotives or steamships with them.

Mr. FOLK. I understand that at present the bill does not contemplate that. The bill does contemplate, however, licenses required for research or for industrial pursuits. In making it unlawful for any person to operate any equipment or devices utilizing fissionable materials without a license from the Commission, such provision would undoubtedly deter the development of harmless fissionable materials.

The CHAIRMAN. What do you mean by "harmless fissionable materials"?

Mr. FOLK. We have radioactive materials now, like radium, which have a spontaneous splitting of the atom; that is what gives

radium its effect. Yet it isn't harmful to anybody exercising proper precautions in using it. I anticipate in the future that we are going to discover a number of substances that can be used where the action is not so violent that it cannot be used safely as a substitute for other things.

The CHAIRMAN. Any material that is fissionable, that releases any amount of energy, is potentially a source of destruction, is it not?

Mr. FOLK. I don't believe it is necessarily. Would you say that radium is?

The CHAIRMAN. No.

Mr. FOLK. Radium releases energy; radium is split up.

The CHAIRMAN. Granted, but is it a scientific fact that radium produces energy in any appreciable amount necessary to do the work of industry?

Mr. FOLK. No, but I can conceive of there being discovered other elements, perhaps some of much less atomic weight than uranium and thorium and the like, which would nevertheless release fissionable energy.

The CHAIRMAN. It seems to me just as soon as it releases enough energy to be worth while, to do the work of industry, to do the work of so many kilowatt-hours, if you please, it would then be capable of being used explosively.

Mr. FOLK. Well, the suggestion that I have made, or that NAM has made, is that if such is found to be the case, the Commission should regulate it and police it, but I am confident myself that there will be fissionable materials discovered that don't need regulation, that will produce sufficient energy to be used commercially or industrially, and still not be a public danger. If it proves to be a public danger, or is likely to be, this Commission should have authority to know what is going on, and if they find there is such danger, then it immediately comes within their province under the suggestion I have made. Have I made myself clear?

The CHAIRMAN. Oh, yes; I understand your point; I don't agree with you, but I understand it.

Mr. FOLK. Just so I make it clear; I was in hope you would at least agree with something we had to say.

It should suffice if the authority of the Commission be limited to the regulation of such use thereof as might endanger the public safety.

Provision is made that—

Where any license might serve to maintain or foster the growth of monopoly, restraint of trade, unlawful competition, or other trade position inimical to the entry of new, freely competitive enterprises, the Commission is authorized and directed to refuse to issue such license or to establish such conditions to prevent these results as the Commission, in consultation with the Attorney General, may determine.

This provision is too broad and very objectionable. It opens the way to possible unjust discrimination against applicants for a license. Any private ownership of property is a monopoly of that property. Any refusal of a property owner to allow others free use of his property is to that extent a restraint of trade. In any event, the word "unlawful" should be inserted before "monopoly" and also before "restraint of trade," just as it is with respect to "competition," referred to in the foregoing as "unlawful competition." The antitrust laws could then provide adequate safeguards.

I might say that also where you say "or other trade position inimical to the entry of new competitors," you might say "inimical to the lawful entry of new competitors."

Have I made myself clear?

The CHAIRMAN. Yes, sir.

PATENTS

Mr. POLK. Now we come to the patents. Section 10 (p. 18, line 19), under which patents covering inventions for the production, refining, and other processing of fissionable materials shall be issued to the Commission and not to the inventor, of course nullifies those provisions of the law, in accordance with the Constitution, by which the inventor is given the exclusive right to his invention for a limited term. Believing as we do, and as is generally accepted to be the fact, that our patent laws have been to a very great extent responsible for the development of new industries, increased employment, and a high standard of living, such overthrow of the fundamentals of our patent system should not be undertaken. It should suffice if the Government merely takes over a non-exclusive license for governmental purposes with provision for just compensation for the rights so taken, as is now provided by law.

Section 10 (b) (p. 19, line 12) provides that any patent already issued to private individuals covering any process or device utilizing or peculiarly necessary to the utilization of fissionable materials is subject to compulsory licensing. This, of course, amounts to confiscation of private property. It is not the taking of private property by due process of law or for public use with the safeguard provided in article V of the Amendments to the Constitution. It should suffice that the Government take, for governmental uses only, a nonexclusive license with just compensation therefor. Compulsory licensing of patents already issued has generally been regarded as unconstitutional confiscation of vested private property.

You see, I make a distinction between patents already issued and those issued in the future. There is a distinction.

The CHAIRMAN. Is it your conception of the law that the Government cannot use its condemnation powers and take private property with due compensation?

Mr. FOLK. Only where the public use is involved, and that doesn't mean use for Tom, Dick, and Harry or anybody that wants it. The Government doesn't condemn real estate and divide it up among its citizens.

The CHAIRMAN. Well, of course I grant you that, but there would be the thought—granted the tremendous effect that these things might have on our economy—that the Government might have the right under the Constitution to take that property upon the payment of due compensation. However, that raises a legal question.

Mr. FOLK. I have paid attention to that especially. Since the very beginning of time, the Supreme Court has invariably held that the patent property was just like real estate, not to be subject to confiscation by the Government, nor for use of governmental purposes even without just compensation. I want to bring that point up. I have never heard any good authority contrary to this, and the bills that have heretofore been introduced in Congress on compulsory

licensing have generally been amended to make it include future patents only.

Senator HICKENLOOPER. What was that last statement?

Mr. FOLK. I can say it again, probably in different language. I say the general interpretation of the law is that taking patent property is a confiscation of that property, and the Supreme Court has held—as recently as in the Glass Industry case—that the Government has no more right to take that property than it has any private property.

Senator HICKENLOOPER. You are dealing only with future patents?

Mr. FOLK. That is right.

The CHAIRMAN. Do you know of any patents in the field now?

Mr. FOLK. Unfortunately, I don't. You could get that, Mr. Chairman, I should think, by asking the Commissioner of Patents to give you a list of those patents relating to fissionable materials. It would be rather an interesting study. Of course, you are not going to get a list of the patent applications. I should think those would be preserved for secrecy reasons during the war and not released.

The CHAIRMAN. I imagine they are available to us.

Mr. FOLK. They should be.

The CHAIRMAN. Now, of course we haven't, but we intend next week to get into that situation in some detail. You know that all the contractors working under the Manhattan district have been working for the Government and have been paid for their work.

Mr. FOLK. Then, in general, it would belong to the Government.

The CHAIRMAN. So the difficulty that you anticipate about patents already applied for would probably not raise too many difficulties.

Mr. FOLK. No; I don't believe it would, but I haven't even got to "applied for"; I have so far considered issued patents, because "applied for" refers to future patents, those that have not been issued. I deal with that in the next paragraph.

The CHAIRMAN. I rather think that the Commissioner of Patents has not issued any patents upon atomic energy devices or upon the production of fissionable materials. If he has done so, we want to know about it.

Mr. FOLK. There may have been some issued before the war. Generally there is, long before a thing goes into commercial use, a patent issued on it.

The CHAIRMAN. I rather think we are dealing with a virgin field here.

Mr. FOLK. Probably so.

Senator HICKENLOOPER. I expect they took out patents on these cyclotrons, and things of that sort—much of the apparatus.

Mr. FOLK. Yes; and they have taken patents out on the processing of beryllium and uranium. I think the next witness will deal with that and knows much more about that than I do. I do know uranium, as a metal, was isolated more than 100 years ago. Naturally, many industrial uses have come of it.

Now, my position is that your bill—unintentionally, no doubt—is drawn so broad that you would have control of those industries. I really raise the point that I think should be given some attention.

While there may be some difference of opinion regarding compulsory licensing of future patents, even in such case it is questionable whether Congress has the authority to grant other than an exclusive right.

The granting of a patent subject to compulsory license is the negation of an exclusive right. In any event it is contrary to the spirit and intent of the constitutional provision for promoting the progress of science and useful arts, by the grant to the inventor of an exclusive right for a limited time, a provision which for more than 150 years has proven its merit.

The National Association of Manufacturers is therefore opposed to the confiscation of patent property without due process of law, and is likewise opposed to compulsory licensing even of patents granted in the future. The provision in our Constitution for the granting of exclusive rights, which have served so admirably in the past, should be continued with respect to this new art in order that the development thereof may not be hampered. It would deter research and development work if the party engaged therein must bear his own losses if he is unsuccessful and must share his discoveries with others who sit idly by, in case he is successful.

Senator HICKENLOOPER. Mr. Chairman, may I interrupt here?

The CHAIRMAN. Surely.

Senator HICKENLOOPER. Mr. Folk, under the general principle of eminent domain, let us say, such as we use in land acquisition and other things with adequate compensation, do you still think that the compulsory turning over of patents to the Government and compulsory licensing would be in violation of the Constitution?

Mr. FOLK. Undoubtedly with reference to patents already issued, if it is not for a public use. Of course, I say the Government can condemn patents for its own use, for Government purposes, but when it condemns patents to distribute to anybody who wants to come into the field privately, that is a different matter.

Senator HICKENLOOPER. Let me ask you this: Suppose the Government decided that all firearms were the property of the Government for national defense, and that private individuals could neither manufacture or use firearms, and that any firearm already in existence or any patent for the manufacture of firearms should be acquired by the Government for the exclusive use of the Government.

Mr. FOLK. Of course, they could pass a law, a police regulation, forbidding the use of firearms, just as they did forbidding gambling devices, for example. Just because you forbid a patented device doesn't mean the patent is confiscated. The patent gives to the inventor the right to exclude others. So far as stopping him from manufacturing, you don't have to take over his patent at all.

Senator HICKENLOOPER. No; but suppose that you supplement that seizure by provision for adequate compensation? Of course, the fellow who holds the patent never thinks the compensation is adequate, but the law could set up what it considered a fair yardstick there.

Mr. FOLK. As I have said, under our system of government, private property in the case you mention should not be confiscated for the benefit of private individuals in the United States. That is the only answer I can give you.

Senator HICKENLOOPER. I wasn't approaching it from the standpoint of benefit to private individuals. I was merely trying to explore this question of the Government declaring as an over-all policy that this whole field has an overriding public interest, that the Government elects to take over the entire field, and then in the public interest making a declaration that certain activities can be farmed out, as we

do with the Navy. We say the Navy is a public responsibility, and yet we farm out the building of ships to private enterprise or private companies on occasions. Now, something comparable to that might be worked out.

Mr. FOLK. I can only say that if the Government wants to stop the manufacture of TNT or firearms by private individuals, it can do so, as far as I know. Certainly they could by some interpretations that might be given to it, but I do not think the Government would have the authority to take away the only thing the inventor has, the right to exclude others. If the Government itself took that over and manufactured it, that would be taking it over for Government purposes and just compensation should be paid for it. There is no need to take over the patent; a nonexclusive right would be all the Government would need in any event. Undoubtedly if the patent holder should find he was barred by law from making the device, he would be glad to sell his patent and get something for it.

Senator HICKENLOOPER. That patent law has been built up to encourage exploration, to encourage it by whatever financial consideration can flow from the work of an inventor. Now, if adequate compensation is set up for that invention, that is, for the genius or the exercise of the genius, then wouldn't that take the place of the exclusive right to manufacture and market? The exclusive right to manufacture and market, let us say, is in the nature of a reward and is a part of the encouragement for working out the invention, as I would view it.

Mr. FOLK. Of course, the reward to the inventor is only an incident. The whole purpose of it is to develop the art and science.

Now, I can not see any difference between the Government, seizing a million acres of land out West that is privately owned, saying, "We are going to take that over and submit it so the Homestead Act so that anybody can buy that property that wants to." I don't consider that as taking it for a public use, and I don't consider that the Government has any right to do it. I feel the same way with reference to patents. I see no distinction between one form of private property and another.

I am glad to raise this question; it is not a simple one.

Senator HICKENLOOPER. I want to make it clear, Mr. Folk, that as far as my own view is concerned, I am very zealous that private enterprise be not excluded from exploration in this field. There are certain fields of protection, however, which I think we will have to provide for. But it is rather confusing. There is a twilight zone in there.

Mr. FOLK. It isn't twilight to me; I am sorry it is to you.

The CHAIRMAN. In other words, your basic belief is that there is no difference between the instance you mention, in which the Government might take a million acres of land and put in out to private use, and operations in this field, the field of atomic energy?

Mr. FOLK. Well, I was giving it broader interpretation than that—to any patent rights they may have. The Government has a right to take the patent for its own purposes, but has no right, after it has granted the patent, we will say, to take it away from you and say, "We are going to give it to somebody else."

The CHAIRMAN. But we have to think of this problem in terms of its peculiarities, which is a masterpiece of understatement.

Senator HICKENLOOPER. How do you reconcile, then, the theory of eminent domain? Your argument then would carry just as much into the field of eminent domain and say that the State or the Government couldn't come and take any land for road purposes.

Mr. FOLK. That is a public use. That is provided for in the Constitution.

Senator HICKENLOOPER. Then you get down to the question of what is appropriate use, and that is where your twilight zone comes.

Mr. FOLK. Of course public use is a very difficult thing to define. It is easy to say what isn't public use; but sometimes it is very difficult to say what is public use. I will grant you that.

Senator HICKENLOOPER. I am not so certain I would agree with that. I think with changing conceptions of industry and business in our whole economic system, the public use may change from time to time. That is, what yesterday was manifestly in everybody's mind not a public use may tomorrow be generally accepted as a public use.

Mr. FOLK. That may be true, but let us not give the Commission any authority until we are definitely sure it is a public use in the strict sense of the term.

Senator HICKENLOOPER. I think I agree with that; I think we should be quite sure.

The CHAIRMAN. Let us take the TVA and see if we can make a helpful analogy. TVA used the powers of condemnation to secure large tracts of land. Now they are operating the thing as a Government institution, a Government monopoly in that area, actually operating it.

Would you say that it would be beyond the powers of the Government to lease out the management of any of those plants?

Mr. FOLK. I haven't given the matter sufficient thought. I have only treated the matter with respect to patents, as I understand it, and we are dealing with a rather difficult subject, as I think we all appreciate.

The CHAIRMAN. Yes; but I think that the Government would have the right to take the operation around the Norris Dam, we will say, and lease it out to Commonwealth & Southern for operation without running into the danger of a successful attack by the property owners who had that land taken away from them.

Mr. FOLK. I can conceive that that would be an incidental use in which the tail went with the hide, and you might deal with it in that way. But there must be back of it primarily a Government use in order that they can condemn that property.

I want you to understand that you have raised some questions here that I have not discussed with the Committee on Patents and Research, which is a very able committee, and necessarily you will have to interpret these as my individual views. I suppose you understand that. I don't believe they will differ with me, knowing the committee, but I want it definitely understood that I have not been instructed on that particular subject.

The CHAIRMAN. All right, sir.

Mr. FOLK. Now as to general comments—and we have to wind up somehow, you know—the creation of an Atomic Energy Commission such as is proposed in S. 1717 or even in the May-Johnson bills, H. R. 4280, H. R. 4566, and S. 1463, with the creation at the same

time of a National Science Foundation, along the lines proposed in the Kilgore or Magnuson bills, S. 1297 and S. 1285, respectively, would result in an overlapping of, and conflict in, the authority and functions of those two proposed Government agencies. Perhaps the functions of the Atomic Energy Commission can be combined with that of a National Science Foundation by the creation of an Atomic Energy Committee such as can readily be provided for in the above-mentioned bills for the creation of a National Science Foundation.

A careful consideration of S. 1717 makes it apparent that the broadest possible control, as distinct from regulation or policing, is given to the Commission with respect to every possible aspect of this new art. Enterprises involving some new industries that have already arisen, having no direct relation to the use of atomic energy, and new enterprises that are likely to be developed in the future involving the use of atomic energy, would be under the absolute control of the Commission. It would be a misnomer to refer thereto as "free enterprise."

While, as stated above, the National Association of Manufacturers recognizes the necessity for such regulation and policing of the new art of atomic energy as may be necessary to safeguard the public from danger therefrom or from misuse thereof, the National Association of Manufacturers at the same time is apprehensive that S. 1717 and other bills now in Congress along the same general lines would unnecessarily hamper the development of the art. The principal reasons the National Association of Manufacturers objects to such broad authority being given to the Commission as provided for in the above-mentioned bills may be summarized in recommendations made by the National Association of Manufacturers' Committee on Patents and Research and approved by the National Association of Manufacturers' Board of Directors.

The CHAIRMAN. Now, Mr. Folk, I take it that the provisions of the May-Johnson bill providing for Government control of operation are, in your opinion, too restrictive?

Mr. FOLK. They are more drastic than the McMahon bill, and the last bill that was introduced by Congressman May is quite an improvement—H. R. 4566, I believe. But there are still some features that should be changed, or this bill could be straightened out.

The CHAIRMAN. But even the May-Johnson bill in your opinion is too drastic and too liberal as far as the Government's sphere is concerned?

Mr. FOLK. That is exactly the opinion of the committee, and I am speaking for them when I say that. The resolutions they adopted will show that is the case, because that included the May-Johnson bill. [Reading from the resolution adopted by Committee on Patents and Research of the National Association of Manufacturers:]

They would impose severe and unnecessary restrictions and impediments upon research and exploration in one of the most advanced and potentially fruitful fields of scientific investigation and endeavor.

They would deter and impede the development of atomic energy for industrial and other nonmilitary uses in the United States and would tend to put the United States at a disadvantage in relation to other nations that did not adopt similar regulations.

They would discourage invention in this field by subjecting to Government condemnation and seizure patents, application for patents, and inventions relating to atomic energy.

They would interfere with and tend to destroy the freedom of development of science which is essential to technical, social, and industrial progress.

And, they would subject scientific research and development to bureaucratic control.

As above stated, the National Association of Manufacturers recognizes, however, the necessity for proper regulation and policing of this new art so as to obviate danger to the public therefrom.

I hope I have made the position of the NAM clear.

The CHAIRMAN. Any questions, Senator?

Senator MILLIKIN. I regret that I couldn't be in on the beginning of your presentation.

Mr. FOLK. The presentation is there, aside from the questions that have been asked, and which I was glad to have answered.

Senator MILLIKIN. I shall read the transcript with great interest.

Mr. FOLK. Thank you very much. We have given this very careful consideration. I have been associated, as I said, as patent adviser of the National Association for 7 years, and all these important questions have been given very careful consideration by them.

Senator MILLIKIN. Mr. Chairman, was this matter touched upon, as to what private right to patents should exist out of the research and development financed by the Government during the war in these various plants?

The CHAIRMAN. Mr. Folk stated it is his position that if the Government paid for this work that they were entitled to the patent rights. Isn't that right, Mr. Folk?

Mr. FOLK. That is what the Government has paid the man to do, and it belongs to the Government as a result. Of course, there may be cases in which the man made investigations preceding that and could show it wasn't included in what he was paid for, and that is a different proposition.

It has long been settled that not only in the Government, but anybody employing somebody to make an invention, when the invention is made it belongs to the man who employed him and paid for it. There is nothing new in that.

The CHAIRMAN. Mr. Folk is also the first witness that we have had before the committee who has taken the position, on behalf of his organization, that there should not be a Government monopoly of the production of fissionable materials, but that fissionable materials could and should be manufactured at will by private individuals under suitable safety and security regulations, and that any monopoly of this field by the Government—that is, the production of fissionable materials—would be an unwarranted invasion of our free-enterprise system as we know it, and he stressed that point. I wanted to make sure that you understood that that was his position.

Senator HART. May I ask one thing, Mr. Chairman, in order to get it straight?

The CHAIRMAN. Surely.

Senator HART. Did Mr. Folk take into consideration the possibility of international agreements which would be restrictive?

The CHAIRMAN. Mr. Folk and I had a brief conversation about that, and I asked him if he did not think that such a handling of the matter by private individuals might not impede and possibly obstruct an inspection system which might be worked out internationally, and he stated it was his opinion that he did not believe that it would. I think I am right.

Mr. Folk. I think we have got to conform to the international arrangements that are made and might affect the amount of policing and regulation you would have to do. I don't think you would affect the question of who makes the fissionable materials, or who owns the ores from which it is made, or who owns the processes by which it is produced, or that there is any necessity for a broad control of atomic energy.

My feeling is that you will discover a great many fissionable materials in which the atom can be split without any danger whatsoever to the public, and the Government should not interfere with the discovery of such devices, as I think it would if you put it under governmental control solely.

This is a very drastic bill, and I really rather dreaded having to take the position I did, but I thought it was due the committee that I tell you the views of the National Association of Manufacturers.

Senator MILLIKIN. Mr. Chairman, I wonder if the witness would accept a qualification to his statement, that we must accept the international arrangements that may be made. I assume that he meant the international arrangements which may be made, to which the Congress assents.

Mr. Folk. That is what I assumed, of course, naturally.

Senator MILLIKIN. May I ask the witness whether he could possibly divide this subject into, let us say, two phases: First, the phase that we are in now, where we don't know what the international arrangement will be, where we have a whole lot to learn about the whole subject; where we do know that we are dealing with a deadly thing, which might suggest that for a period of time, a short period of time, it is advisable for the Government to maintain complete control over the whole subject; and that once that period of time has passed, we could then open the thing up on a much broader public and private enterprise scale.

Mr. Folk. My suggestion wouldn't prevent that being done. When I say the Government should regulate and police, I think all the authority the Government needs to control the dangerous situation is given to the Commission. I don't think it is necessary for the Commission to be the only one manufacturing fissionable materials. If other people are allowed to manufacture it, it should of course be under policing so as to avert any possible danger to the public.

Senator MILLIKIN. I might go along with you easily on that as something for the future, once we know where we are in the use of this energy as a weapon. I suggest—and I am just thinking out loud—that perhaps we might look at the whole situation at the present time, at the uncertainty of foreign affairs, and whether we are set for peace or whether this is just an armistice, since we are lacking knowledge as to what may be agreed upon internationally, and that during that period of uncertainty it might be wise to make a complete and total control over the subject. However, as soon as we can say to ourselves that we are now entering a period of peace, that the weapon is no longer the predominant feature, that the development of this thing commercially and for peaceful purposes is now the predominant feature—at that point it seems to me we could make a drastic alteration of our views and say, "Now we are ready to turn this thing loose under control and supervision," as distinguished from the tight control of the energy that is proposed by all of these bills.

Mr. FOLK: You raise an interesting question, but I am fearful that once you have socialistic government control, which is state socialism, it is going to be very hard to ever throw it off.

The other feature I make is the proposition we have that so far as the public danger or safety is concerned it should be regulated and policed by your Commission. Further than that I don't think it is necessary to go. What difference does it make whether the Government owns that material or a private person owns that material, if the use of it is safeguarded?

Senator MILLIKIN. Well, I can see where the work in private enterprise on that energy might become so widely diffused that while control and supervision is certainly called for, it might become impracticable to maintain it.

Mr. FOLK. I have no objection to the bill being as it is, provided that any person indulging even in research or development or industrial use shall be required to give the Commission information as to what he is doing, so that the Commission can see whether the public safety is being safeguarded.

I don't believe we are far apart, except that I do object to the Government monopoly.

Senator MILLIKIN. I am in accord with your fundamental philosophy, but it seems to me there may be a period of time when we will have to violate some of our conceptions on the subject in the interest of public safety and in the interest of assuring the security of the United States.

Mr. FOLK. I am glad to get these various views, and I will repeat, as I said when you were not here, that you have gone into a great many phases of this for which I haven't received any approval by the patent committee, and I am stating my personal views in regard to that, as you will understand. I believe they will support me. That is all I can say. I have been with them 7 years in an advisory capacity, and generally I know what they think.

The CHAIRMAN. You say at the bottom of page 4 of your statement:

As the art develops it is almost certain that harmless fissionable materials may be discovered, not now known to be capable of fission, but which can be extensively utilized for industrial purposes without creating a public hazard, and for the use of which there will be no need even for regulation.

We briefly touched on that, Mr. Folk, but I wonder what scientific basis you have for any such prediction.

Mr. FOLK. I am hazarding a guess, because I know the radioactive materials are supposed, and I think it is generally accepted, to be spontaneously breaking down of the atom, and is doing it by such a slow process there is no danger. Now, I could conceive that some other material, for example lead—that the dream of the alchemist might come true by which you could change lead into gold, and could do it without any danger to the public in so doing.

Radium, for example, is a spontaneous breaking down of the atom. There is no danger to the public in general.

Isn't it possible that some other elements may be found, maybe having a lighter atomic weight than uranium and thorium, and still be perfectly safe for the public to use?

The CHAIRMAN. But all of them would produce energy, if they are going to be any good.

Mr. FOLK. Yes.

The CHAIRMAN: And if you can produce energy, that energy could be turned into a weapon.

Mr. FOLK. I doubt it. There might be some that wouldn't be. That is my point. Some might be perfectly safe and not a danger to the public. I don't like to tie it up beyond what you know now.

Senator MILLIKIN. You mean there might be an element exploited that might not be capable of these deadly chain reactions?

Mr. FOLK. That is exactly right.

Senator MILLIKIN. At the same time, it might produce energy which might be harmless for peacetime purposes?

Mr. FOLK. That is right; that is a guess, but I have seen so many wonderful things done during my lifetime that I am fully willing to make that guess.

Senator HART. There again, following Senator Millikin's thought that this is really interim legislation, though he did not so express it, those scientific developments, as I gather, are not yet in sight and there is no particular reason for worrying about them in any way right now. But, as I gather from the short time I have been here, you rather fear that something will stay on the books here, stay in the statutes, which will be too difficult to change when that time does arrive?

Mr. FOLK. That is one reason. That isn't the only one. I am also fearful that you will discourage people from searching for those materials in the ground. What is the use of discouraging them? The patents under this bill will go to the Government. If the researcher is unsuccessful, the loss is his; if he is successful, he has to turn it over to the Government.

That is one of my principal points, the discouragement of looking for the very things we want to find.

Senator MILLIKIN. The percentage of success in the patent field is infinitesimal, is it not?

Mr. FOLK. That has been my experience as to the last 50 years.

The CHAIRMAN. Thank you very much, Mr. Folk.

Mr. FOLK. Thank you for giving me this opportunity.

The CHAIRMAN. Mr. Bransome and Mr. Kett.

Mr. Edwin D. Bransome is president of the Vanadium Corp. of America, and Mr. Frederick Kett is general manager of the mining division of the Vanadium Corp. of America.

STATEMENT OF EDWIN D. BRANSOME, PRESIDENT, AND FREDERICK F. KETT, GENERAL MANAGER, MINING DIVISION, VANADIUM CORP. OF AMERICA

Mr. BRANSOME. Mr. Chairman, we have an apology to make. Mr. Kett will read this record, but in the presentation of it we thought we were addressing the committee in executive session. On page 3 of this record, we have some figures which we have ineffectually tried to blot out. We can pass around copies to the committee, or we can remove that page and pass them around to anybody who wants them.

The CHAIRMAN. I suggest that you let us have the statement as it is for the members who are present, and we will see that the matter remains secret.

Mr. BRANSOME. We are sworn to secrecy.

The CHAIRMAN. Yes; I understand.

Senator MILLIKIN. If we are omitting anything from the public session which you think we should deal with, we can have a short private session afterward.

The CHAIRMAN. Certainly.

All right, Mr. Bransome.

Mr. KETT. If it is to be assumed that atomic energy and its development is of importance to the safety and progress of the United States, then it is obvious that the sources of supply and stocks of raw materials from which atomic energy is derived are of paramount importance and that their availability should be the subject of immediate and exhaustive study.

Unless recent developments have materially changed the picture, it may further be assumed that uranium is still the only raw material for the development of atomic energy programs.

Published records indicate that world sources of uranium in substantial amount have been from:

1. Pitchblende—Canada and the Belgian Congo.
2. Certain vanadium ores known as roscoelite and carnotite from Western United States, chiefly Colorado, Utah, Arizona, and New Mexico.

Some pitchblende discoveries have been recorded in the United States, but to date not of sufficient importance to be considered a potential source of supply.

Senator MILLIKIN. May I interrupt? Do we have any roscoelite in Colorado?

Mr. KETT. Oh, yes.

Senator MILLIKIN. What is the layman's term for that?

Mr. KETT. That is the layman's name, roscoelite. It is a vanadium mica.

Occurrences of carnotites are reported in Russia, but grade and extent are not published or known to us.

If the foregoing is true in respect to the sources of uranium, then we are reduced to two methods of safeguarding the interests of the United States in respect to this raw material:

(a) Importation and stockpiling here of all the pitchblende or uranium concentrates thereof available to the United States.

(b) Intensive prospecting and development of carnotite and roscoelite ores in the United States and immediate mining and refinement of such ores, in accordance with the considered dictates of competent authority.

These programs could be carried out concurrently and so continued until imports of uranium containing materials were shut off by exhaustion or foreign legislation or international agreement.

Until uranium is conceded to be supplanted by other raw materials as requisite in the development of atomic energy, it would seem criminally negligent not to place the United States in a position to be self-reliant in respect to raw materials in times of emergency.

It seems needless to point out that times of emergency are usually dictated by the aggressor with due regard by him to the unpreparedness of the nonaggressor.

Within the boundaries of the United States, all carnotites and roscoelites carry uranium oxide, U_3O_8 , with run-of-mine carrying a maximum content for a vanadium milling grade ore of about 0.30 percent U_3O_8 , an average content of about 0.15 percent U_3O_8 , and a

minimum content of about 0.05 percent U_3O_8 , or 6 pounds, 3 pounds and 1 pound contained U_3O_8 per ton of vanadium ore.

Carnotite (not roscoelite) does occasionally occur in the form of concentrations containing up to a maximum of 30 percent U_3O_8 . These concentrations occur mostly in what are known as carnotite "trees" and are actually replacements of logs or branches of trees by more or less pure carnotite, always containing vanadium as well as uranium. These so-called "trees" are few and far between, encountered nearly always in the process of mining vanadium ore.

Senator MILLIKIN. Are there any deposits of what might be called exclusive uranium ores?

Mr. KERR. Not that I know of in the United States.

Senator MILLIKIN. They are all mixed?

Mr. KERR. They are all mixed with vanadium, except the pitchblende. There have been very minor amounts of pitchblende found in Colorado years ago, but as I say in here, they are out, as possible sources of uranium.

While some of these "trees" are very high grade, the average uranium oxide content is not over 4 percent and the total tonnage of such material for the whole of the uranium-producing area would probably not exceed x tons per year, or say y pounds of recoverable uranium oxide. This is an unimportant production compared to the possible uranium production from the vanadium operations, which production could provide z pounds of uranium oxide from the present facilities.

The uranium in these low-uranium-content, milling-grade vanadium ores up to 1940 has been allowed to go through the vanadium treatment processes into tailings, which were impounded. Such tailings were later disposed of to the Government.

In 1940, plant scale experimental work in the Vanadium Corp. of America Colorado plant demonstrated that a satisfactory recovery of the uranium values could be made in the course of the vanadium refining process; thereafter, Vanadium Corp. of America has continuously produced and marketed a uranium sludge containing some 50 percent U_3O_8 .

As before noted, carnotites and roscoelites carry both vanadium and uranium with run-of-mine ores containing far greater vanadium content than uranium. Therefore, if uranium becomes the major product and vanadium either a byproduct or waste product, uranium recovery will necessarily be expensive, but only in comparison to uranium recovered from pitchblende and not when its relative value in atomic energy program is considered.

However, marked economies may be effected if vanadium is recovered and credited to the operation, and such economies would obtain as long as the sale price of the vanadium so produced would permit competition with vanadium ores from other sources and vanadium uses were substantial.

Production of vanadium from United States vanadium-bearing ores is a highly technical operation and so far as is known no single process can be applied economically to ores from different localities with varying impurities. Complicated operating plants and highly trained technical personnel are requisites and such personnel must be continuously available.

Prospecting, development, mining, and processing of carnotite and roscoelite ores with uranium recovery as the major objective, it is believed, can best be accomplished by those private enterprises which are now or will be in the future engaged in the exploitation of vanadium and its various products. Government assistance would be advantageous, but Government restrictions or any other proposed legislation, except as to product disposal, would hamper production to the extent that an important going industry in the United States would be killed.

Senator HART. May I interrupt, Mr. Kett, in order to complete the picture?

In recent metallurgical developments, has anything been found, discovered, or developed which seems to endanger the use of vanadium in industry as has been the case over the last few years? Is there any new element or new alloy which is replacing it?

Mr. BRANSOME. I can answer that question in this way, Senator. Vanadium is always being displaced as are other elements from certain uses. Vanadium happens to be a rather expensive alloy, but they put it in because it is a master. The minute you can find some other element to supplement that which is cheaper, they will use it. There are always other uses cropping up.

Senator HART. I simply wish to bring out how important to our national industry as a whole is the continued production of vanadium. It would be less important than we now know if there were something else in sight which would supplant it.

Mr. BRANSOME. I think that question is self-answering. If there is something that will supplant vanadium, it will be supplanted in the march of progress.

Senator HART. My question is, have there been recent metallurgical developments which would indicate that?

Mr. BRANSOME. Not to our knowledge.

Mr. KETT. In regard to product disposal, namely uranium, it must be emphasized that the Government should have full control of such uranium products and that the processes used make such complete control a very simple matter.

Generally speaking, individual vanadium deposits are small; new deposits must be constantly developed and brought into production or the whole vanadium-mining industry in the United States of America will eventually—and not very far in the future—have to stop for lack of ore. Therefore, restrictions on vanadium production will automatically restrict efficient uranium recovery, if not make such recovery impossible. Whether the uranium is currently recovered in the vanadium process or allowed to go through the process into the impounded tailings for future recovery, the whole vanadium mining industry and the western plant facilities must be kept entirely healthy and in their highest state of efficiency as long as uranium in any quantity may be required at short notice.

We think that the right of location and patent—that is the patented ground, the mining property—should be expressly stated, at least where such location is made primarily and in good faith for elements other than radioactive ores.

We think that the right of condemnation and seizure should not be extended to mining properties, or to plants which are capable of producing radioactive elements but whose main operation is the produc-

tion of elements that are not radioactive, and which plants could operate without production or appreciable loss, actual or potential, of radioactive elements.

We think that S. 1717 should offer such facilities and protection to the vanadium producer as to stimulate to the utmost in the United States of America the search for and development of new sources of vanadium and its associate element, uranium.

The CHAIRMAN. Before you go into your summary, Mr. Kett, what specifically do you suggest should be incorporated in S. 1717 to accomplish that objective?

Mr. KETT. Taking the bill itself, on page 9, line 2, I will read that sentence, incorporating our suggestions:

The term "source materials" shall include any ore *after but not before mining, extraction, and removal from its place of origin* containing uranium, thorium, or beryllium * * *. [Italics indicate suggested insertion.]

That would cure the whole business. That would simply mean that anything still in the ground is not to be controlled. In other words, no Government department can take out 3,000,000 acres from circulation and say, "You cannot locate claims here, or patent claims, or have anything to do with it."

Senator HICKENLOOPER. You would still retain the independent prospecting rights and location?

Mr. KETT. I mean that the mining law should not be changed at all. Anybody should be allowed to stake out a claim, work it, and patent the claim, after which they own it in fee simple, with no restrictions on the prospecting, location, and development of claims containing vanadium and uranium, which it always contains out there.

Senator HICKENLOOPER. Just watch them after they get the ore out of the ground?

Mr. KETT. The minute the stuff is mined, OK—all the control you want on it; but don't stop free prospecting for the materials.

The CHAIRMAN. That would seem to me to be rather sensible. After all, what we are interested in is the uranium with no disposition, at least on my part, to try to control vanadium or any other useful metal that doesn't have fissionable possibilities.

Mr. BRANSOME. Mr. Chairman, I might add this: You have a few hundred small producers out there that are constantly prospecting for ore, producing it and selling it to the people that treat the ore. You certainly don't want to restrict those fellows.

In this bill at one point it goes beyond source materials and says: the Commission shall arrange for the exclusive operation of facilities employed in the manufacture of fissionable materials by employees of the Commission.

This in itself is so restrictive that it seems to me you have pulled a curtain down on all the progress of the development of fissionable materials except by a few people in the Government, who may or may not have the urge to go ahead in accordance with the dictates of their own desires to improve scientific knowledge.

The CHAIRMAN. I think that ought to be changed. Of course the intent is the package product, and not of course the ores in the ground.

Mr. BRANSOME. But it is poorly worded in there, Mr. Chairman, if I may presume.

The CHAIRMAN. Will you cite the page?

Mr. BRANSOME. It is page 7, line 10. That is beyond our source material job, but if that ever starts it will go back to source material, in my opinion.

The CHAIRMAN. You suggest the use of the word "manufacture" rather than "mining."

Mr. BRANSOME. That is right. As I say, I am going beyond the source materials into fissionable materials, but these words "by employees of the Commission," in my opinion, are impracticable.

The CHAIRMAN. Of course, everybody should be permitted to mine the material.

Mr. BRANSOME. Well, you mine the material, but suppose you are treating fissionable materials themselves. Suppose you take a huge company with a large research department. Any industry that goes in must be employed by the Commission. If my understanding of this is correct, employ means employ, and that means you must be hired and paid and controlled both as to discipline and duties by the Commission, which is impractical.

The CHAIRMAN. Well, I want to make sure that we understand one another. It is the intent of the bill, as you heard Mr. Folk and the committee discuss it, to make the manufacture of fissionable materials a Government monopoly in the field. It is not the intent of the bill to make a Government monopoly of the mining of the source materials.

Mr. BRANSOME. My only purpose in pointing out this particular wording, "employees of the Commission," is to indicate that it would require considerable exploration. Let me say this: I don't want to confuse you, but at any time we might go on, as a corporation—or other companies in our industry—into the fissionable material job, or go beyond just the source materials. We have research departments that are constantly doing that, so our interest is there.

The CHAIRMAN. Of course, that opens up a much wider field. As I said, I agree with you that the mining of the materials should not be a Government monopoly.

Is it your contention that you would like the Vanadium Corp. possibly in the future to go into the process of manufacturing fissionable materials?

Mr. BRANSOME. Our research and development department is constantly working on the use of uranium and other elements, whether they are heavy or light. Necessarily—well, not necessarily, but coincidentally we have developed certain processes in respect to uranium, and we may be getting into the fissionable materials, and that is our interest in this.

The CHAIRMAN. Was that work done before you entered into Government operations?

Mr. BRANSOME. On uranium? Not as a fissionable material, but we have patents on uranium for use in steel.

The CHAIRMAN. Have you any patents on it with relation to this process?

Mr. BRANSOME. No, sir.

The CHAIRMAN. Have you filed any applications for any patents?

Mr. BRANSOME. We may have, but not to my knowledge. If we have, they are in a very embryonic state.

The CHAIRMAN. But what you would like to have the right to do is to set up a plant to be owned by the Vanadium Corp. to manufacture fissionable materials?

Mr. BRANSOME. If we thought that was the thing to do. Without having that, everybody in that plant or in that laboratory would be infracting the law if they were not employees of the Commission.

The CHAIRMAN. Well, that is true.

I take it, then, that you believe that the manufacture of fissionable materials should not be the monopoly of the Government but that any company that wished to engage in manufacturing the finished product should be permitted to do so, to sell it on the market?

Mr. BRANSOME. With proper control as to manufacture, use and sale, with the proper controls as laid down by the Commission and subject to change as the need progresses. As Senator Millikin pointed out this morning, it might be necessary to hold the atomic energy project right now—and in my opinion it is—in complete subjugation to the Government.

The CHAIRMAN. In other words, if you were now prepared to go into the manufacture of fissionable materials, you do not think you should be permitted to do so at this time?

Mr. BRANSOME. I think we should be encouraged to go into it with the control that the product disposal is in the hands of the Government, at least for the time being, until this period that Senator Millikin says is over. In my opinion—I am speaking for myself—if your committee wanted to project a period of a year, 6 months, or whatever it is, and say, "We will review it at that time and find out if this emergency period is over," rather than say, "This is going to reside in the hands of the Government," that would be better, because as Mr. Folk very ably pointed out, once it gets in there you have got to take five sticks of black powder to blast it out.

Senator MILLIKIN. That is not enough.

Mr. BRANSOME. I guess that is right.

Senator HICKENLOOPER. That just makes the noise: it doesn't move the thing.

Mr. BRANSOME. So unless that restriction is limited, you are running into very severe danger again, in my humble opinion, of restricting your program and restricting your development, and very dangerously restricting it. As you know, and without any reflection on governmental agencies, when a governmental agency—at least the Government agencies that we have been in contact with—reach the age of maturity, they seem to me to sort of pull in; they are helpful, but, my gosh, I never saw them go out and bust anything wide open the way private industry will do; and that is just what we want to prevent—having this thing as a little club, and I mean a social gathering instead of having competition in the field, having everybody work on it at the same time. In the interest of safety of the United States and the progress of the world, if atomic energy is what we think it is, we have got to be awfully careful about handling the progress of it and not hold it down, not be so frightened of it. This thing isn't going to develop next week so that atomic energy is going to be such—and I hope the authorities agree with me—that you can produce enough atomic energy to run an automobile, or anything.

One authority says, "Sure, you could with a cupful of it." But you would have to have 50 tons of a protective element to keep from killing the driver.

So the point of all this fear of the atomic energy busting wide open overnight and having public or private enterprise do it is senseless. It took \$2,000,000,000—

The CHAIRMAN. And more.

Mr. BRANSOME. And more for a couple of bombs. You people know more about the project than we do. But there isn't one single company that is going to go out tomorrow or next week or next year, in my opinion, and have the power of the world—like Mr. E. Phillips Oppenheim used to write about—in his hand and start sending telegrams to somebody saying, "Do it my way or I will blow the world up."

I think that is a question of development. For goodness sake, don't stop the development.

Senator MILLIKIN. Let's get back now to the hills of Colorado.

Mr. BRANSOME. I would like to be there right now, Senator.

Senator MILLIKIN. I cannot say too strongly that I would like to be there, or my constituents might take me at my word.

If a prospector out in the hills of Colorado staked a claim, worked out, and found that the ore contained appreciable amounts of uranium, would there be any objection to announcing that that kind of uranium ore had been discovered?

Mr. BRANSOME. There is in here a paragraph which I would like to call to your attention. I cannot find it just at the moment; but if it is discovered, the prospector discovers it, the minute he brings that above ground he reports it if it has got radioactive material in it.

Senator MILLIKIN. Now, is there any objection, regardless of the wording of the bill, to that requirement?

Mr. BRANSOME. Not at all.

Mr. KETT. That could be handled through the county clerk's office, because all these discoveries have to be recorded with the county clerk before you can take the claims up.

Senator MILLIKIN. All right. Now, he commences to develop that prospect and get the ore out of it. What I am thinking of in the back of my head is whether there is any point in the mining of the ore—not the processing of it, but in the mining of it—where the Government could not maintain such a supervision that a misuse of that ore could be made. For example, I am thinking of the possibility of bootlegging an ore of that kind.

Mr. BRANSOME. Let me anticipate you. If you could take all the ore that you get in Colorado and put it out above ground, you cannot do a single thing with it until you separate the uranium from the vanadium; and even then, if you had tons of the ore, or a thousand tons of U_3O_8 , you are running into no more danger than you would by having a thousand tons of sand.

Senator MILLIKIN. I quite agree. Now, let's take an Oppenheim squint at this thing. Suppose a fellow had that stuff piled up, and suppose he sold the crude ore to some mischievous outfit that might want to deal in this thing in a secretive and harmful way.

Senator HICKENLOOPER. Some mad scientist.

Senator MILLIKIN. Well, this is all Oppenheim, as I say. Supposing he smuggled that ore into some foreign country that didn't have it and wanted it awfully bad.

Even taking that view of it, could we not by supervision and by knowledge of what is going on, maintain an adequate protection over the crude ore?

Mr. BRANSOME. Without question. Any part that slipped out I don't think would be very dangerous at all.

Senator MILLIKIN. Let's say that instead of doing that he sends his ore to one of your plants in Colorado. Now, what happens in that plant? You are after vanadium. Give us a little picture of what happens in your plant.

Mr. BRANSOME. If you would like to see it, Senator, we have got some samples here to show you what would happen.

Senator MILLIKIN. I would like to know what happens to this complex ore that has some uranium in it at a vanadium plant. Tell us just what happens there—I don't mean to describe your secret processes, but set before us the progress of that uranium ore.

Mr. BRANSOME. All right; you crush the ore itself. Then you treat it so as to get it in shape to roast it, and it goes through a huge roaster, a huge furnace. Finally you drop it into a quench box, into water. A certain part of that is soluble in water, and other parts have to be treated otherwise. At one point you have got your vanadium and uranium in solution. You separate those. There is no secret about that. The know-how is what counts. You separate those, and part of your vanadium goes with the uranium, and the vanadium keeps on. This goes out here [indicating] and is distinctly controllable. It is a small part of the ore itself, it is a small part of the content.

That goes out and is treated from there on, and we have been doing it for years. That goes into one bucket and the Army takes it over—the Manhattan district takes it over.

Senator MILLIKIN. Can you see any reason why there couldn't be a complete control and supervision over one of your plants that goes through that process without Government ownership?

Mr. BRANSOME. Oh, absolutely. It can go through without Government ownership and until the time it gets through there is nothing dangerous in it. You say, "Now, Government, it belongs to you; you can do what you want with it."

The Commission—I assume it is to be a commission—says: "You take this U_3O_8 . That goes to John Smith, that portion of it goes to John Jones, and that goes to somebody else"; and they are going to work on producing fissionable materials.

Senator MILLIKIN. As far as we have gone, there is no reason why the Government should own the mine?

Mr. BRANSOME. Not the slightest.

Senator MILLIKIN. And there is no reason why the Government should own a plant of the nature that you are describing?

Mr. BRANSOME. Every reason against it.

Senator MILLIKIN. Thirdly, that the Government is in position at all times to exercise a protective supervision over those two steps?

Mr. BRANSOME. That is right, complete control of inventory, which everybody does. Every company controls its inventory from start to finish. The Government can control that very easily.

The CHAIRMAN. Of course, there is no provision of the bill which calls for Government ownership of the production of the source material. You realize that?

Mr. BRANSOME. Yes.

The CHAIRMAN. And there is no provision of the bill that calls for the Government to own the material that you separate before you start the chain reaction process.

Mr. BRANSOME. That is right.

The CHAIRMAN. I just wanted to make sure Senator Millikin understood that.

Senator MILLIKIN. I would like to ask one more question, Mr. Chairman.

I think what I am going to suggest follows as a necessary corollary of what you already testified to. Is there any reason for governmental wholesale withdrawal of land believed to contain uranium ores, or ores that have uranium content?

Mr. BRANSOME. Following what the chairman said, we are in agreement that the restrictive measures that we are against are not continued in this particular bill. We came as a company to put ourselves on record for consideration for future bills, and we assume that this will be available to other committees, and to the Senate and the House, to read this discussion in the event of other bills coming up. We will always be willing to testify.

Senator MILLIKIN. I gathered the implication from your testimony that if you want to have uranium ores you have got to allow our established mining system to continue to operate, because that is the only system which will induce men of the prospector type to go out and find these things.

Mr. BRANSOME. Plus this fact, Senator, if I am not interrupting you, that vanadium deposits of carnotite are very small deposits in most instances. You will run along with a face about so big [indicating]. Now, that is not a very big face of ore, is it? That will pinch right down to as big as your finger, and you will run along underground sometimes 300 to 400 feet in a tunnel big enough for a man to walk and to put a car in and take it out before you find it widens out again. So you are a small man. Our crews, our prospectors, are out constantly going to various places. The dots on a map of the vanadium occurrences in Utah, Colorado, New Mexico, and Arizona will indicate that to you, and we would be glad to leave a copy with the committee. You can see they are just spotted all over the place.

The more people you have out seeking—they will be seeking uranium now, not vanadium—the more people you have doing it, the more you are going to produce. If you pull it into the Government domain, it is going to be done by a Government agency, I assure you it isn't going to be done within one smidge of what private industry is going to do.

Senator MILLIKIN. I would like to say for the record, for I don't know whether it is understood in the East and in other parts of the country, the prospector for ore is the greatest and perhaps the last remaining individualist in the United States. He operates on the same incentives that the inventor operates on. The next shot is going to make him rich, and he won't let anybody tell him where to put in that next shot. He knows where he is going to get rich, and he is going to work on that. He has his own inducements that bring him into that kind of a life. He has complete independence, and you couldn't get him to forsake it. You couldn't hire him by a corporation and tell him to go out and prospect a particular area. He wouldn't be interested in working for a private corporation.

He wants to find this mine and make its development, and get his place in mining history, and make a fortune just as an inventor operates under the same kind of stimulus.

You cannot regiment prospectors. You cannot give a prospector orders as to where he is going to look and what he is going to do.

Mr. BRANSOME. You can give them to him.

Senator MILLIKIN. You can give them to him, but he will pay no attention to them. He is a class of person all to himself, and he is the fellow that has developed the mining industry of this country.

Mr. BRANSOME. He has complete independence, beans and bacon.

Senator MILLIKIN. The worst thing that could ever happen, if we need metals in this country, is to attempt to regiment that individualist, the mining prospector.

I am sorry to have gone through all that, but that is not understood. You know, there is a very common impression that a fellow says to himself, "Well, I am going out and find a gold mine," and that then he takes a spade, goes up in the mountains, digs a hole, and finds or does not find a gold mine. Or, "I am going to get myself a silver mine."

There is an enormous ignorance and oversimplification of the matter. It is very rare that you have a gold mine or a silver mine. Our basic economy in mining rests on complex ores, such as the type of ore you are talking about. You just don't go out in the hills and sink your spade in and find one of those.

Those fellows will take a sack of beans and a side of bacon, and they will live in a hovel. They care nothing about the comforts of life. They go out in all kinds of weather pursuing their own theory of where they can find a mine. Ninety-nine or 990 times out of a thousand they don't find it, but it is that uncontrolled search for it, that unregulated search for it, that has developed the mines of this country. It would be a calamity if we ever did anything to interfere with that.

Mr. BRANSOME. Mr. Chairman, I might bring out that we were sincere on this front page of ours when we said we were looking at the interest of the United States. As a corporation, we would call it to your attention that we are not motivated entirely by self-interest—far from it—because our chief source of supply of vanadium has been from without the country and not within it. We could get along for quite a long time without any of this ore being produced for our individual company.

The CHAIRMAN. Will you go ahead, Mr. Kett?

Mr. KETT. We believe that the best interests of the United States will be served by encouraging the prospecting, development, and mining of uranium-bearing vanadium ores in the United States and that no further restrictions should be placed thereon except the licensing or other approved control of product disposal and proper accounting of such products as to amount, grade, and location, whether at mine, stockpile or treatment plants.

Representatives of the Government and the vanadium mining industry should agree as to the minimum quantity of uranium in vanadium ores which is practically extractable.

Plants or mills treating such uranium-bearing vanadium ores should be required to dispose of all uranium produced to the United States Government in a form that can be practically produced and at a price agreed upon by the United States Government and the producer.

The CHAIRMAN. Mr. Bransome, is your corporation the sole producer of vanadium in this country?

Mr. BRANSOME. No, sir; I would say we were by far the junior partner in this country.

The CHAIRMAN. Who is the major in the field?

Mr. BRANSOME. The subsidiary of Union Carbide.

The CHAIRMAN. Do you know which one?

Mr. BRANSOME. U. S. Vanadium Corp.

The CHAIRMAN. Are there any other competitors of any consequence?

Mr. BRANSOME. There have been sporadic competitors.

As we pointed out in here, the simple mining and production of vanadium ore is one thing. The treatment of it and the production of vanadium pentoxide in a form in which it can be used is a very complex job, and it requires so much know-how, so much detail and so much technical background—I think background is the wrong word, technical backing—of laboratory and chemists, metallurgists, and so on beside the mining department, that people think it is a cinch to go into the game and they find themselves——

The CHAIRMAN. Broke?

Mr. BRANSOME. Busted wide open.

The CHAIRMAN. In other words, to complete the picture, there are thousands of prospectors——

Mr. BRANSOME. I think thousands might be wrong.

The CHAIRMAN. Let us say hundreds of individual producers who ship their material for processing either to the U. S. Vanadium Corp. or to the Vanadium Corp. of America.

Mr. BRANSOME. And there are several small producers.

The CHAIRMAN. Are there small producers?

Mr. BRANSOME. I think there are still some. I don't know their functions since the emergency period, because the need for vanadium is not so great.

The CHAIRMAN. At least, the two big producers for the Manhattan district, as far as you know, were the subsidiary of the Union Carbide and yourself?

Mr. BRANSOME. That is right.

Senator MILLIKIN. That suggests, Mr. Chairman, that it would be a relatively easy matter to supervise that phase of the business?

Mr. BRANSOME. Well, I wouldn't want to say that, because we wouldn't want to discourage anybody from going in. There might be some people going into the business.

Senator MILLIKIN. As it stands today, there are the two big companies you mentioned, and possibly some smaller ones. There are not enough of them so as to have a great uncontrollable supervisory problem. Is that correct?

Mr. BRANSOME. If there were 50 more, it wouldn't make any difference. You could still control it.

Senator MILLIKIN. It would be an easy thing to supervise?

Mr. BRANSOME. An easy thing.

Senator MILLIKIN. And an easy thing under which the Government could make contracts for that kind of ore?

Mr. BRANSOME. It has been doing it.

The CHAIRMAN. Does all vanadium ore contain uranium?

Mr. BRANSOME. No; not all vanadium ores. The vanadium ores in this country contain uranium to a more or less degree. When get to any 0's—0.009 or 0.003 content—it just doesn't fit unless your

uranium becomes so precious as an element to produce atomic energy, and then you might spend a thousand dollars a ton on it to get 1 pound. But you must consider that 1 percent uranium is 20 pounds of uranium; 0.25 is just one-quarter that, or 5 pounds.

Now, you might get 90 percent of that, you might get 75 percent of it, but when you get down to 0.08—when you get below that, it gets difficult to get it out; it is too expensive. The expense is all relative.

The CHAIRMAN. What are these samples that you have got with you?

Mr. KETT. Do you want to look at them?

The CHAIRMAN. Yes.

Mr. BRANSOME. I think you can get more out of looking at a few samples of ore than by looking at any number of pages of description.

The CHAIRMAN. Senator Millikin has probably seen it in extenso.

Senator MILLIKIN. I would like to ask the witness whether in his opinion wholesale withdrawal of vast areas of land in the Western States that might have some uranium in it would be conducive or repressive to the development of uranium?

Mr. BRANSOME. Not only that, but stupid, in my opinion.

Senator MILLIKIN. It would have the effect of taking about half my State out of the Union, and they have got to declare war on us to do that.

The CHAIRMAN. They are going to carve a piece out of my State, you know, for the UNO.

I think it ought to be clear in the record, Senator, that there is no provision in this bill which attempts any such action, which I agree is a totally unnecessary procedure.

Senator MILLIKIN. The question is whether there should be something in the bill that would impose a restriction on other agencies of the Government against profligate action on the subject.

The CHAIRMAN. Do you know of any attempts by any Government department—the Department of the Interior would be the one affected—looking toward taking over any great amount of territory on the theory that they could obtain uranium?

Mr. BRANSOME. Dame Rumor hath it that that is the program, and that is why we are particularly concerned. Otherwise we certainly would not be coming down wasting your time and ours.

The CHAIRMAN. There has been no proposal advanced by the Secretary of the Interior, who testified extensively on the bill. There was no suggestion of that kind made.

Mr. BRANSOME. They did withdraw some 3,000,000 acres, didn't they?

The CHAIRMAN. Was that public land?

Mr. KETT. Yes. They returned all except 220,000.

Mr. BRANSOME. Two hundred and twenty thousand acres is quite a jag of land.

Mr. KETT. And that ground was taken out for another purpose, but it actually did cover practically all the vanadium territory in the State of Utah.

The CHAIRMAN. How was that done, Mr. Kett?

Mr. KETT. It was taken out by the Department of the Interior.

The CHAIRMAN. Acting under what authority?

Mr. KETT. That I don't know. Secretary Ickes just took it out.

Mr. BRANSOME. He did it under an emergency war power, I believe; I am not sure about that, Mr. Chairman.

The CHAIRMAN. We can call on the Secretary for a statement as to why that was done.

Mr. KETT (indicating ore samples). This is the roscelite containing about 2 percent vanadic oxide, and very little uranium. However, the uranium is recoverable.

This is an ordinary grade carnotite, 2 percent vanadic oxide and about .20 percent uranium oxide. That would be 4 pounds of uranium oxide per ton.

These are a little higher grade. You will notice they are a darker color. That is an indication of the vanadium content right there. The darker they get, the higher grade they are.

Here you commence to get still darker. That runs up to 6 percent vanadic oxide and about 5 percent uranium oxide. The uranium is not very evident but it is in there. The yellow color is uranium.

This is a carbonized piece of vanadium ore, high grade.

Here is a piece of petrified log. You can see the grain of the wood in that.

That would be considered pretty high grade uranium ore. You see the yellow. That is uranium. That is a replacement of wood.

This is still higher grade vanadium. This is calcium vanadate, the red on there.

Here the yellow begins to show quite plainly, the dark streaks being the vanadium and the yellow uranium.

Senator MILLIKIN. What percent?

Mr. KETT. That is about 4 percent each.

This is another piece of petrified wood, very much smaller, you see. It is a chip.

These are all in sandstone. They are impregnated in sandstone.

This is one that is impregnated in conglomerate. You see the little pebbles? That is rather rare. That came from down in the Indian Territory from the Navajo Reservation.

Here is a piece of high-grade uranium "tree." You can't get it any higher grade than that. That will carry 30 percent uranium oxide.

Senator MILLIKIN. I thought it would be heavier than that.

Mr. KETT. They say out West if you put it in your pocket and keep it there long enough, you will get a blister. I don't know whether you will.

That powder is what we manufacture.

Senator MILLIKIN. That is 50 percent?

Mr. KETT. Fifty percent uranium oxide. That comes from our place looking like this.

Mr. BRANSOME. And it will not blow up.

The CHAIRMAN. It occurs to me that the Navy has certain oil reserves for national defense, bearing upon the withdrawal by Secretary Ickes of 220,000 acres. Is that the amount, 220,000 acres?

Mr. KETT. That is all in the State of Utah.

The CHAIRMAN. Now, that was about 220,000 acres that they finally withdrew?

Mr. KETT. They finally withheld that.

The CHAIRMAN. I suppose that was on the same principle of sequestering for future uses for defense part of the natural resources. Have you any feeling about that, as to the wisdom of doing that?

Mr. KETT. No, I haven't, and I don't think that would curtail operations in the mineral field to any extent. I don't know just which acreage it is that the 220,000 is in.

The CHAIRMAN. It occurred to me there was an analogy between withholding certain public land that might have a high uranium content exclusively for defense purposes.

Mr. KETT. Well, there is no such thing.

Mr. BRANSOME. In this country.

Mr. KETT. It is all contained in such a very minor constituent of these vanadium ores that you cannot just say, "This is a uranium district." It never is. It is a vanadium district carrying perhaps a little more than the average amount of uranium. It is so definitely pinned to vanadium that you cannot separate them.

The CHAIRMAN. Thank you very much.

Mr. BRANSOME. Answering your question, we certainly would not, as a company or as individuals, be against anything that tends to cooperate toward the national defense either now, in time of emergency or to prepare for it in the future; and that is one of the main reasons for our coming down here, as we say in our statement.

The CHAIRMAN. Yes; I think we understand.

Mr. KETT. Could I add something, Mr. Chairman?

The CHAIRMAN. Certainly, Mr. Kett.

Mr. KETT. What we really would like to see in here is a very short clause. I wouldn't attempt to tell you the wording of it, but something like this:

"No land at present belonging to the United States Government or in the future acquired by them should be withheld or withdrawn from public location."

Senator MILLIKIN. Mr. Chairman, I would like to suggest that the witnesses give us the exact language that they would like to see by way of amendment, and submit the exact language to us, giving their own words on it.

Mr. BRANSOME. We would be glad to do that.

The CHAIRMAN. Let me ask you this. When you withdraw, as the Secretary has, this acreage, does that bar prospecting on the acreage?

Mr. KETT. The only way you can take out a claim then is through a lease, a Government lease from the Department of the Interior, and that is a long-winded procedure.

Mr. BRANSOME. You have to go into the Department of the Interior and get a prospecting license. Then they allow you so many acres—this is the present arrangement—in a State, and you must, after you do all your prospecting—and mind you, somebody could be following you along the path and then it is put up to public bid after you have put in all your work. The thing is not conducive to exploration and development of uranium materials.

We have I don't know how many acres in Arizona and New Mexico in the Indian reservations. We went in there and prospected, and then these things came up for public bid. The only reason we ever did that, Mr. Chairman, I assure you, was because the war was on. Otherwise we never would have bothered with it. There is no sense sending a man in, or 10 men in, on a desert and having them stay

there for 6 or 8 months to develop claims, and then have somebody follow you right along and say, "Sure, if we think it is good, we will take it," then not knowing what you are going to pay for it. They come in and get it.

The CHAIRMAN. That is very disturbing to the fellow that does it. Senator MILLIKIN. This process of exploration on the public domain leads either to a possessory title in the miner or to complete title if he wants to go to patent; whereas, under the leasing system he never owns, he is a lessee on terms prescribed by the Government.

The CHAIRMAN. This committee will meet again at 10 o'clock Monday morning, in a room to be announced later.

(Whereupon, at 12:25 p. m., the committee adjourned until 10 a. m., Monday, February 11, 1946.)

ATOMIC ENERGY ACT OF 1946

MONDAY, FEBRUARY 11, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m. in room 324, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Millikin, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will be in session.

Dr. Stewart, I understand that you are appearing from the Office of Scientific Research and Development. We are glad to have you with us. Will you go right ahead, sir?

STATEMENT OF IRVIN STEWART, DEPUTY DIRECTOR, OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT, ACCOMPANIED BY JOHN T. CONNOR, FORMER GENERAL COUNSEL, OSRD

Mr. STEWART. I shall be glad to, sir.

My name is Irvin Stewart. I am Deputy Director of the Office of Scientific Research and Development and I am appearing here in the absence of Dr. Vannevar Bush, the Director, who is temporarily in California.

The Office of Scientific Research and Development (OSRD) was established on June 28, 1941. Among other things it succeeded to the responsibilities of the National Defense Research Committee (NDRC), which had been established by the Council of National Defense on June 27, 1940.

When the NDRC was established, President Roosevelt instructed the Committee on Uranium, which had been established some months earlier with Dr. Lyman J. Briggs, Director of the National Bureau of Standards, as chairman, to report to the NDRC. The Briggs committee was made a subcommittee of the NDRC. When the NDRC on June 28, 1941, became an advisory committee within the OSRD, the Committee on Uranium continued as a section of the reorganized NDRC. Later the work on atomic fission was reorganized in such a way that it was conducted immediately under the Director of the OSRD rather than as a part of NDRC operations.

During the period of approximately 1 year when the NDRC had the power to contract, contracts were signed on its behalf by Dr. Bush as its chairman. When OSRD was established and Dr. Bush became its Director, he designated the executive secretary as the contracting officer of OSRD. I held that position at that time, so my

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name appears as that of the Contracting Officer in most of the OSRD contracts in the field of atomic fission.

Research and development in the field of atomic fission continued to be a responsibility of the OSRD until the end of April, 1943, at which time the Manhattan district assumed that responsibility along with the responsibility for engineering and construction which it had originally assumed approximately 1 year earlier.

It is my understanding that your committee wishes to have the record contain the facts as to how OSRD and the War Department handled patent rights in the atomic fission project, and I wish to state the facts with regard to the patent provisions we inserted in OSRD contracts. I shall leave to Capt. R. A. Lavender, USN, retired, the OSRD and the Manhattan district patent adviser, the explanation of the contract provisions in the War Department contracts, and the administrative procedure that he followed under both the OSRD and the War Department contracts.

In its contracts OSRD used two forms of patent clause. The form adopted by the NDRC shortly after its organization in the summer of 1940, and known as the short form, provided essentially that the Government had the power to determine the disposition of all rights in discoveries and inventions made under NDRC contracts. A number of the vitally needed industrial organizations to whom NDRC submitted research and development contract proposals were unwilling to accept such a provision.

The CHAIRMAN. Now, you are talking about no field in particular, but you are talking about all fields?

Mr. STEWART. That is correct, that is the general statement.

The CHAIRMAN. Are there any companies in this field that refused to accept the short form?

Mr. STEWART. I will cover that a little later in the statement, sir.

The members of NDRC decided that some modification was required if research and development on weapons of war was to be conducted by the most competent and experienced organizations in the country with the speed which the state of world affairs indicated was essential. Therefore, Mr. Conway Coe, then Commissioner of Patents and a member of NDRC, was requested to negotiate the matter, and the discussions which followed with potential industrial contractors resulted in the recommendation by Mr. Coe and the adoption by NDRC of a second type of patent clause, thereafter known as the long-form clause, which was modeled after the patent provisions which had been used by the Army and Navy for many years in their contracts with nongovernmental organizations for research and development work. Essentially the long-form clause left with the contractor the title to inventions made under the contract, subject to a license in favor of the Government for military, naval and national defense purposes. With the adoption of the long-form clause NDRC signed a number of contracts, with industrial organizations which had been hanging fire for several months pending agreement upon a mutually satisfactory patent clause.

Those two types of patent clauses were regularly used by NDRC and by OSRD. The long-form clause was used primarily in those cases where NDRC or OSRD was dealing with a contractor who had an established position in the field of work or a substantial amount of basic information which NDRC or OSRD wished to have concentrated upon a specific problem concerning the development of a

weapon or an instrument of war. The short-form clause was used in cases where the Government took the initiative in stimulating the assembly of a group of men to work in a field where such a fund of information was not available in a single organization. As an illustration, I might mention the radiation laboratory established under an OSRD contract at the Massachusetts Institute of Technology to conduct work in the field of microwave radar. In that case scientists had to be gathered together from all over the country and many new laboratory facilities had to be acquired by the contractor. Therefore, we used the short-form patent clause in the contract, and the result has been that the Government has acquired title to scores of inventions in the field of microwave radar. In addition, the short-form clause was regularly used in OSRD medical research contracts because of the unusual public interest involved. This committee may be interested to know that a complete statement of the use of the long- and short-form patent clauses by OSRD has already been furnished by Dr. Bush to the Kilgore Subcommittee on War Mobilization. In summary, OSRD had 780 short-form contracts under which \$338,911,644.92 was obligated, and 1,410 long-form contracts under which \$165,675,748.52 was obligated.

At the time the program on atomic fission was taken over by NDRC, the initial contracts were executed with organizations which already had done work in that or related fields. Also, the program started on a small scale, and the chances of success in terms of weapons (which was the NDRC interest) were considered relatively modest. Therefore, the early NDRC and OSRD contracts in the field of atomic fission contained the long-form patent clause under which the contractors would receive titles to patents and the Government would receive a royalty-free license. As the project grew, as those contracts began to produce successful results, and as the tremendous possibilities of those successful results extending far beyond the field of military weapons began to take shape, Dr. Bush became concerned about the matter and reviewed the situation with various interested OSRD officials.

About that time also, in the late spring of 1942, Dr. Bush communicated the results of the combined efforts in this work to President Roosevelt, and the President fully grasped the significance of the project and the results of its solution. Therefore, the President decided that Government control should, at least initially, be exercised through the handling of patent rights, and he directed Dr. Bush to arrange as far as possible for the vesting in the Government of the title to patents on inventions and discoveries made on the project.

Dr. Bush and I then requested Mr. John T. Connor, OSRD counsel, to proceed, with the advice and assistance of Captain Lavender, to negotiate the matter with the various contractors involved. Mr. Connor first approached the Standard Oil Development Co. representatives, and found that they were receptive of the suggestion that the Government control the disposition of all patents on the atomic fission project by the use of the short-form patent clause. The Standard Oil people not only agreed to give the Government such control over inventions and discoveries thereafter made, but they also agreed to amend earlier contracts so as to cover all such work since its commencement under NDRC contracts.

Thereafter the problem was discussed with Columbia University, Westinghouse, the M. W. Kellogg Co., the University of Chicago, the

du Pont Co., the University of California and the other OSRD contractors in this field. Because of the unusual public interest involved, they all agreed to accept the suggested change to the short-form patent clause covering all research and development work in the field under OSRD contracts, and to make that change retroactive to the beginning of work under those OSRD contracts. It took a little time to work out the details of effecting the necessary contract amendments. We had the benefit of the legal advice of Mr. Oscar Cox, then general counsel of the Office for Emergency Management, and of his associate, Mr. Malcolm Langford. Acting upon the legal advice of Messrs. Cox, Langford, and Connor, we decided and the contractors agreed that no monetary consideration would be given by the Government for the patent rights that already had vested in the contractors through operation of the original provision, but instead the necessary consideration would be supplied by supplemental agreements continuing the work as each of the contracts involved required renewal.

Senator MILLIKIN. Had any applications for patents actually been filed at that time by any of these contractors?

Mr. STEWART. I am told yes.

Senator MILLIKIN. Will someone tell us about that later on?

Mr. STEWART. Yes; that will be covered.

The CHAIRMAN. I don't quite get the consideration, Doctor—"but instead the necessary consideration would be supplied by supplemental agreements."

Mr. STEWART. Our contracts, sir, were written for limited periods of time and for amounts of money not in excess of stated sums; and as we neared the end of a particular period, we put in more money and changed the patent clause at that time.

The CHAIRMAN. In other words, when you changed it from the long form to the short form, when you renewed the agreement, you gave them a little more money?

Mr. STEWART. Yes, sir; but that was for additional work.

The CHAIRMAN. Yes; I understand.

Senator MILLIKIN. What was the consideration for the acceptance of the short form?

Mr. STEWART. The fact that the work was to be continued beyond the period which originally had been stipulated.

The CHAIRMAN. Well, that isn't quite accurate as to why they took the short form instead of the long form, which was Senator Millikin's question. Providing your testimony is borne out, they really did it for patriotic reasons, didn't they?

Mr. STEWART. I thought it was the consideration of the narrower legal questions involved.

Senator MILLIKIN. That is exactly what I was probing, and I was wondering what the legal consideration was.

Mr. STEWART. The extension in time for the financing of the work for the extended period; but the basic consideration, as stated earlier, was that it was the public interest in the entire project that caused them to be willing to do it.

That process of supplementing and amending the contracts case by case took a few months, but all necessary contract amendments were executed well before the OSRD research and development contracts were terminated and the project transferred to the Manhattan

district in the spring of 1943. In its termination agreements OSRD inserted a provision under which it was expressly stated that the Government retained all of its patent rights.

The result is that, under all NDRC and OSRD research and development contracts, and under all subcontracts involving research on the atomic fission project, the Government received the right to determine the disposition of all patents covering inventions and discoveries made during the course of the required work. In five other contracts primarily for materials or for the maintenance of equipment in standby condition which did not involve research, OSRD used the long-form patent clause.

Senator MILLIKIN. Would any of the contractors providing materials or maintenance equipment be in a position to learn anything which they might patent?

Mr. STEWART. I believe not.

Senator MILLIKIN. Thank you.

Mr. STEWART. One contract for production, which as work progressed required investigation and research, carried the long form; it was never renegotiated because no inventions were made. In addition, there are three contracts under which "in-between" clauses were used in unusual factual cases.

For your information, the short-form patent clause used in OSRD contracts provides as follows:

PATENT PROVISIONS.—It is understood and agreed that whenever any patentable discovery or invention is made by the contractor or its employees in the course of the work called for in paragraph No. 1 hereof—

That was the paragraph defining the subject work—

the contracting officer shall have the sole power to determine whether or not a patent application shall be filed, and to determine the disposition of the title to and the rights under any application or patent that may result. It is further understood and agreed that the judgment of the contracting officer on such matters shall be accepted as final, and the contractor, for itself and for its employees, agrees that the inventor or inventors will execute all documents and do all things necessary or proper to carry out the judgment of the contracting officer. The contractor agrees that it will include the provisions of this paragraph in all contracts of employment with persons who do any part of the work called for in paragraph No. 1 hereof.

Senator MILLIKIN. I suggest that it is very clear as to who has the power to determine what shall be done with the power, but I suggest also that it is not made clear that the United States Government owns the patent.

Mr. STEWART. May I suggest that that is probably covered in the next paragraph?

In administering all OSRD contracts, including those in the atomic fission project, containing the short-form patent clause, Captain Lavender operated under a general delegation of authority that provided for (1) a reference either to the War Department or the Navy Department, depending upon which Department was the source of a request to OSRD to undertake the particular project, for a determination as to whether or not an application for a patent should be filed on behalf of the Government, (2) if the War or Navy Department determined that such an application should be filed, the filing of the patent application, and the arranging for the assignment of the entire right, title and interest to the Government.

Senator MILLIKIN. I still suggest that that does not say that the Government gets those patents free of consideration.

Mr. STEWART. May I ask your indulgence for just a couple of sentences more?

Senator MILLIKIN. Yes.

Mr. STEWART (continuing). And (3) if there was a determination by the interested Department that no patent application should be filed on behalf of the Government, notification of the contractor that, if it so elected, it might file in its own behalf with the understanding that it would grant to the Government a nonexclusive, royalty-free license for governmental purposes. That delegation of authority also provided that the procedure described above should not be followed in some exceptional cases wherein Captain Lavender was advised by the OSRD contracting officer for the particular contract that because of unusual facts some other disposition of the patent rights should be made.

For inventions and discoveries arising out of OSRD contracts in the atomic fission project, the general policy was established by Dr. Bush and me, and followed by Captain Lavender, of vesting title to patents in the Government.

Senator MILLIKIN. Now, what makes it clear that there is no consideration to the inventor?

The CHAIRMAN. Have you got a copy of the contract here, the long form and the short form?

Mr. STEWART. Yes; the short form I have just read.

The CHAIRMAN. Is that all there is to it?

Mr. STEWART. That is all there is to the short form.

Senator MILLIKIN. It seems to me, if I may suggest, as far as we have gone, that provides a very clear mechanism as to who shall make application and who shall determine who shall make application, and in the one case if someone else makes application that it would grant to the Government a nonexclusive royalty-free license for governmental purposes. In other words, it is a sort of a power of appointment, but so far I do not see that the United States Government gets that free of consideration.

The CHAIRMAN. Senator, if you will look at the language again, the contracting officer of course is the agent for the Government, and he shall have the sole power to determine whether or not an application shall be filed to determine the disposition of the title to and the rights under any application or patent that may result.

Senator MILLIKIN. Well, I still claim that that is in the nature of a power of appointment rather than a grant to the Government or a right reserved to the Government to have the patent free of consideration. That is just off the cuff. You gentlemen have given it a lot more study than I have.

Mr. STEWART. It has been our interpretation of the clause, which has been concurred in by all of our contractors, that under that clause we could order the title into the Government, and nobody has ever raised the question.

Senator MILLIKIN. Without consideration?

Mr. STEWART. Without consideration, yes; and I can state flatly that there has been no consideration in any case.

Senator MILLIKIN. And no one has made a claim for it?

Mr. STEWART. That is correct, sir. It was recognized, however, that in some cases some other disposition might be required, and Captain Lavender understood that any such exceptional cases should be referred to Dr. Bush and me for the determination required by the contract provisions.

So far I have discussed only the OSRD contract provisions. In addition, the Director of OSRD is concerned with the patent problems arising under the War Department research and development contracts as a result of an arrangement established at the request of Mr. Henry L. Stimson, then Secretary of War, at the time when the research and development work was transferred to the Manhattan district. At that time Mr. Stimson told Dr. Bush that in his opinion it was advisable to have one centralized administrative group handling all patent rights on the atomic fission project, and Mr. Stimson requested that the OSRD Director be the custodian of such rights. General Groves also pointed out that Captain Lavender had already set up a patent administrative organization and was familiar with the problems. As a result of those discussions, the War Department atomic fission research and development contracts provide that the OSRD adviser on patent matters shall be the contracting officer's representative for patent matters. Captain Lavender was the OSRD patent adviser and as such acted as the patent adviser for the Manhattan district.

Senator MILLIKIN. Does the Government as such have the right to make a patent application, or is that always in the name of an individual?

Captain LAVENDER. It is filed in the name of the inventor.

Mr. STEWART. I shall be glad to try to answer any questions you may have concerning the OSRD contracts and patent policy in this field. Before doing so, however, it might be advisable for Captain Lavender to describe the procedure he worked out for administering these problems arising under OSRD contracts, and you also may desire him to describe the contract provisions and patent administrative procedures under the War Department contracts.

The CHAIRMAN. Mr. Connor?

Mr. CONNOR. Sir, I have nothing to add to this statement, but I will be glad to answer any questions.

The CHAIRMAN. Thank you very much.

Captain Lavender.

STATEMENT OF CAPT. ROBERT A. LAVENDER, UNITED STATES NAVY, RETIRED, ACCOMPANIED BY COMMANDER ROLAND A. ANDERSON, UNITED STATES NAVAL RESERVE

Captain LAVENDER. My name is Robert A. Lavender, captain, United States Navy, retired, on duty in the Office of the Secretary of the Navy and assigned personally by the Secretary of the Navy to the Director of the Office of Scientific Research and Development, and appointed or designated by Dr. Bush as adviser on patent matters to OSRD.

Commander Roland A. Anderson is my first assistant on contractual and administrative matters.

The problem that faced the Manhattan district was quite different from the problem that was faced by OSRD. That is, in addition to carrying on the research and development, they were required to make contracts for the quantity production of all manner of equipment. The contracts ran from the construction of buildings and sewers in cities and towns, up to the construction of the apparatus that went into the heart of the atomic energy program.

In addition to that, they required research to work out further problems as were developed by OSRD and carry on other developments.

So it was felt that on a construction contract, or where they were purchasing merely equipment off the shelf from contractors, there would be no patent clause at all, and it would be no more than if the Government was going out and purchasing this equipment.

Senator MILLIKIN. May I repeat a question asked a while ago? I can see where if you buy something off the shelf there is no patent angle involved.

Captain LAVENDER. That is correct.

Senator MILLIKIN. Would a contractor that installed or assembled that stuff be in a position to observe anything else that might be patentable, or would he be in a position to patent the arrangement of that stuff?

Captain LAVENDER. I shall come to that, if you will indulge me for a moment, because I will now describe the four patent clauses that were used in the Manhattan district production and research contracts.

For the research contracts we had the regular short-form patent clause without any additional limitations. That is, the Government had the right to determine the disposition of the whole right, title, and interest in inventions.

Senator MILLIKIN. Let me ask you at that point whether in your opinion that is the same as saying the Government shall own the patent without consideration if it shall desire to do so?

Captain LAVENDER. That is correct, sir. Then a type of contract was used where they had the short-form patent clause modified, where the contractor, as a matter of contract right, could retain a nonexclusive license in outfields, and I shall define "outfield" as commercial activities, and "infield" as any mechanical device, apparatus, or process that is used in the atomic energy program. That type of contract was used where there was some information given to the contractor as to the research work that had been done, and it was, you might say, particularly applicable to the atomic energy field.

Then there was the third type of contract with the short-form patent clause, in which we had the right to determine the disposition of the rights under inventions made in carrying out the work under the contract, but the contractor retained the sole license under the inventions with the right to grant sublicenses. That contract was used where we went to a contractor in his own field of development, but there was some engineering or redesign for the particular work that we were engaged in. In other words, it was a contract where there was a slight modification of the standard production but with the chance that in working with this or assembling the material he may find some invention that did have some reference to atomic energy which the Government would desire to control.

Therefore, we said that as far as the commercial rights are concerned, he can have those rights the same as the ordinary development contract by the Navy and War Departments, but that the Government

still had the right to determine the disposition of the rights except for the reserved conditions, and it did have the title to the invention, so that the Government could exercise all of the powers that the title to the invention and the patent gives, and have not only the infield rights in whole, but would have a license under outfield rights as well.

Senator MILLIKIN. May I ask at that point, please, that you give us some examples of the type of thing you have been talking about?

Captain LAVENDER. We go to a contractor; for example, the Westinghouse Co. The Westinghouse Co. has established a very forward position in transformers and associated equipment. We asked them under several of these contracts to design control circuits and other equipment involving transformers, and also other equipment to be used with the calutron, which is one of the devices developed at the University of California, and the Manhattan district went to the contractor because he was preeminent in this field. So in giving him the information as to how it was going to be used, we realized that there was a possibility that there may be some invention that would so relate to the atomic energy program that we would want the title to it, but as far as any of the inventions in their application to commercial work were concerned, it was felt that the public should have the benefit of having that type of equipment put on the market for all commercial activities.

Senator MILLIKIN. Might that type of equipment, the information that would be given by a patent application, give possible clues as to other things that we might not want to reveal.

Captain LAVENDER. Well, those applications, of course, were very carefully scanned, and those applications are still in the Patent Office, because the Government files those applications. It has full control over them as to when they are going to be released to the public.

If an application is written so that there is no clue at all as to how it can be used, and there is no reason for that application to remain in the Patent Office, then the application may be issuable as a patent. But the Government still has control of that application so that it can keep its secret as long as it desires.

Senator MILLIKIN. By what authority does the Government impose a wall of secrecy around an application?

Captain LAVENDER. That is a provision in the law. It is 35 U. S. Code 37, which says that when the title of an invention is in the Government, the normal response of 6 months that is required for an applicant to respond to an office action by the Patent Office shall be extended to a period of 3 years so that the Government then can wait the 3 years until it submits its next amendment, and a claim again can be put in the application which would not be allowable, so that it is rejected again and then another 3 years is given. That is the machinery that has been set up by the Congress for the Government to control the date of issue of a patent.

Senator MILLIKIN. Has the Congress determined how you should establish priority in that case? Suppose I today filed an application covering the same subject matter as one of these impounded applications. How would I know that there was something of that kind there? What explanation would the Patent Office make to me?

Captain LAVENDER. At the present time there is a public law which says that during the emergency the Patent Office may issue orders of secrecy, in which case the applicant is notified of that order, and he is forbidden then to disclose it to any other person. The application is

not issued, so at the present time there would be set up in the Patent Office an interference. A notice would be given by the Patent Office of the pendency of another application which covers the same subject matter as one of these applications owned by the Government. We have received notification of one such interference. The interference is suspended and, as long as the present law, which is a war emergency law, continues, that application filed by the independent inventor will not issue. That will be one of the items that should be taken up by the Congress at this time to provide the machinery for the Commissioner of Patents to notify the Commission that is to be organized and authorized of the existence of an application covering common subject with the Government's program. Then arrangements may be made by negotiation for seizure of those rights to maintain its secret, if it is necessary to do so.

Senator MILLIKIN. Now, in the case where I have made that application, I get a notice that there is an interference, and I assume that you also have notice of my application and that there is an interference?

Captain LAVENDER. That is correct, sir.

Senator MILLIKIN. That being the situation, how am I able to protect myself against that interference? How do I know what the ground of it is? Am I just suspended off in the thin air until Congress does something?

Captain LAVENDER. Well, at the present time the application would be under an order of secrecy, so that your right to have interference has been suspended. The law also provides that if the Government uses that invention and infringes a claim that is later issued when the matter is fully determined, then the applicant is permitted to recover for the reasonable use of that invention before the application issues, whereas the rights of an inventor do not otherwise accrue until the patent issues.

Senator MILLIKIN. Does that general system prevail under the law in peacetime as well as wartime?

Captain LAVENDER. It does not.

Senator MILLIKIN. The justification, in other words, is a matter of wartime necessity?

Captain LAVENDER. That is right.

Senator MILLIKIN. Would you mind stating again now what the Congress should do?

Captain LAVENDER. I would suggest that the Congress merely authorize the Commissioner of Patents, authorize and direct the Commissioner of Patents to report to the Commission and give copies of applications, of all of the applications that have been filed and are being filed in the Patent Office that include statements regarding the release of atomic energy. The Commission then will be in a position, through other provisions, of obtaining rights under that invention through negotiations with the inventor. It can purchase the invention itself, and when it does so it will have control over its future disclosure.

Senator MILLIKIN. Thank you very much.

Captain LAVENDER. Now, the fourth group of contracts are those where the purchases are off the shelf, and it occurred in some cases where manufacturers were called upon to furnish equipment with which they had not been familiar in their manufactures before the

time of the contract. Time was necessary ordinarily in such cases to investigate the patents that may be involved in this equipment, if the contractor was to assume the liability for the infringement of patents. There was in these contracts for equipment, when there was not time, a clause which provided that the Government would assume the liability for the infringement of patents.

Where we purchased a piece of equipment off the shelf in which the manufacturer had had extensive experience, we used the same clause that is used in other Government contracts, namely, that the contractor assumed the liability of patent infringement.

The next problem that faced the district was that at times they would reach a point in the assembling of a plant or the changing over from the research work that had been done to quantity production where they ran into a great many very highly technical engineering problems.

The CHAIRMAN. Captain, I just want to get this straight. Dr. Stewart said they had the long form and the short form. He explained the conditions under which it had been used up until they turned it over to the Manhattan district.

Now, you have mentioned four variations, as I understand it, of the short form. You apparently didn't use the long form at all?

Captain LAVENDER. No; the long form was not used in its language, but we approached the long form in this way: In the third category, where the contractor retained as a matter of contract right the sole license under that invention, he really had the title except that the Government had the shell of the title, so that it could exercise full control over the invention.

The CHAIRMAN. Now, have you got a break-down with you of the numbers of contracts that were treated in each one of those categories?

Captain LAVENDER. That can be worked out. I haven't worked it out, but I can give you the approximate figures.

Of course, if you are going to work it out from a dollar point of view, the dollar values are very heavy in favor of the third category, because there is where all the quantity production was. I would estimate offhand, and I haven't ever worked it out, from my familiarity with it, that there are about 5 to 10 percent of the research contracts in which the Government had the whole right, title, and interest, and the contractor retained nothing. That is category 1.

It would run from 25 to 40 percent in category 2, and the rest of them were the equivalent to the long form, or category 3.

The CHAIRMAN. How many applications have been filed with your consent in the Patent Office?

Captain LAVENDER. The actual number of cases that have been filed, I have been told, should be given in executive session; but I have that approximate number and I can give it to you. That is about the only thing that they said should be given in executive session, but I should be very glad to give that.

The CHAIRMAN. Can I assume, Captain, from what you have told us that all applications that have been filed have been filed through you?

Captain LAVENDER. That is correct, except as provided for with the OSRD that where it has been determined that the Government is not going to file an application, then the contractor has the right to file that application subject to a license in favor of the Government.

I might elaborate a little bit on that point to tell you of the conditions under which it is determined that an application shall not be filed. Take a case where the invention is a small detail—it may be a frame that is used for handling a particular piece of equipment. We call it a “dolly.”

Now, the use of that invention is not extensive. There are an enormous number of patents in the background that have been issued to cover that. The inventions themselves are analyzed to see whether or not there is any improvement over the prior art. If it relates to anything toward the center of the atomic program, of course we file. If it is some little mechanical detail that perhaps may be used in a very few cases, where the chances of getting a valid claim are very small, it isn't worth it from a manpower proposition and expense to the Government to go ahead and prepare to file an application on that and then have it battled through the Patent Office year after year trying to get some claim that in the end doesn't amount to much to the Government. We might spend more trying to get a patent on it than we would if somebody else got the same idea and we had to pay royalty.

On the other hand, it may be that that invention relates fairly closely—as it would be under a third-category patent clause—to the particular work of the contractor; so to him it is different because he may be able to explore a market where it would pay him to file that application. We say then that as far as the Government is concerned it is not worth while to file, but if the contractor desires to file, let him file and we can get a license.

The CHAIRMAN. Well, Captain, what I don't know about patent law would fill a great many books, but what I want to find out is this: Are there any patent applications now in the Patent Office by private companies applying for patent rights on processes which brought about the fission of the atom?

Captain LAVENDER. There are some that have been filed by independent inventors.

The CHAIRMAN. Not connected with the Government's project?

Captain LAVENDER. Not connected with the Government's project at all.

The CHAIRMAN. And there are no patent applications down there that came through you bearing upon the basic situation of splitting the atom?

Captain LAVENDER. Oh, no. All of the applications that relate to any of the basic work of this project, as supervised by OSRD or the Manhattan district, have all been filed by me, and, in accordance with provisions of the contracts under which they arose, the assignments of title are such that the Government has the title to those inventions.

The CHAIRMAN. How about what might be termed “atomic energy devices”? Have any patent applications come through you on those? Have any of them been filed by any of the contracting firms?

Captain LAVENDER. No, we have filed all of the applications, I think, with the exception of a very few, most of which are those that have been turned back to the contractor, who has been told that he can file. The latter are all on minor, unimportant mechanical details and devices that have a particular commercial application.

There was in process just this last week, for instance, such an application. I received a letter from a company saying that they were going to file these applications that have arisen under a contract. I believe their contract was of category 2. Those applications are going to be taken over by me, because all applications that are filed that have anything to do with the processes involved must be filed and prosecuted by me.

The CHAIRMAN. Captain, were there any cases where the Government had the right, title, and interest in the patent but granted an exclusive license to private contractors?

Captain LAVENDER. Not except those in which the contract itself provided that right. There have been requests for licenses under certain inventions which have not been granted, because the Manhattan District or the War Department did not desire to establish any kind of a precedent that would in any way hamper the Commission that is going to be formed.

The CHAIRMAN. Well, Captain, I just want to get this straight. The Government does own outright quite a few patents?

Captain LAVENDER. That is correct.

The CHAIRMAN. Now, under the contract that was made with the contracting officer, the other parties to the contract were permitted to have an exclusive right to produce under those patents even though the Government held them. Is that correct?

Captain LAVENDER. They had the exclusive right in outfields.

The CHAIRMAN. In outfields?

Captain LAVENDER. In normal commercial application.

The CHAIRMAN. Not in any way connected with atomic energy?

Captain LAVENDER. That is right.

The CHAIRMAN. So the Government owns the title to the patent that is good for any application of atomic energy?

Captain LAVENDER. That is correct.

The CHAIRMAN. But if a pump, we will say, could be used in a hundred other different ways, the Westinghouse, we will say, has an exclusive right to use it in a hundred different ways?

Captain LAVENDER. That is correct. I will just define your word "exclusive," because that has a particular patent law meaning. Exclusive license is construed as a right to exclude others, even the owner of the title. For instance, if I had a patent, I could designate someone as the exclusive licensee, in which case I myself would have given up the right to use.

We use the word "sole license". That means that there will be only one licensee and that is the contractor.

But the Government, because it has the title, not only has not given away the infield rights, but it is also permitted to operate in outfields. I only mentioned that because "exclusive license" in patent law has a definite meaning whereby the exclusive licensee could even exclude the owner or the titleholder.

The CHAIRMAN. The Government then can operate in the outfield as well as Westinghouse?

Captain LAVENDER. That is correct.

Senator MILLIKIN. But no one else?

Captain LAVENDER. That is correct.

The CHAIRMAN. Now, do you regard the break-down of this as confidential information which should be given in executive session?

Captain LAVENDER. The break-down of the number of contracts?

The CHAIRMAN. That is the only thing that I understand you regard as that which should be given in executive session.

Now, are you prepared to give us a list of the patent holders?

Captain LAVENDER. You mean the contractors?

The CHAIRMAN. Yes.

Captain LAVENDER. Yes, but that normally will be furnished by the contract section of the Manhattan district, because they are the custodians of the contracts, and they will give you a list of those that come under the different categories. I can also furnish you that.

The CHAIRMAN. And you can furnish us the name of each company that has filed a patent application down at the Patent Office?

Captain LAVENDER. Those would be practically nil because all of them have been filed through my office.

The CHAIRMAN. You filed those?

Captain LAVENDER. I filed them.

The CHAIRMAN. Quite a few of them?

Captain LAVENDER. Yes, sir. It is only in those cases where the patent division has determined that the Government will not file an application that the application is filed by the contractor.

The CHAIRMAN. Through you?

Captain LAVENDER. No; he can file direct; but I would say there are not more than 15.

Senator MILLIKIN. Fifteen contractors or applications?

Captain LAVENDER. Fifteen applications.

The CHAIRMAN. Again just to make clear, what are those 15—I don't mean by name.

Captain LAVENDER. You mean the subject matter?

The CHAIRMAN. Yes.

Commander ANDERSON. They relate to mechanical developments.

Captain LAVENDER. I think one is a very minor improvement on a diaphragm pump, and after examination I determined that it wouldn't be worth while for us to try to get a patent on it. The company itself said, though, that they would like to file an application, so we turned it over. As a matter of fact, I take the initiative because it has been referred to me to determine whether or not an application should be filed. If I determine that it will not be filed, then it is my next move to inform them that they may. Then they will inform me whether or not they intend to do it.

The CHAIRMAN. And there are 15 of those that you feel the Government has no interest in and has turned over entirely to the private contractor?

Captain LAVENDER. Except that the Government has a license under the patent if and when it issues.

The CHAIRMAN. Even though it is in an outfield?

Captain LAVENDER. Even though it is in an outfield, yes, sir. There have been a great number of determinations that the patent division will not file the application, but it has only been in about 15 cases that a company has come back and said they would file.

The CHAIRMAN. I may be a little obtuse about it, but I understand you want to give in executive session the numbers of those which the Government has filed. When the Government has filed a certain number—X number—in those the Government has, or is claiming, the exclusive right, or only the exclusive right as pertains to the atomic energy field?

Captain LAVENDER. We can put it this way, that the Government holds the title to the invention and all patents that may issue thereon. If the contractor by contract right retains a license, then that license is operative in all outfields, but the Government has all infield rights. There are no exceptions of infield rights.

The CHAIRMAN. Now, this further question: Have they retained—any contractor—by contract right, any claim to use any of these things in two instances: (a) the production of fissionable material, or (b) the application of fissionable material to atomic energy devices in the future?

Captain LAVENDER. There has been no contractor who has retained any right to use the inventions in either of your classes (a) or (b).

The CHAIRMAN. All outside industrial uses?

Captain LAVENDER. Whatever license they have retained as a matter of contract right has been in outfields.

The CHAIRMAN. That clears it up for me.

Senator MILLIKIN. Of these applications that are impounded in the Patent Office, how many people have access to them?

Captain LAVENDER. We have set up a very definite way of handling these applications, and they are known in the Patent Office as "special handling" cases. These special handling cases are designated at the time that I filed them, in the letter forwarding the application to the Commissioner of Patents. These applications are sent down to Richmond—that is, to the examiners when they are down there—only by an official of the Patent Office and delivered personally to the chief examiner of the division. The chief examiner and his assistant were the only ones who were designated by the Commissioner of Patents to handle those cases. They are kept in separate safes in the Patent Office.

Senator MILLIKIN. That is two people. Does anybody else get to look at them?

Captain LAVENDER. I would say "No." An examiner may be examining one, and the chief examiner may be on a case and have someone come up. But I have been down there several times and I know that they are very strict as to anyone being around the examiners when they are working on those cases.

Senator MILLIKIN. So at one time you said the chief examiner and now you have mentioned chief examiners. How many people could this possibly clear through in the Patent Office?

Captain LAVENDER. Each case would go to the examiner of a division who is known as the chief examiner. Now, he may have one other person—his assistant—work on that case with him. In some of these divisions there are quite a large number of cases so that one person couldn't handle them all. The only other way I suggested was that another person in the Patent Office might see them would be, say, a person who happened to pass along at the time that this case was on the desk of the chief examiner.

Senator MILLIKIN. Is there a compartmentalization so far as these particular impounded applications are concerned, so that by rule or by law in some way or other one examiner cannot be talking to another?

Captain LAVENDER. Oh, yes. The Commissioner of Patents has issued very definite instructions as to the disclosure of information to anyone who is not entitled to receive it.

Senator MILLIKIN. Have these men been very carefully studied in the light of this particular problem?

Captain LAVENDER. I would say "Yes," because the chief of the division has been a person of long service and he didn't come into that position except as his integrity, his reliability, and other characteristics were very well developed. The heads of these divisions are all very well tried officials.

Senator MILLIKIN. You would have complete confidence?

Captain LAVENDER. I have complete confidence in the system.

Senator MILLIKIN. And complete confidence in all the individuals that are involved in it?

Captain LAVENDER. That is correct. I have on several occasions been to Richmond in connection with the work on this and have talked with the examiners that have most of my cases, and I have found them all to be a very fine, reliable group.

Senator MILLIKIN. Can you tell us whether you know as a fact that the background of these men, so far as their country of origin is concerned, has been studied.

Captain LAVENDER. I didn't quite understand.

Senator MILLIKIN. If John Doe, examiner, is born in X foreign country, has that feature of it been studied specifically in the case of all of them?

Captain LAVENDER. I don't know, but I can only say this: The heads of these divisions have been tested and tried throughout a number of years, and I don't think that there is any chance of a leak there.

Senator MILLIKIN. I do not by my questioning impute anything of that kind, but in all of these things we have to take extra precautions, and I have been wondering whether a special study of those men has been made in relation to this particular stuff in its relation to the foreign implications.

Captain LAVENDER. Well, I imagine that the security division of the Manhattan district has checked the system that was established, and probably the personnel.

Senator MILLIKIN. It might not be a bad idea to look into that.

Captain LAVENDER. I feel sure the Security Division has done that.

Commander ANDERSON. The Security Division has approved them and the handling of this method.

Senator MILLIKIN. We can interpret that as meaning the system, but do you give the same answer to the personnel?

Commander ANDERSON. They have all been approved by the Department of Commerce, and taken oath with respect to which they are requested to keep all applications under secrecy. They are under the Espionage Act.

Senator MILLIKIN. That doesn't quite go to the thing I am driving at, and that is as to their suitability for the job they hold in connection with this particular thing we are talking about.

Captain LAVENDER. I shall suggest that to the Security Division and ask whether or not they have investigated the individuals.

Senator MILLIKIN. I think the odds are that they have, but it is so important that I think we ought to know rather than speculate about it.

Captain LAVENDER. That is one thing I have not the direct responsibility for, otherwise I would be able to give you the answer.

I get clearance from the Security Division; that is, any person that comes into my employ is cleared not only by the FBI, but if he is an Army or Navy officer, he is cleared by the Service Intelligence, and then he is cleared again by the security officer of the Manhattan district.

Senator MILLIKIN. May I suggest, Mr. Chairman, that the Captain look into that specifically and give us specific information on it?

Captain LAVENDER. I shall be glad to do that.

The CHAIRMAN. Very well, Senator. Will you do that, Captain?

Captain LAVENDER. I shall be glad to.

The CHAIRMAN. Captain, are all of these patents in the status of patent applications, or have any patents been issued?

Captain LAVENDER. There are no patents issued that were filed by the Government. There are certain patents relating to atomic fission which have been issued to independent inventors before the emergency.

The CHAIRMAN. Before we got into it as a country?

Captain LAVENDER. That is right.

The CHAIRMAN. Now, are there any patent applications covering the making of the bomb?

Captain LAVENDER. Yes.

The CHAIRMAN. Are there any patent applications giving the bomb-making details in those patent applications?

Captain LAVENDER. Well, I think that I had better give you that in executive session if you are going into any of the details of it.

The CHAIRMAN. Not what details there were, but whether there were any of the details given in the patent application. You don't want to talk about that?

Captain LAVENDER. Not any more than just to say that the bombs are covered by applications.

The CHAIRMAN. I wonder what is the necessity for covering the bomb itself by applications for patents?

Captain LAVENDER. Well, it is very important for this reason: I knew that as soon as the bomb went off there would be a great deal of speculation among various scientists and others, engineers, who had not been connected with the project. I knew that a great many applications would be filed in the Patent Office, so I was interested in having filed in the Patent Office these applications, so that if any applications were filed and we got into interference, the Government would not be suffering the handicap of being the second one to file, because the first to file has a great advantage from an interference procedure point of view.

The CHAIRMAN. You see, Senator, this information which we have just received makes all the more pertinent your line of inquiry. I didn't dream, frankly, up until this point that there was a patent application down there showing how the bomb was put together. Did you?

Senator MILLIKIN. No. Personally, I regret it.

The CHAIRMAN. I, too.

Captain LAVENDER. I was reserving for any discussion in the executive session another special handling of these applications relating to bombs, which I am sure fully safeguard it. I didn't mention that at the time I discussed the special handling cases.

Senator MILLIKIN. I assume from your other answer on security that the physical custodianship of these various applications is such that there isn't the remotest chance of any intruder getting hold of them.

Captain LAVENDER. That is true, and again that particular phase was investigated by the Security Division of the Manhattan district, and it approved the special provisions that have been made on the basis that they were absolutely secure.

Senator MILLIKIN. Are you personally acquainted with that phase of the business?

Captain LAVENDER. Yes, I am.

Senator MILLIKIN. Are you satisfied?

Captain LAVENDER. I am satisfied.

The CHAIRMAN. Captain, how does the fact that you have filed an application on the making of the bomb compare with other military weapons in the practice that has been followed? For instance, the bomb sight.

Captain LAVENDER. I am not familiar with what the Navy Department has done in the filing of applications for bomb sights, because my last duty with the Patent Division of the Navy Department was in 1937. But the provisions that we are making, so far as the bomb is concerned, are far more extensive than what was done with the bomb sight applications at the time I was in the Department.

The CHAIRMAN. Do you know of any case where a perfection of a weapon has been filed on by the Government?

Captain LAVENDER. Yes; a great many of the devices that I know of have been kept under the provisions of 35 United States Code 37.

The CHAIRMAN. That practice was established to protect the Government, we will say, from foreign inventors claiming at a later time that they were responsible for the use of the weapon?

Captain LAVENDER. That is correct, and the foreign inventor or independent inventors coming in and filing an application only for the Government to find that it was in a disadvantageous position because it had not filed the application and was second to file.

The CHAIRMAN. Have there been any applications from foreign inventors on atomic bombs that you know of?

Captain LAVENDER. What they contain I do not know, but I do know that there are pending in the Patent Office quite a good many applications by foreign inventors.

The CHAIRMAN. Filed before we got into the thing?

Captain LAVENDER. I think most of them were filed after we got into it. There was one application that was filed over here on a patent that had already issued in France, and that is still pending in the Patent Office here.

The CHAIRMAN. When was that filed, do you know?

Captain LAVENDER. It was filed in France and issued in France in the fall of '39, and the corresponding application was filed over here a little over a year later.

Senator MILLIKIN. Mr. Chairman, I believe it would be a good idea if we went into that a little in executive session.

The CHAIRMAN. Perhaps we had better not pursue it now.

Senator MILLIKIN. Captain, what were the considerations that allowed these people to have outfield rights? Did they insist upon having outfield rights? Was it just something that was tossed in, or how did it come about?

Captain LAVENDER. First, the policy was well thought out, I believe. I had had experience in the research and development contracts with the Navy Department, and I realized that before we went to a contractor with a proposition that we ought to have a very definite policy that would be reasonable, having particularly in mind that where an invention had commercial application the public had the right to have that made available to it, so that there wouldn't be this impounding of inventions, or a limitation.

Now, the contractor, when he determines that an invention is made with commercial activities, has got quite a little risk money involved in it to take an invention and apply it commercially. It was thought out, as far as I was concerned, with these four categories, and then the proposition was put up to the contractors. Some of the contractors felt that they ought to have a sole license instead of a nonexclusive license.

Senator MILLIKIN. That is, sole as against the Government?

Captain LAVENDER. That is right. If it were a mere construction contract with very little chance of having anything of any value to the atomic energy program, they were given the right to retain a nonexclusive license, but in a good many cases, or in one case in particular that I am thinking of, I felt that they should have the sole license. I have had a very careful check on all of these contractors. I have seven branch offices throughout the country, and in each one of those places I have a fine staff of patent attorneys who check all of the invention records. They see the equipment as it is being built and they report these inventions.

In this particular case, I began to see inventions being reported that were just a little more than construction. That tipped me off right away that I should look into that matter because of the interests of the Government. I found that after they had gone into this work they realized that they would have to do some research—of development, as distinguished from research. I confine research to the basic principles. I found that they had assigned some of their engineers to this development work, whereupon I proposed to the company that we renegotiate that contract, that the subject work had changed as a result of the progress of the contract, and that it should be in category 2 where they only get a nonexclusive license. The company saw the logic of the matter and they agreed to renegotiate the contract so that on the next extension period there would be a legal consideration, and it was changed over to the category 2.

Senator MILLIKIN. Would any of these contractors to whom you refer have refused to go ahead with their work had they not been given some patent rights?

Captain LAVENDER. No, they went ahead. When the Manhattan district went to these people, to the contractors, and asked them to make something or do something without any contract at all except just a letter of intent, they went right ahead with their work; that is the reason why the contract would come along months later. Then the whole thing would be negotiated. I don't know of a single company that ever said, "We are not going to do anything on this until we get all of these contract rights worked out."

Senator MILLIKIN. Then those privileges they have gotten, whatever they are, are sort of a gratuity we have given them?

Captain LAVENDER. No, I don't think it is a gratuity. I think it is a good sound business proposition. If we had gone to these con-

tractors where they were furnishing the equipment and came under category 3, we will say, and said, "We want the whole right, title and interest, and you retain nothing," it would be natural for the Government to pay for it, because we were taking all of the invention rights. It has been purely from a business point of view of the Government that we don't take more than what we need to have to have control of the project.

Senator MILLIKIN. You have not been paying more. I premised the whole thing on whether or not you would have to pay more in order to deprive them of any patent rights, and in your opinion it was not necessary to pay more, so the thing still stands in my mind as a sort of a gratuity.

Captain LAVENDER. No; I see that I haven't made myself clear. I believe that it should be the policy of the Government that the Government pay for what it gets and doesn't pay for what it doesn't get.

The next thing is that the Government should take or get only that part which is necessary for its administration. So it would be sound business, then, if we are going to disrupt these commercial companies in their normal business and take their highest professional men away from them and pay only the per diem salary they are getting so that the company cannot go ahead with its normal development, that we should take from them only what is necessary for a particular policy and determination of the Government. It has been just a pure business proposition with me in recommending how much and how extensive rights we should obtain.

Senator MILLIKIN. Here is what is nagging at me, Captain. Let us suppose that John Doe is a little fellow making a valve of some grade, and Richard Roe is a big fellow making a valve, and you picked Richard Roe as the man to do this particular kind of a job for you. Now comes peace, and Richard Roe appears with a lot of improvements on a product which the Government has really paid for and put him in position to make. Where does that leave this little fellow, John Doe?

Captain LAVENDER. It left John Doe with the full opportunity, when the first man was working for the Government, to go ahead and exploit or advance his position in the manufacturing field; whereas you took the engineers from the other company and had them working on something that was for the Government.

Senator MILLIKIN. Yes; but with this distinction: John Doe, the little fellow, does not have the resources of the United States Government to go ahead with his developments, whereas Richard Roe has the resources of the United States Government behind him.

Captain LAVENDER. All right. There still is a very easily adjustable position, because the Government has the title to the invention, and if it comes under category 2—which it would be if it had more than just a sort of readjustment of a standard equipment of the company—the Government then can grant a license to the small man in exchange for a license under anything he may have.

Senator MILLIKIN. That is under one category, but what about the category where the contractor has an exclusive right as against the Government?

Captain LAVENDER. Well, in those cases it is true that the Government does not get the right to grant these licenses to the other company; but those cases cover merely a slight adaptation of the standard

company's products, and I don't think it would be very effective in changing the relative position between the small company and the big company before and after the date of the contract.

Senator MILLIKIN. To my mind it might very seriously, but let us pass to two relatively big companies. I don't care to make a demagogic point out of it. Take two big companies. One big company hasn't had this Government business; the other big company has, or the other big company has had the Government business as a result of Government money through the whole operation of our system, coming out with improvements and patents that puts the other big company under somewhat of a disadvantage. The other big company can say, "We paid our share of taxes to put our competitor in the better position he now is in."

The CHAIRMAN. And I might also point out, Senator, to further fortify the question, that A company might in the field have been put over to making tanks, where there was no possible peacetime advantage—that is, assuming they both competed in the same line of work—and then B company, which you are talking about that gets this exclusive right has an advantage, and A company would certainly be in a stronger position to complain about it.

Captain LAVENDER. I think in some cases, a very few cases, there may be inequality between two big companies after this project is over, but in all considerations of this phase great weight must be given to this factor: While the big company that was not engaged in this particular work for the Government was working along, he was not hampered by having his good top men taken from his company in an entirely unproductive field, as you might say, or to a great extent an unproductive field along the lines of his endeavor.

Senator MILLIKIN. But might he not in turn have been working on similar things in some other field?

Captain LAVENDER. Yes.

Senator MILLIKIN. And thus he has suffered the same dislocation?

Captain LAVENDER. He had the free choice of the field he was working in, a company not working for the Government.

Senator MILLIKIN. I think, Captain, if I were answering the question, the strongest thing I could say for it was that you wanted to stimulate the inventiveness and resourcefulness of the people who were working in this thing, and giving them some sort of little interest in what they were doing might have that tendency.

Captain LAVENDER. I have, of course, been in very close contact with this project in all of its phases, and I have been greatly impressed by the large number of really top engineers and designers that these companies have given to this project where I know that the work that they were doing, as far as the Manhattan district project was concerned, practically divorced them from giving any other energy, brains, and ability to the company that was employing them.

Senator MILLIKIN. I want to say to you very frankly that I am not much impressed with that argument because we took a lot of top-notch younger fellows and put them in the Army, and they didn't have any of those advantages.

Captain LAVENDER. Oh, that is true.

Senator MILLIKIN. And in the Navy, too.

The CHAIRMAN. Of course, the biggest percentage belong in the category that you are talking about, the biggest percentage of the patent applications belong in this category.

Captain LAVENDER. No; not the important ones. The important ones have arisen under the research contracts, and under those under category 2 where the company only retained by contract right a non-exclusive license.

The CHAIRMAN. But, Captain, as I understand it, the great bulk of the patent applications that come under the whole project are in the field where the outside company has an exclusive right with the exception of the Government.

Captain LAVENDER. No; I would say not. The number of inventions that are made by contractors having the third category are very minor in nature, and are of not so much importance, certainly not to the project, and they cover only minor improvements. In this general analysis of the situation, you cannot go by numbers, because some of the most important fields of this whole atomic energy program are covered by a very few outstanding basic patents.

The CHAIRMAN. Well, one company has advertised, I believe, that they have 5,000 improvements. Is that correct?

Captain LAVENDER. My understanding of the record is that it was 5,000 different applications of all their inventions to industry in general, not meaning that they had 5,000 inventions that they had made. One invention may be applicable, or one device may be applicable to 150 uses.

The CHAIRMAN. Bringing that 5,000 down, how many patent applications has that company filed, if you know?

Captain LAVENDER. That company has filed none. We have filed all those applications.

The CHAIRMAN. How many that you filed originated with that company?

Captain LAVENDER. Well, of course, that contract isn't over yet and we have people who are checking upon it. I would say that there are about perhaps 100 applications that will ultimately be filed, but one application may have many different applications to industry.

The CHAIRMAN. They probably didn't err on the side of understatement when they claimed the number of practical applications, when they said 5,000.

Captain LAVENDER. I don't think they did, either. I think they were conservative. When they referred to industry in general that is going to be benefited by the program, there is one invention that will probably have 500 different uses that I call to mind.

The CHAIRMAN. If an individual of a company works in the atomic energy field at his own expense, what restrictions are enforced about the patent values arising in this way now?

Captain LAVENDER. We do not permit anyone to work for a contractor who has not signed an agreement to assign his inventions in accordance with the contract.

The CHAIRMAN. Of course, under the law the way it is operating now, if John Jones went ahead and invented some very useful atomic energy device, there would be no provision under the law by which you could take it over.

Captain LAVENDER. I didn't understand that.

The CHAIRMAN. Well, let's assume John Jones is down in his laboratory, and he comes up with some invention on fission.

Captain LAVENDER. In his own laboratory?

The CHAIRMAN. Yes; his own small laboratory.

Captain LAVENDER. An independent inventor?

The CHAIRMAN. Right. Now, if he came up with something extraordinarily useful in the field, there would be no way that you could get hold of it.

Captain LAVENDER. Except that I think that the Government could go to him, if it involved the national defense. There is one part of the Espionage Act which does not require that the person disclose that information came as a result of some relation with the Government—that is, that he received it from the Government. But if the Government knew of this information, they could go to him and place him under the conditions of the Espionage Act, where he would not be permitted to disclose that to another.

Now, what would actually happen, the way that I visualize this is going to work out, is that if the Commissioner of Patents will be authorized and directed to notify the Commission of the existence of an application in which reference is made to atomic energy, then the Commission should have authority to go to him and to purchase or make some arrangement with him.

The CHAIRMAN. But in the absence of legal right, that is under an act of Congress, there would be no way that the Government could proceed to take over this patent.

Captain LAVENDER. They could not take over the patent, or an application for a patent, because that would require an assignment. The Government cannot file an application in its own name, so it must be filed in the name of the applicant. But I believe, although I do not know of any particular case in point that has been decided by the courts, that the Government, if it finds that some person has information the dissemination of which is contrary to the national defense, can under the provisions of the Espionage Act, if it so desires, require that that man do not disclose that information to anyone.

Now, that is in effect seizing the invention and restricting him more under police power.

The CHAIRMAN. That wouldn't change the ownership, but merely his right to divulge it?

Captain LAVENDER. That is right.

The CHAIRMAN. That you would have to pay some compensation for, I take it?

Captain LAVENDER. I don't think you would, because I think you could offer the compensation, but I think it would come under police power rather than seizing under eminent domain.

The CHAIRMAN. So Jones might make the greatest invention in the field that had yet been made, and still be deprived of any award for it?

Captain LAVENDER. If he did not want to accept the award that was offered to him through confidential negotiations.

Now, it is true that a person who has a patent cannot obtain from the Government, from the Army or the Navy, the facts concerning the equipment that corresponds to his patent if the Army and Navy do not desire to disclose that in the Court of Claims, and that leaves the claimant in the Court of Claims with a perfectly valid issued patent but no way to prove his case because the information as to the proof of the case is wholly within the knowledge of the Army and Navy. That case has been decided by the Court of Claims that they will not enforce a call for information against the Navy Department if the Navy Department certifies it involves the national defense.

Senator MILLIKIN. I know your own deep concern in this subject, Captain, and I am sure your mind will be relieved by a dispatch from London. I read it:

Prof. Harold J. Laski, chairman of the British Labor Party executive committee, said today the words, "Existing atomic bombs must be destroyed at once to be sure no power could compel submission of another power by using the new weapon." "It is also clear that the atomic bomb has thrown suspicion between major international states," Laski asserted, "and nothing is to be obtained by pretending that a commission on atomic energy set up by the UNO is anything more than a very small step on the path toward the disposition of these suspicions."

All we have to do, Captain, is to get rid of these bombs, get rid of our Navy, with a complete demobilization of our Army and Air Force and everything is just going to be swell.

Captain LAVENDER. Including making everybody forget everything they ever heard about fission, or anything else.

Senator MILLIKIN. That is right. So you see, we are wasting a lot of time, Mr. Chairman. Mr. Laski has solved these problems for us.

The CHAIRMAN. I think any solution that Mr. Laski had to offer would probably come in for rather strenuous examination, Senator.

We have interrupted you, Captain, with a lot of questions. Unless Senator Millikin has something, suppose you go ahead.

Captain LAVENDER. I don't know that there is anything more to say, except that I have this organization that is very close to the contractors. I have a group that is in each area in which research work is going on. I have instituted a regular procedure on the reporting of inventions, the determination of who the first inventor was, because it is most important that it be determined who the first inventor was, in placing his name on the application. Otherwise, the patent would be invalid. The work is proceeding and has been proceeding, I think, on a perfectly good, sound, and satisfactory basis since the Manhattan district took over.

Senator MILLIKIN. There is one question I would like to ask. What do you know about the patent applications of Kellogg or the existing patents owned by Kellogg relating to this subject?

Captain LAVENDER. Well, I might say that I know the whole story from beginning to end as far as negotiations and administration of their patents are concerned.

I do not know what patents they owned before they came into the Manhattan district activities. They, of course, are a subsidiary of the Kellogg Co. The Kellogg or Kellogg Co. has granted a license to the Government under all of the patents that it owns or controls that were developed before the effective date of the contract that may be used in any of the plants, equipment, or anything else that is related to the work that they were doing, which was a voluntary act on their part. So far as their patents are concerned, that is the situation.

As to the present condition, they started out with a long-form patent clause which was renegotiated to a short form. The clause that they have with the Manhattan district is No. 2, modified to this extent: They have the right to grant sublicenses; they have a non-exclusive license with the right to grant sublicenses. That comes within a recognized condition where they themselves do not manufacture, so the mere license for them to make and use and sell would be a vain thing. It would be of no value to them.

Under those circumstances, the same as with other contractors where they are not manufacturing, they have the right to grant sublicenses.

Senator MILLIKIN. There is no essential secrecy about the type of invention you are talking about?

Captain LAVENDER. No.

Senator MILLIKIN. What is the general nature of those inventions?

Captain LAVENDER. The general nature—there were valves that were used particularly with highly corrosive elements, where the valve that was in use before would not maintain any degree of tightness over a period of time.

Senator MILLIKIN. That has always been the main problem of a valve, hasn't it?

Captain LAVENDER. Yes, sir. There is one of them that goes to a means of supporting a bearing where the bearing surfaces would have to be made of a certain number of limited metals, and they would be attacked by corrosive elements. It is very effective in that there is no corrosion of the bearings.

There is another one on valves with a particular way of opening and closing the valves and there are inventions that are particularly adaptable to oil refining, the handling of gases, and other matters.

Senator MILLIKIN. Are those of enormous value, those exclusive license rights?

Captain LAVENDER. Well, the license rights are not very extensive because they only have a nonexclusive license, so the Government can grant licenses to other companies.

Senator MILLIKIN. I thought you said they had the right to sublicense. That is valuable, isn't it?

Captain LAVENDER. Oh, yes; it is. It is something that they would have to have; otherwise the license would be of no value, because they themselves do not manufacture this equipment.

Senator MILLIKIN. If a man has a valve that will hold where no valve has ever held before, he certainly has got something of enormous value.

Captain LAVENDER. He has, but the Government can still license other persons. They do not have the sole license.

Senator MILLIKIN. Oh, I didn't understand that.

Captain LAVENDER. There is a tremendous difference there. You see, that is getting closer toward the basic processes.

Senator MILLIKIN. Then let me probe that a little further. The Kellex Co. has the right to make the stuff itself.

Captain LAVENDER. That is right.

Senator MILLIKIN. Does it have the right to license it to John Doe Co.?

Captain LAVENDER. It does.

Senator MILLIKIN. The Government also has the right to license it to John Doe Co.?

Captain LAVENDER. That is correct.

Senator MILLIKIN. So if any unfair practice develops so far as Kellex is concerned, the Government could mitigate that by making its own sublicenses?

Captain LAVENDER. That is correct.

Senator MILLIKIN. The Government could let them out for nothing if it wanted to?

Captain LAVENDER. That is correct.

The CHAIRMAN. Has the Government, as far as you know, granted any licenses to any other companies?

Captain LAVENDER. No, because they desired not to make any decisions in view of the fact that the Commission is going to be formed. They didn't want to make any decisions as to the granting of licenses to individual companies.

The CHAIRMAN. Really Kellex's rights aren't worth very much if they can be destroyed by the issuance of, say, 6 or 10 licenses by the Government?

Captain LAVENDER. That is correct.

The CHAIRMAN. It is not worth very much?

Captain LAVENDER. That is right, but it does permit them to operate. They are permitted to operate as a matter of contract right, but it doesn't give them a dominating position in the field.

Senator MILLIKIN. The other fellow has a fishing license. He has either got to get a license from Kellex or the Government, and he might not get it from either. Is that not a correct statement?

Captain LAVENDER. That is correct. If the Government chose to lock it up, they would be vesting a very valuable right in Kellex; but just as soon as they release it to two or three others, I suppose they have pretty much destroyed their monopoly of the field.

Senator MILLIKIN. Mr. Chairman, have any of the names of other companies been mentioned, in your memory?

The CHAIRMAN. Yes, only incidentally, Senator. Mr. Rafferty, of Union Carbide & Carbon Corp., and whose subsidiaries, the Linde Air Products Corp. and the Carbide Corp., worked in this field, testified that they had devised, they thought, many things of future use and value to industry, but that they had not filed through the Government patent applications.

I believe du Pont has not made any claims at all for improvements or inventions.

Captain LAVENDER. No; the situation with du Pont was a little different. Du Pont said they didn't want to have anything to do with the determination as to who inventors were. They said, "We will give all of our men, the necessary men to work this out;" but the Manhattan District took the responsibility of ferreting out the inventors, for they wouldn't themselves lay any claim that any of their men made any invention.

The CHAIRMAN. What does that principle resolve itself into, practically?

Captain LAVENDER. Well, I might give you a little as to their reason as given. This is only second-hand knowledge, but they were working with the University of Chicago on this, and they didn't want to let anybody think that du Pont was coming in and was going to grab up any of the patents, so they said, "Well, we will just say to you, the Manhattan district, that we will cooperate with you in the getting of the records of these inventions, but you will have to take the initiative, because it is not going to be said that du Pont is going to make any claim that it made or that one of its employees made the invention."

They even went so far as to ask me at one time that every time that I prepared an application and sent it to one of these du Pont men for execution that I would have to make a certificate that no

one in the Chicago University had had anything to do with it. Well, I just told them that I was more or less of a practical person, and if I presented that to them for their signature, that meant that it had been checked by my group in Chicago on which were representatives of the Chicago University, and that it was to go ahead and be filed.

The CHAIRMAN. Acting under that principle, what rights has du Pont gotten?

Captain LAVENDER. Under that contract, they get nothing.

Senator MILLIKIN. Captain, if I understood your statement correctly, du Pont said: "We are not going to have anything to do with determining who made an invention; you fellows determine that."

But assuming that you fellows determine that a du Pont man had made the invention, then what happens?

Captain LAVENDER. Then they will do their part to cooperate to get the application executed.

Senator MILLIKIN. But what rights would du Pont then have in the application?

Captain LAVENDER. None. That related to certain du Pont contracts. There were other contracts with du Pont that were in category 2, in which they retained a nonexclusive license. But in working with the University of Chicago, the big contract was the one which they said they didn't want to have to make the initial decision that one of its employees was the inventor of a certain invention.

The CHAIRMAN. How about their subcontractors?

Captain LAVENDER. The subcontracts carried the same provisions, normally, but the patent clause can be changed with the approval of the Patent Division. If the subcontract is merely a purchase contract, then we approve the no-patent clause and use the same principle in determining what a subcontract patent clause should be as we do on the prime contract.

The CHAIRMAN. Did du Pont get anything out of any invention made by a subcontractor?

Captain LAVENDER. Not to my knowledge, but that matter is always present in the administration of these matters, because before the final payment is made on any contract or any subcontract it must be cleared by my division, so I am satisfied that all the inventions have been reported.

Now, with these thousands of contracts I cannot say whether or not du Pont in any of these cases did receive any right.

Senator MILLIKIN. So far as you know, Captain, du Pont has met in full spirit the basic proposition that they did not want to profit out of any of these inventions?

Captain LAVENDER. Yes, that is true.

Senator MILLIKIN. Has any large corporation failed in what you might think would be proper cooperation in any of these invention matters?

Captain LAVENDER. No; we are completely satisfied with the administration.

Senator MILLIKIN. But in the end the Government's interest was fully protected?

Captain LAVENDER. That is right.

Senator MILLIKIN. And on a nonselfish basis?

Captain LAVENDER. Yes.

The CHAIRMAN. Union Carbide took no patent rights at all, as I understand it.

Commander ANDERSON. Not on their basic contracts. There may have been some subsequent contracts on which they retained a nonexclusive license.

The CHAIRMAN. Similar to Kellex?

Commander ANDERSON. Yes, or duPont; but this basic contract had the short-form patent clause. There were several other prime contracts let in which they were permitted to retain a nonexclusive license.

The CHAIRMAN. Which could again be destroyed by the Government issuing licenses to other people?

Commander ANDERSON. That is right.

The CHAIRMAN. I am a little puzzled. What is that worth to a company like Kellex when it could be destroyed—any head start in the field?

Captain LAVENDER. No; it is not so much that they do have some head start, but it insures to the company that it will not have any islands in the general progress in which it cannot operate; that is, as it is proceeding along its normal course of development. It is a protective measure.

Senator MILLIKIN. And the Government's reserved right is a protective measure to competitors?

Captain LAVENDER. That is correct.

The CHAIRMAN. Of course, I can see the value to it, that if they are working intensely in the field they would be able to get from island to island without having the trouble of coming to the Government and getting each individual process licensed to them.

Captain LAVENDER. Well, I was using "island" in the opposite sense. I was thinking of progress in time as being more or less on the ocean, that the island would be out there, that they had to go around or they couldn't enjoy their normal progress of crossing, so that it is their protection that they will be able to operate in this field.

Senator MILLIKIN. It conjures to my mind the picture of Simon Legree chasing Topsy across the ice.

Captain LAVENDER. There is just one other thing that I might mention, and that is that at no time in this administration of patent rights has any company been granted any right under any inventions that were not made by itself, that is, by it as a contractor. In other words, we haven't granted any license to company A who has made inventions under 1, 2, 3; and 4, and granted licenses under those inventions 1, 2, 3, or 4 to another company, so that there isn't as yet any company that I know of that has got a position where he can use the other and perhaps necessary inventions that arose from other contractors; contractors have retained only the rights under the inventions that they, as contractor, made. That puts the Government in a good, strong position.

The CHAIRMAN. I think we ought to have a short executive session. The open hearing will now recess.

(Whereupon the committee retired into executive session, at 12:05 p. m.)

ATOMIC ENERGY ACT OF 1946

WEDNESDAY, FEBRUARY 13, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to notice, at 10 a. m., in room 424, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senator McMahon (chairman), Millikin, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The meeting will come to order. The first witness this morning is Mr. Klein, engineering manager, Stone & Webster Engineering Corp.

STATEMENT OF AUGUST C. KLEIN, ENGINEERING MANAGER, ACCOMPANIED BY J. R. LOTZ, CHAIRMAN, BOARD OF DIRECTORS, STONE & WEBSTER ENGINEERING CORP., BOSTON, MASS.

Mr. KLEIN. My name is August C. Klein. I reside in Newton Center, Mass. I am engineering manager of Stone & Webster Engineering Corp. I am a fellow of the American Society of Mechanical Engineers, a member of the American Gas Association, and of the engineering societies of New England.

I have written a great many papers on steam-power-plant design and construction and on the economics of the supply of steam and power to industrial utilities.

Senator MILLIKIN. In what branch of engineering are you?

Mr. KLEIN. As engineering manager, Senator, my work has to do with all of the various activities of Stone & Webster Engineering Corp.

Senator MILLIKIN. What I meant was: Are you a mechanical engineer or an electrical engineer?

Mr. KLEIN. I am a mechanical engineer by training. I am a graduate of Stevens Institute of Technology, with a degree of mechanical engineer.

Senator MILLIKIN. Thank you.

Mr. KLEIN. I am accompanied here this morning by Mr. J. R. Lotz, who is chairman of the board of directors of Stone & Webster Engineering Corp.

As to the atomic bomb project, from July of 1942 until July of 1945, my entire time was given to the duties of project engineer for Stone & Webster Engineering Corp. in the design and construction of the electromagnetic plant for the Manhattan district at Oak Ridge.

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Since then I have continued in general supervisory charge of the work. Incidental to this major plant and included in my company's contract were a heavy water plant at Trail, British Columbia, the selection of the site for the Clinton engineer works, selection of a site for the metallurgical pilot plant at Argonne Forest, Ill., the design and construction of pilot-plant structures at Argonne Forest, Ill., and engineering and management of construction of the city of Oak Ridge and the procurement of uranium ore and other essential raw materials prior to the organization of the raw-materials branch of the Manhattan district.

I have outlined my connection with the project as a background for some comments and a principal recommendation which I believe your committee should carefully consider before bill S. 1717 is finally enacted.

Your committee has been through an arduous series of hearings at which statesmen, scientists, military and naval experts, and others have expressed their views. This morning I would like to speak to you as an engineer who has been through 4 years of practical daily contact with the problem to urge that you do not fail to include an outstanding construction engineer as a member of the Commission and as a division head in the organization proposed by your bill. He of all the membership of the Commission which will make recommendations to the President, the State Department, and the Congress, may be best qualified to appraise those recommendations in practical terms of time, dollars and ability of the country to produce.

To save time, with your permission, I will read a statement which has been prepared.

The legislation proposed by bill S. 1717 may well be the most important postwar legislation that Congress will be called on to pass for many sessions. It creates a Commission whose powers for domestic and international good can not be overestimated. In international relations it will be a powerful arm to the President and the State Department in advancing the cause of permanent peace, and in our domestic affairs it will have a profound influence on every phase of industry through the creation of cheap sources of power. It will also have a profound effect on medical science.

It is therefore highly important that the bill should be written to provide the best possible Commission organization, one which will achieve its objectives in the shortest possible time.

The bill, in general is, in my opinion, an excellent measure giving the Commission it proposes the broad powers over the development and utilization of atomic energy which are necessary to promote its objectives. However, the bill is, I believe, defective in that it fails to include a Division of Engineering under the provisions of the last sentence of section 11 (a)—that is the section which calls for additional divisions as may be determined by the Commission from time to time. The point I am making is that the creation of a Division of Engineering subsequent to the formulation of the Commission under the provisions of that section is not sufficient to provide the Commission with the necessary engineering strength for the reason that a Division of Engineering created under the provisions of that section would place engineering under the direction of one of the directors selected for his ability in the field of research, production, materials selection, or military application.

It is my belief that one of the directors should be an administrative engineer selected for his experience and ability in fields which qualify him to promote the aims of the act.

By this bill, the Congress will create a Commission to control one of the greatest industries in the country, an industry which will rank with the steel, automotive, and electric power industries.

The CHAIRMAN. That is your considered opinion?

Mr. KLEIN. It is, indeed.

The CHAIRMAN. Do you develop that in your statement?

Mr. KLEIN. I do not.

The CHAIRMAN. If not, I would like to explore that a little with you.

Mr. KLEIN. All right, Senator.

The CHAIRMAN. Wouldn't you, Senator Millikin?

Senator MILLIKIN. Yes.

The CHAIRMAN. That is a rather interesting statement.

Mr. KLEIN. I can foresee that within a period of time the ramifications of the use of atomic power for peacetime use, irrespective of its military applications, will extend to all industry. Such being the case, under the provisions of this act the Commission will retain control of many related operations that will be, first, the exploration and the mining of uranium ore; second, the refining of the uranium ore to bring it into the condition which is best suited for the separation or the production of fissionable materials from processes now available or to be developed through the agencies of research and engineering in the future; third, once that fissionable material has been developed, I believe it should be the principle of this Commission to extend the use of that material to all industry as quickly as possible. If, as we believe, we will obtain in that way a form of cheap energy, we will see this country dotted with superpower plants connected, as I bring forth a little later in the statement, with all of the leading electric power distributing systems in the United States. Some of those may be Government controlled and operated through agencies such as the TVA. Others may be operated under license or under control of this Commission by the electric generating utilities, and connected to their electric distribution systems; or it may occur that a series of interconnected electric systems will jointly develop one of these plants, or two or three of them, much the same as our large hydro-electric plants are now connected.

Senator MILLIKIN. Do you see any ramifications in the use of this energy other than for power or in the field of medicine?

Mr. KLEIN. Yes; I was using power in the narrow sense of electric power generation but there are other uses. The first use of atomic fissionable material will be to generate heat. That heat can be used to generate steam. That steam can be used in all industrial processes which now use steam either on account of its heat content or because of its chemical composition.

For instance, the gas industry uses a lot of steam to put through coal to make gas, in which it is broken up chemically.

Senator MILLIKIN. It also has some domestic significance, I suggest, because some towns are heated with steam heat.

Mr. KLEIN. That is correct, and in certain cases those stations might use fissionable material.

Senator MILLIKIN. Is there any chemical significance to it that you see, other than as a source of power?

Mr. KLEIN. Not that I can see at the moment, Senator.

Senator MILLIKIN. Other than medicine?

Mr. KLEIN. Not that I can see at the moment. This phenomenon of fission is not a chemical process; it is a physical process, the same as taking a rock and splitting it in two parts.

Senator MILLIKIN. If I run a machine-tool factory, aside from the power significance, can you see any application that I might have for this material?

Mr. KLEIN. I would say not within your lifetime or mine. I would say at some remote period fissionable material might be used in large industries for generating steam for heating.

Senator MILLIKIN. Of course, when we start a great field of experimentation in a thousand laboratories in this country, the Lord only knows what applications might be found.

Mr. KLEIN. That is correct, and that is one of the reasons for my statement that this will eventually be a tremendous industry, one of the greatest in the country.

The CHAIRMAN. Mr. Klein, I don't know whether I understood your last statement when you said, "Not during our lifetime."

Do you mean to say that you do not expect this development for power within our lifetime?

Mr. KLEIN. No; I did not make myself clear. I expect that within our lifetime we will see some of these large superpower plants that I spoke of; but the idea of having a piece the size of a pea buried under your doorstep and heating your house during its whole life, or dropping one in an automobile or airplane, I think will not come during our lifetime. I think that is far more remote, and we will need a great deal more experimentation and engineering development than we can expect in that time.

The CHAIRMAN. You know that is a very interesting observation coming from an industrial engineer like yourself. There has been, I think, some tendency to discount the scientists who said that, on the ground that they were not in a real sense practical men, but that is more impressive to me coming from you.

Now, let me ask you this question: If you are right, then within our lifetime there will be a very great redistribution of our economy. If superpower plants with atomic energy, that is, energy produced by fissionable material, become possible, that would raise very considerable havoc with the coal industry, for instance, would it not?

Mr. KLEIN. Senator, the dislocation of the coal industry or the dislocation of any industry will be gradual. It will be so gradual that I think the industries can take it in their stride.

As I recall the figures, we mined coal, oil, and natural gas—which are our principal media of heat—last year in an amount equal to about a billion and a half tons of coal.

The CHAIRMAN. Now, we mined 680,000,000 tons of coal.

Mr. KLEIN. I am adding oil and I am adding natural gas. Let us say a billion for round figures. One pound of uranium is equal to about 1,500 tons of coal—1 pound of fissionable material; so, if we divide those through, we have a requirement of something like 600,000 pounds, or 300 tons of fissionable material to replace our whole present fuel output.

The CHAIRMAN. 300 tons?

Mr. KLEIN. 300 tons of fissionable material.

Now, a carload of coal as we see it on the tracks carries about 50 to 100 tons.

The CHAIRMAN. So the entire energy output needed in the country could be hauled in six freight cars.

Mr. KLEIN. If you dare to do it. You would set up a bomb condition, the minute you get too much of it together.

The CHAIRMAN. But that gives you a graphic illustration of what it is.

Mr. KLEIN. The point I was trying to make, Senator, is that this thing is going to come gradually. The expense for plants to generate that much fissionable material is going to be prohibitive on the present basis, and we must have very much better techniques. We must have a great advance in our research discoveries, and a corresponding parallel advance in our engineering.

The CHAIRMAN. Of course, aluminum used to cost \$16 a pound, and it is down to 14 or 16 cents.

Mr. KLEIN. That is correct, and we may expect some similar improvement in this matter of recovering and separating fissionable material.

Senator MILLIKIN. Let me ask you this: Later on in your statement, do you venture a prediction as to how many years are involved before we make a good start at this?

Mr. KLEIN. I don't; I haven't done that.

Senator MILLIKIN. Do you care to make one?

Mr. KLEIN. I would like to think we ought to make a good start from the minute this Commission is created. The Commission should be created practically as a going concern, and that is the reason that I recommend a very strong engineering division, so that the Commission can proceed with strong research, engineering, and production divisions.

I believe the first work of the Commission will undoubtedly be directed toward military objectives.

Senator MILLIKIN. When you speak of a good start at the present time, assuming we had a Commission at the present time, do you visualize the use of the existing facilities that have been developed?

Mr. KLEIN. Oh, absolutely; we must continue to operate.

Senator MILLIKIN. Otherwise, if you have to start from grass roots, the investment required to make any quantity of that energy would be prohibitive under the present state of affairs?

Mr. KLEIN. We must start from what we have.

To revert to the statement, it will be well, therefore, for your committee to consider how the interrelated functions of research, engineering, production, and materials are usually controlled in large industrial organizations. Not all large industrial organizations perform all of these functions. Many of them draw on outside sources for research or engineering design and construction. Much research work for industrial corporations is handled by institutions, such as the Mellon Institute, the Battelle Institute, and by research fellowships created in our leading universities. The bill, incidentally, provides for just such assistance to the Commission. Not all of them handle their own engineering design and construction. Such organizations as Stone & Webster Engineering Corp. are available to furnish these services. However, for those who do perform all three of these functions research, engineering and production problems are handled by

separate groups, each headed by an executive specially selected for his ability in that particular field. These divisions necessarily have a different approach to the problems of the corporation and have different viewpoints which must be explored and harmonized whenever important action effecting the policies of the corporation is to be taken. We may visualize the work of the Atomic Energy Commission to be comparable to the work of such industrial corporations.

The CHAIRMAN. Frankly, according to the bill, I thought the Division of Production included a Division of Engineering.

Mr. KLEIN. I will tell you later why it should not.

The CHAIRMAN. That is all right. I am glad to know. That is why we seem to have overlooked engineering.

Mr. KLEIN. Let's do it the other way; let's make the Division of Engineering include production, although I believe they should be separate as I will point out.

As provided in the bill, there will be a Division of Research which should be headed by an administrative physicist of outstanding qualifications.

There should be a Division of Engineering, headed by an administrative engineer experienced in the field of design and construction and having a thorough knowledge of the industrial fabric of the country and of the possibilities and limitations of production-line manufacture of equipment. That is, the manufacture of equipment on a production-line basis.

There will be a Division of Production, headed by an administrative plant operator, and this division should concern itself primarily with the operation of plants for the production of fissionable material.

Let me amplify this point, if I may because it seems the right point to do so. We in our business have had a great deal of contact with the operators of all sorts of industrial plants and we find that more and more the heads of the production divisions are coming to concerns such as ours for handling their engineering and construction matters.

The operation of the fissionable material plants which are going to be turned over to the Division of Production and the change in technique which is going to be necessary for them to make during the entire life of the project will be sufficient to occupy the entire services of a top-flight production man. Those operators are interested in such things as labor relations, the orderly flow and sequence of materials to the plant and out of the plant, and standardization of operations. They could do a small amount of development engineering, but more and more the large industrial concerns are coming to a recognition of the fact that their engineering and construction problems should not be handled by a Department of Production. The principal job of those fellows of the Production Department is to get plant output, and that is sufficient to occupy, it seems to me, this Division of Production which you have set up here.

Senator MILLIKIN. I think, Mr. Chairman, it is largely a turn on words. The witness makes it clear that production does not necessarily mean the things he is talking about.

Mr. KLEIN. The operation of these three divisions would, it seems to me, be about as follows:

The Division of Research would undertake a broad research program, looking toward the discovery of basic information which will simplify or improve the production of fissionable material and further its commercial, military and medical uses.

The Division of Research would also investigate matters requested by the Division of Engineering and Production, and approved by the Commission as a whole. It would make recommendations regarding changes in operating and utilization practices.

The Engineering Division would have an important part in passing on such recommendations from the standpoint of determining plant investment costs and operating savings (the latter in conjunction with the Division of Production). It would also explore and report on the ability of industry to furnish any new equipment required and would prepare time schedules of the work involved. Later, upon approval of any such project, the Division of Engineering would supervise the design and construction of the plants, including procurement of equipment.

To amplify that a little further, I conceive that the work of this Commission will result in great improvements in our present methods of securing and utilizing fissionable materials. I believe that the work of the Commission may result in very extensive changes, improvements, and alterations to our existing plants and might even result, and probably will result, in the need of constructing entirely new plants, possibly utilizing new processes and new research discoveries.

Senator MILLIKIN. Let us just make a little imaginative foray at this point. Let us take out of the picture the war potential and the war use of this energy; let us assume—impractical as it may be—that we have reached a state of dependable peace where we can take that out of the picture.

At that point, do you think that the controls visualized by this bill and other bills would be necessary? At that point, why couldn't we turn this over to private enterprise with some security controls?

I was speaking of controls that would prevent the energy from getting away and doing harm or some such detrimental effect. Why couldn't we limit the work of the Commission to controls of that kind?

Mr. KLEIN. That might be possible when we reach that millennium, Senator, but I cannot see that we are going to reach it for an appreciable period of time; and during that appreciable period of time, I believe that the controls set up in this bill are necessary.

Senator MILLIKIN. So your premise is that we have a war factor to consider while we are also considering the exploitation of the energy for peaceful use?

Mr. KLEIN. I think that is correct. Close contacts among all three divisions would be maintained throughout the design and construction period, and the Engineering Division would be responsible for coordinating such contacts. I say that for the reason that the design and construction engineer has the best sense of timing of any of these divisions. We find in our work that it is our responsibility to set up time schedules and then make the research people and the production people make decisions that we need in order to live up to them. Both of them have a propensity to lag, and the engineer is time conscious and money conscious—that is, the design and construction engineer.

The rest of these division heads will not be so conscious, unless the engineers educate them.

The operations of these three divisions would always be closely related, whereas the operations of the other two divisions now provided by the bill would be more self-contained and independent.

Another function in which the Division of Engineering would play a leading part would be in connection with the utilization of fissionable material. The most important potential use of this material is to produce cheap heat which, in turn, may be used to generate steam or to heat air or some other medium for industrial process operations, or for the generation of electric power. Of these, electric power generation is of the greatest importance. All of these operations in the generation of heat, its use for process purposes, and for the generation of electric power are fields in which the engineer is best fitted to function.

In the use of fissionable material for power generation many problems must be overcome. It is not unreasonable to expect that they will equalize in magnitude those which were encountered and solved in the construction of the three fissionable material plants which have been constructed in the last 3 years. The first application of atomic energy will undoubtedly be in superpower plants, operated in conjunction with existing large electric distributing systems. It will be important to utilize as much as possible of the existing electric utility systems and in that field the knowledge and experience of the engineer will be essential. The services of an able Director of Engineering would be indispensable in connection with this major development of atomic power utilization.

The CHAIRMAN. Mr. Klein, even if we powered these powerhouses with atomic energy, it wouldn't change the distributive system, would it?

Mr. KLEIN. No. I made an analysis some time ago of the amount of replacement of equipment in a normal electric power system and came to the conclusion that about 6 percent of the present investment in a complete electric utility system would be replaced if fissionable material were used for the generation of all heat. It is not very difficult for any of these utilities to take 6 percent out of their depreciation reserve. They could take that sort of thing in their stride.

Senator MILLIKIN. Over a reasonable period of time?

Mr. KLEIN. Over a reasonable period of time; yes.

Senator MILLIKIN. I think that is an interesting statistic. Have you made the same kind of study on oil and coal?

Mr. KLEIN. No, I have not; but I can say to you that this was on the basis of replacing coal with fissionable material, generating steam, using steam in a turbine, generating electricity as we do now and distributing through our present distributing and transmission systems.

Now, if we had oil the replacement would be a little less because we would have no coal- and ash-handling system, you see, to discard.

It is possible also that by some not-too-remote stretch of the imagination we might use this heat to heat air, and that air be used in a modification of the present gas turbines. The statistics there would be about the same.

Senator MILLIKIN. Do you visualize that as this program advances there will probably be advances in the coal business that will enable it to divert, let us say, into the chemical field more than it is there now,

and thus perhaps the economy over a period of time of the coal-producing industry might not be disturbed appreciably at all?

Mr. KLEIN. That is quite possible, Senator, although I think that the one thing that will safeguard the coal industry is the growth of the country as a whole, the large number of new homes, the large industrial plants, and that that growth will be so great that it will absorb most of the available fissionable material, let us say, for a period of a good many years.

Then, again, the present power plants may be, and undoubtedly will be, retained in their present condition for the generation of peak-load power. Utilities always have a very sharp peak at some-time of their operating year, and we have standing by thousands or millions of kilowatts of equipment to operate only a few hours a year; but necessarily, we must do it to take care of that sharp peak, and they will be retained for that purpose just as we are today retaining many power plants which would be inefficient or obsolete if they were operated for more than a few hours a year. It doesn't pay to throw away the investment, and I think that also will come into this picture.

Now, it might be well for me to point out a few of the reasons why the functions of the engineer and of the research scientist are so fundamentally different that the operations of the two should be separated and controlled by Directors of equal standing. These stem primarily from the difference in approach of the two toward their problems.

The scientist, dealing in research, discovers all sorts of facts about the world around us and the universe beyond. Frequently, these discoveries lie dormant for years, decades, or even centuries. Sooner or later the engineer takes them up and puts them to practical use, thereby furnishing society with improvements in living conditions and the general welfare of the people. Incidentally, the engineer's work causes these discoveries to yield monetary returns which in turn furnish the funds for financing additional research.

The scientist discovered helium in the sun's corona; engineers separated it from natural gas for military, medical, and commercial use. The scientist discovered the principles of catalytic chemical reactions. The engineer applied them to the design and construction of the great synthetic rubber and high-octane gasoline plants. Scientists developed means for separating isotopes and discovered the phenomenon of uranium-235 fission through observing the action of submicroscopic quantities of uranium. Engineers multiplied their experiments a billionfold, produced the atomic bomb, and opened the door to the era of atomic power.

The viewpoint of the engineer differs from that of the research scientist in the following respects:

The scientist's work is performed on a laboratory scale. The engineer must deal with full plant operation.

The scientist's experiments are completed within a period of a few hours or a few days and his apparatus can be constructed to have a very limited life. The engineer must design and construct plants which will operate continuously for months or years.

Senator MILLIKIN. I don't know whether this is an appropriate place to raise this, because I do not know what is in the rest of your paper.

We have spent, we have been informed, about \$2,500,000,000 under these different routes of approach we made in developing the energy. As I understand it, all of them will work, but some of them will work better than others, so there is an obvious waste of money, a necessary waste of money, in doing what we did in order to get results quickly in a virgin field where we were not completely sure of what we were doing.

Have you any notion as to the cost involved in starting from grass roots with any one of the known processes and building a plant that would develop the energy?

Mr. KLEIN. Well, the process that we are most familiar with is the electromagnetic process, so-called, that you saw at Oak Ridge. That process costs, according to General Groves' statement in the record, \$317,000,000 for engineering and construction and \$33,000,000 for research, or about \$350,000,000. That was the first plant to be designed and the first plant to be completed.

Senator MILLIKIN. Since you have that appendix here, I assume that you are going to develop this theme later in your paper. I don't want to interrupt the continuity, so let us defer that until you come to it.

Mr. KLEIN. The scientist is able to draw on the most highly skilled personnel to do his work. The engineer must provide apparatus within the capacity of plant operators of average intelligence and education. It is this phase of the work that calls for development of intricate automatic control equipment.

The scientist performs his experiments on a single piece of apparatus. The engineer must design equipment to multiply these operations manifold. Duplicate pieces of equipment and spare equipment must be provided which are completely interchangeable. For this he requires a knowledge of shop practices and shop technique which is not essential to the scientist.

The engineer is always working against the important factors of time and cost. The scientist is not so concerned. In this connection I was interested in reading the testimony of the first witness before this Commission, Dr. Sachs, in which he states that "university research is inherently characterized by a 'traditional discursive attitude and leisurely tempo.'"¹

Such an attitude would quite properly permeate the Division of Research and would at the same time preclude its head from also directing a Division of Engineering effectively.

It is particularly important that a strong Division of Engineering be created from the moment that the Commission begins to function. While the testimony before this committee has indicated that it will take any other nation an appreciable period of time to construct a nuclear fission plant, a fissionable material plant, and that there is in fact a doubt whether the industrial economy of most foreign nations could support such a program at this time, the thing that we have to fear is that research either here or abroad will result in such radical improvements in the production of fissionable materials, conceivably through the discovery of new methods and the use of new materials, that the time will come when the industrial handicap other nations are under may be removed. It is to be expected that our research

¹ See pt. 1 of the hearings on atomic energy, p. 27.

work within the coming decade will produce just such a result, and the extent to which we maintain our present lead in the development of atomic energy will depend upon the skill and speed with which we implement our research discoveries by parallel engineering advancement and by the design and construction of new fissionable material production plants. It is especially important that we maintain our lead during the next decade, in order that we may continue to occupy a dominant position in the atomic energy field, and that we may thereby be enabled to use that position to create a strong United Nations Organization. Once that is done, and the production of fissionable material and use of atomic energy is controlled by international agreements, then we may continue our advances in making this great force freely available to all the countries of the world without fear of a war of aggression and annihilation.

I recognize the importance from an administrative point of view of having a small membership in the Commission; the smaller the number of the Commissioners, the greater the speed of action, and I therefore suggest that a place be made for the recommended Division of Engineering by the consolidation of two of the other divisions. The ones that seem best adapted to such a consolidation are the Division of Production and the Division of Materials.

Senator MILLIKIN. Mr. Klein, there has been some suggestion that you might make an entirely different approach to the subject, that instead of having a Commission of technical men—because to have such a condition, if you are going to give due weight to all of the branches of science and engineering involved here, you would have a very unwieldy affair and it would probably be such a large Commission that it would not function—the thing to do is to have a Commission of men who are not technical men but have under them a series of divisions branching off into all the necessary fields for the proper consideration of the subject.

What do you think of that?

Mr. KLEIN. I think the bill as it is set up sets up an organization which is preferable to the one you now suggest. I do think that every one of these directors as set up in here could be essentially an administrator, and should not be selected primarily for his technical knowledge. A technician without administrative ability would not function properly as one of the directors, or the head of one of these divisions. He should have, however, as a background for his administrative ability proper experience in the field which is represented by the principal division of which he is a director.

The research man should be an outstanding physicist. The production man should be one of the top flight and best large-scale industrial plant operators that we have in the country. He need not know too much about fissionable material. The head of the engineering division should be an outstanding engineering administrator, thoroughly familiar with the field of large-scale construction and design.

Senator MILLIKIN. Do you think that that assemblage of talent should be on the Commission itself?

Mr. KLEIN. I do, indeed.

The CHAIRMAN. Your suggestion is, as I just understood it from Senator Millikin, that these men should be members of the Commission with these qualifications. Do you mean that, or do you mean the heads of the projected divisions?

Mr. KLEIN. As I understand the set-up which the bill will make, there are five members of the Commission.

The CHAIRMAN. That is right.

Mr. KLEIN. There is a chairman, and each of the other commissioners is a director of a division. Now, it is those four directors that I am speaking of who should be administrators primarily with experience that would permit them to operate their divisions almost on a parity, hardly secondary.

Senator MILLIKIN. Your thought is that under those men you could then have, in your new echelon of organization, subdivisions in the whole field of knowledge?

Mr. KLEIN. That is right. Let's take our own organization, for instance, just as an example. I was a project engineer on this project. I am a mechanical engineer. Under me I had a chemical engineer in charge of the chemical division, a civil engineer in charge of the structural division, and a mechanical engineer in charge of steam power plants and utilities, and each of those was also an administrator and controlled the operations. But I did not pretend to be able to design the component parts.

Let me say that our employees have taken out of this project, or been asked to take out, some 200 patents. I haven't taken out a single one of those.

The CHAIRMAN. Mr. Klein, I feared that we were talking at cross purposes. You see, there is no intention to make the commissioners the heads of the divisions. [Reading from S. 1717:]

SEC. 11 (a). ORGANIZATION.—There are hereby established within the Commission a Division of Research, a Division of Production, a Division of Materials; and a Division of Military Application. Each division shall be under the direction of a Director who shall be appointed by the President, by and with the advice and consent of the Senate, and shall receive compensation at the rate of \$15,000 per annum. The Commission shall delegate to each such division such of its powers under this Act as in its opinion from time to time will promote the effectuation of the purposes of this Act in an efficient manner. Nothing in this paragraph shall prevent the Commission from establishing such additional divisions or other subordinate organizations as it may deem desirable.

You are in error in thinking that the Commission of five is to be divided up—at least as proposed in this bill—so that one commissioner has production, another commissioner has research, another commissioner would have engineering, if we were to adopt your suggestion. The Commission of five is the policy organization, you see. These are corresponding to a full-time board of directors as proposed in the bill, whereas the heads of these divisions are the operating works managers, you might say, in that particular field.

Mr. KLEIN. All right, if I have misunderstood the intent, that is the way I have read it, then I will alter these recommendations to recommend to your committee that you add to these a Division of Engineering also under the control of the top directors, so that from the inception of the operations of the Commission there is a strongly established Division of Engineering.

The CHAIRMAN. I just wanted to make sure that you understood.

Mr. KLEIN. I did not. I understood the fact that there were five commissioners, and apparently I interpreted that there was a chairman and four director heads, and the directors were commissioners.

The CHAIRMAN. That is not quite the same, but I don't think it affects your basic point that there should be a Division of Engineering and Construction.

Mr. KLEIN. As to this consolidation, maybe under the circumstances it isn't necessary, but let's go through with it, we are familiar with the materials problems which were of primary importance in this project, namely, the procurement of uranium ore and its refining. We undertook to get out the first uranium ore and see to its refining before the Manhattan district was in a position to function. On our entry into the project, facilities had to be provided in the form of additions to chemical manufacturing plants to provide for the rapidly growing demands for uranium compounds and for other materials such as carbor, beryllium, and so forth. Apparently this need for increased plant facilities has existed up to the present. We may assume that one of the first steps of the new Atomic Energy Commission would be to reduce plant operations to a fraction of the present rate; thereby, raw material requirements would be greatly reduced and present suppliers would find themselves with an excess of material production facilities. The problem of procuring materials, therefore, should be not difficult and this work could well be placed under the Division of Production. This is where it is handled in most large industrial concerns.

I also, even with the explanation of the chairman, still believe that the Division of Materials could well be under the control of the director who is responsible for production. He primarily is interested in getting his materials.

The CHAIRMAN. Let's see. You would have a Division of Production which would include procurement of materials. You would have a Division of Engineering and a Division of Research.

Mr. KLEIN. And a Division of Military Application. That would be the primary divisions set up.

Senator MILLIKIN. Whether you have them in the top commission or in the next lower echelon?

Mr. KLEIN. That is right.

The CHAIRMAN. It might be, of course, if this bill were enacted into law, that the President in selecting the top five commissioners might well also give considerable thought to qualifications along these lines. That would be highly desirable and advisable, perhaps, but certainly it would be essential when you came to the point of appointing or designating the man who was actually going to operate that particular section.

Mr. KLEIN. I, therefore, recommend consolidation of Division of Production with Division of Materials.

In passing on these suggestions, it may be well for your committee to consider the relative magnitude of the work carried on in the fields of Research, Engineering, and Production, during the development of the atomic bomb. These may be visualized by an analysis of the expenditures made by each group. The figures already appear in the record in the statement of expenditures submitted by General Groves. In the attached table they have been arranged to indicate how much money was spent on each of the processes for research, for engineering and construction, and how much is currently being spent for production.

If you will turn to the table at the end of the statement, you will find a statement of expenditures for the atomic bomb project which I have extracted from General Groves' testimony.

This table is captioned "Engineering and Construction, Research and Production Expenditures—Atomic Bomb Project."

There were three principal processes. The amount expended for engineering and construction, expressed in millions, was \$500 for the diffusion, \$317 for the electromagnetic, and \$302 for the metallurgic, exclusive of housing and exclusive of research.

Now, the amount expended on research for those three divisions was \$45,000,000, \$33,000,000, and \$42,000,000, respectively.

In other words, if we take the percentage of the whole, combined engineering, construction, and research, about 90 percent was spent for construction and engineering and 10 percent only for research.

I can visualize that in the future the percentages may not be so much at variance, but I can visualize that the expenditures for engineering and construction will always be many times the expenditures for research.

(The following table was submitted by Mr. Klein and made part of the record:)

*Engineering and Construction, Research and Production Expenditures,¹
Atomic Bomb Project*

Process	Engineering and construction		Research		Production cost per month	
	Amount, millions	Percent	Amount, millions	Percent	Amount, millions	Percent of construction
Diffusion.....	\$500	91	\$45	9	\$6.0	1.2
Electromagnetic.....	317	91	33	9	12.0	3.8
Metallurgical.....	302	88	42	12	3.5	1.2

¹ See statement by Maj. Gen. L. R. Groves in pt. 1, p. 73, of the hearings before the Senate Special Committee on Atomic Energy.

Senator MILLIKIN. I believe this is a good point now to renew my question.

If you were building any one of these plants from grass roots, what is your guess on what it would cost?

Mr. KLEIN. Let us go to the electromagnetic, of which we know the most. This shows we spent \$317,000,000 for that. I believe that if we were to start out anew, knowing all we know, with all the plans and specifications that we have, with all the knowledge of the manufacture as to techniques, production-line procedures, that plant—which took about 1 year to build from the time we broke ground—could be constructed under present conditions in about the same time, and it would cost not over two-thirds of that amount of money, or maybe less than two-thirds.

Senator MILLIKIN. Would you be willing to make just a rough guess that perhaps the percentage is the same on the others?

Mr. KLEIN. Senator, I really don't know.

Senator MILLIKIN. I won't press you on that.

Mr. KLEIN. Now coming to production, of course the figures are not so clean-cut. We have available only General Groves' statement of the production cost per month. That is \$6,000,000 for the diffusion.

Senator MILLIKIN. May I interrupt again? In regard to the testimony you have just given on possible saving of costs, if you were to do it all over again, I think that has a very direct bearing on the point that to go ahead with the job requires the use of existing plants; it is

perfectly obvious, at least to me, that there is no private enterprise that would be spending \$350,000,000 to build a plant of that kind.

Mr. KLEIN. You are quite right, Senator.

Mr. Lotz has just called my attention to a possible misstatement in my testimony. I said 1 year from the time we broke ground until the electromagnetic plant was completed. The electromagnetic plant was completed in two steps. Those figures are correct for the first step, and while the construction of the first step was going on, the research and development work had proceeded so satisfactorily that we were instructed to build another addition. That addition was started at a later date, and the two steps were completed in 2 years.

I still believe that if we were starting all over again, the principal plant would be done in a year and for about two-thirds of this cost.

Senator MILLIKIN. Do you have any knowledge, other than a general knowledge, of the industrial position of the other nations of the world?

Mr. KLEIN. Only a very general knowledge. I have never been to any of these foreign countries, only what I read and what I learn from talking to engineers who have been abroad.

Senator MILLIKIN. From that general knowledge, I will ask you a very general question: Is it your opinion that it would take any other foreign country, or a possible combination of foreign countries, a considerably longer time to reproduce from grass roots the electromagnetic process?

Mr. KLEIN. Oh, yes; very much longer. I think that any of the countries with the know-how—those are England, Canada, and possibly France and Denmark, and of those the only one that could support such a program is England, and it would take the British 3 to 5 years to do what we have done. I base that not on engineering considerations, but on the fact that they do not have the tremendous industrial organization that we have in the United States.

Senator MILLIKIN. Your answer runs along the general line of other testimony.

Mr. KLEIN. It was the industrial organization that put this thing over.

Senator HART. Mr. Klein, is the statement that you just submitted as part of the record based upon the conditions and the urgency under which the Manhattan district was working, or under our usual peacetime tempo?

Mr. KLEIN. That is based on the usual peacetime tempo, but presupposing we would have full Government assistance in the procurement of any necessary raw materials, and also a freedom from the present flurry of strikes.

Now, reverting to the production cost, General Groves in his testimony has stated that the cost of the diffusion plant will increase and the cost of the electromagnetic plant will decrease. I know from having been at Oak Ridge last week that the cost of operating the electromagnetic plant must have been decreased because of comments I heard by operators, and from very great improvements and economies that I have seen in personnel and in maintenance, and all the other factors which go to make a high production cost. I think on that account it might be reasonable to suppose that the cost of operating the diffusion plant and the cost of operating the electromagnetic plant might come to 2 percent a month, which means that

it would take 4 years of production expenditures to equalize the construction work which has already been completed.

Senator MILLIKIN. I don't quite get the significance of that.

Mr. KLEIN. I am trying to show you the relative expenditures of the Division of Production as compared with the Division of Construction and Engineering.

Senator MILLIKIN. And that statement about the equalization at the rate of 2 percent goes directly to that point?

Mr. KLEIN. It goes directly to that point; yes.

Senator MILLIKIN. You don't intend any other point by that?

Mr. KLEIN. No; it is just to get some sort of a figure within reason which will permit you to visualize what the responsibilities of the Division of Construction and Engineering, and the Division of Production, would be.

I further say that that is at the present rate of operation. Any production curtailment would reduce all production costs still further. Again, surely a director selected for his ability along production lines should not control the much greater rate of construction expenditures.

To summarize, I consider that the proposed Commission should be strengthened by the establishment of a Division of Engineering under the direction of a Director selected for his administrative and engineering qualifications, and that only by the inclusion of such a division can the Commission operate to the best advantage in accelerating the development of atomic energy for domestic utilization and for maintaining the dominant position which the United States now holds in the production of fissionable material and in its application.

Senator HART. Mr. Klein, we have in the country a very few valuable individuals who have a good deal of the mastery of engineering, as well as some branches of the basic sciences, physicists, and chemists. Of course they are very few.

In general, is it your experience that the two categories, the engineers and the scientists, are too much detached from each other, do not collaborate enough, do not know intimately enough the problems of the other side and of the developments that are going on?

Mr. KLEIN. There is not so much a lack of collaboration. We have got the best of collaboration from the scientists in the construction of this plant.

Senator HART. I was not particularly referring to the Manhattan district, but in general all through the country's activities.

Mr. KLEIN. In general, all through this country where there is a project we can get collaboration between the production, between the operators, between the research people and the engineers who are designing and constructing the plants. However, even with that collaboration and cooperation, there is a very definite difference in viewpoint of the three toward their problems, and my point here is that in setting up the administration of these three divisions we should have administrative heads, let us say, of the peculiar temperament that is best fitted to administer those divisions. Do I make myself clear?

Senator HART. Yes; but what I was getting at is to develop the situation that we have been living under for the last generation or two, wherein scientists are quite likely to develop something in their experiments in which, if an engineer or body of engineers were brought closely in touch, they would immediately see practical application.

But that does not always happen, in that the engineers are not cognizant of what is being done in the laboratories and not closely enough in touch with it.

Mr. KLEIN. I think with this set-up of the Commission as proposed here you would accomplish just that. You would have these various directors all working together in close harmony. Now, in many of our industrial concerns we have that cooperation. Part of the trouble is, Senator, that scientists can think up and can discover and propose far more things than the engineers or economy can take care of.

One of the leading chemical companies' president told me some years ago that his principal job was to sift out all of the proposals of all of the optimistic recommendations made by research groups down to a few which the financial structure of this company could handle.

Senator HART. And then usually gets in trouble with his scientists when he sifts out their ideas, too.

Mr. KLEIN. It might be. In this statement at one point I have said that the engineers would take the recommendations of the scientists, would appraise them in terms of cost and operating savings, and would present that information to the full Commission so that they might judge which of the recommendations of the scientists it would be proper to proceed with.

Senator HART. Under whatever form this legislation takes, and whatever organization we eventually arrive at, would it be your thought that some of those particular individuals of whom I speak, who are pretty well in touch with certain branches at least of fundamental science, and are also engineers, should be used to the greatest possible extent?

Mr. KLEIN. I would say so.

Senator HART. I suppose without naming names, you probably have some in mind yourself?

Mr. KLEIN. Yes; I would be glad to—

Senator HART. I was not asking your for any nominations.

Mr. KLEIN. I know, but I started to say I would be glad to tell you in executive session.

The CHAIRMAN. Mr. Klein, we have another witness, and I want to get on because we have got to close, but you made one statement in here that I think is worth while going back to, on page 7. I think it is worth going back to because it is one of the things that bother me. You say:

The thing that we have to fear is that research either here or abroad will result in such radical improvements in the production of fissionable materials, conceivably through the discovery of new methods and the use of new materials, that the time will come when the industrial handicap they are under—

meaning other countries—

may be removed.

Now, you go on to say:

It is to be expected that our research work within the coming decade will produce just such a result, and the extent to which we maintain our present lead in the development of atomic energy will depend upon the skill and speed with which we implement our research discoveries by parallel engineering advancement and by the design and construction of new fissionable material production plants.

You have noted, I presume, the provisions in the bill which provide for the exchange of basic scientific information. Assuming that we locked up within our own breasts all reports of scientific advances, not talking about technical know-how now, not talking about sending any plans for a bomb anywhere, but basic scientific information, would this country have more to lose by that course than any other country, in your opinion?

Mr. KLEIN. You mean by a free exchange of scientific information?

The CHAIRMAN. By restricting the free exchange of scientific information.

Mr. KLEIN. That is a difficult question to answer, Senator.

The CHAIRMAN. Well, your observation, Mr. Klein, that there may be a broad radical improvement, you see, points up the difficulty of the question.

Mr. KLEIN. The scientists have told you, and I think they are right, that there is going to be free interchange of scientific discoveries and knowledge.

The CHAIRMAN. You mean regardless of what we do about it by law?

Mr. KLEIN. I think that you are going to permit it by law. I mean, the scientists have all said that that is the lifeblood of research.

The CHAIRMAN. But do you agree with them as an engineer, as a so-called practical man that translates these esoteric ideas into concrete and steel? Do you agree with that?

Mr. KLEIN. I think it is all right for this reason: If we have a strong engineering organization, and if we continue in the lead industrially, we can do more quicker with such discoveries than any other nation in the world, and for a long time we will be one of the few nations who can support the construction or the extension of fissionable material plants in our basic economy.

The CHAIRMAN. Well, let us see if we understand what you mean. In other words, you would prefer to have access to the basic scientific information developed all over the world, because you feel we could translate it quicker into actuality than if we cut ourselves off from access to it by restricting our own?

Mr. KLEIN. Absolutely, because then we will be facing a hazard that some other nation might make a radical improvement in the process for the separation of fissionable material, and would be able to develop it far ahead of ours.

The CHAIRMAN. You cannot have your cake and eat it, too?

Mr. KLEIN. That is right. Given the same starting point, which is scientific information, we can do much more with it quicker than any other nation in the world, and over the next decade we are going to continue to occupy that position.

The CHAIRMAN. Do you see any intrinsic difficulties in trying to restrict the flow of basic scientific information, as an industrial engineer?

Mr. KLEIN. I see no difficulty in restricting the flow of engineering information, drawings, designs; but from my discussions with the scientists I do see a lot of difficulty in restricting the free interchange of scientific information.

Senator HART. May I ask why?

Mr. KLEIN. The question is: "Why?"

Senator HART. Yes.

Mr. KLEIN. One is because of the temperament of the scientists. You have here in your testimony, I believe, statements of noted scientists to the effect that scientific gossip is the lifeblood of research. I think that was one of the statements made before your committee. Also the scientists are articulate; they are always giving lectures; are always writing papers. Much of the profit that they get from their work comes from the ability to tell the world about it. Again, these scientists are masters of logic and deduction, and they can deduce from certain facts or actions a great deal without needing actual exchange of letters or reports.

For instance, I know that during this war the movement of German scientists, whether Dr. So-and-So moved from Berlin to another location, the segregation of a half dozen of them and the knowledge of what their particular forte in science was, enabled our scientists to draw some pretty good deductions as to what was going on.

The CHAIRMAN. Is this a fair analogy? I have been trying to give this a great deal of thought. The scientists might be compared with the poet who writes a poem. Now, it is pretty hard to keep that a secret, whereas the book publisher who might have a process for turning that out by the million cheaper than anybody in the world can turn it out, can keep it entirely secret.

Mr. KLEIN. I think it is a very good analogy.

The CHAIRMAN. In other words, if Shakespeare were alive today and wrote a sonnet, the chances of it not being known wherever men could read would be negligible.

Mr. KLEIN. Publication is second nature to an author, poet, and to a scientist.

Senator MILLIKIN. That is their reward.

Mr. KLEIN. That is their reward; yes.

Senator MILLIKIN. I would like to ask the witness, supposing it should be decided by this committee—and I don't ask you to participate in the decision or to express any opinion on it one way or the other—that the world is in a position where the primary, or let us say almost exclusive emphasis for a period of time, until there are further clarifications, must be on the weapon side of this business. Would you say that on that assumption there should be complete exchange of science that is contemplated by the bill?

Mr. KLEIN. I would say so, because I think the same considerations affect the problem, that is, the consideration that we are in a much better position to take advantage of any improvements in science than any other nation is.

Senator MILLIKIN. At the present time we have it, and the others may have the theory of it, but they don't know just how we do it. Aren't we therefore making a swap of something that is very substantial and sizable so far as we are concerned against something which is far less substantial so far as other countries are concerned?

Mr. KLEIN. Well, Senator, I believe from what I have read in the press and the Smyth report, that the basic scientific information with respect to these processes is now known to the scientists of several nations.

Senator MILLIKIN. I think that is true.

Mr. KLEIN. I think the British know, and I think the Canadians know it. I know they know it.

Senator MILLIKIN. So you don't mean to go any further than that type of knowledge?

Mr. KLEIN. That is right. I wouldn't give scientific information to any nation who wouldn't give us something in return.

Senator MILLIKIN. Would you say that we should exchange the science involved in the mechanical components of some parts of the electrical diffusion plant?

Mr. KLEIN. No; I see no reason for that; that isn't basic scientific information. That is design, mechanical information.

Senator MILLIKIN. I asked that question just to bring out an illustration that you have given. Do you limit your testimony to the exchange of basic science?

Mr. KLEIN. I understood that was what the chairman's question was directed to.

The CHAIRMAN. Yes; because those are the provisions of the bill, one provision calling for the free interchange of basic scientific information, very carefully guarding, although maybe not carefully enough, according to what the military men say, the technical know-how that goes into it.

Senator MILLIKIN. There is no point in exchanging technical know-how?

Mr. KLEIN. No; because we have it and nobody else has.

Senator HART. I suggest that Mr. Klein does not wish to be in the position of thinking that we should ever teach the world anything about manufacturing atomic bombs, because we hope that they are going to be abolished.

Mr. KLEIN. I sincerely second that.

The CHAIRMAN. Mr. Klein, you have been most helpful to the committee and I want to thank you very much for your intelligent presentation.

Mr. KLEIN. It has been a pleasure to come down to give you our thoughts on this legislation. I appreciate the courtesy.

The CHAIRMAN. The next witness is Mr. Basil Manly, formerly Chairman of the Federal Power Commission, and now vice-president of the Southern Natural Gas Co.

**STATEMENT OF BASIL MANLY, VICE PRESIDENT AND DIRECTOR,
SOUTHERN NATURAL GAS CO.**

The CHAIRMAN. Mr. [Manly, it occurred to me the other day that we might well take a few minutes of your time, and you of ours, to talk about the administrative provisions of the bill which we are considering inasmuch as you seem to have had a somewhat unique combination of experiences; namely, you were chairman of one of our important commissions, and you are now in an executive capacity with a large corporation.

Have you had time to look at the bill?

Mr. MANLY. I have, Senator. I haven't had time to make what I would regard as a thorough study of all its provisions. I would like to say, to begin with, that I know nothing about atomic energy except what I see in the papers, and I don't believe half of that. Therefore, any testimony that I give would relate to the organizational and administrative side.

I might say also that my experience in relation to governmental organizations is a little bit broader even than the time that I served with the Federal Power Commission.

During the first World War I occupied the rather unique position of assistant to the Joint Chairmen of the National War Labor Board, who at that time were former President Taft and Mr. Frank P. Walsh. When Mr. Walsh resigned in 1918, I succeeded him as Joint Chairman of the Board. That was rather a peculiar form of organization. There you had two chairmen of the board, one who had been selected by the labor groups, primarily the American Federation of Labor, and the other who had been selected by the employer interests, primarily at that time the National Industrial Conference Board.

I have off and on, over a period of nearly 40 years now, been connected with both public and private organizations. About half my time has been spent outside the government and about half in, so I think I see it from both the inside and the outside.

How would you like me to proceed, Senator? I have no prepared statement.

The CHAIRMAN. I appreciate that, Mr. Manly. Out of your background of Government experience, and now and before in private business, I would like your comments on the present proposed administrative set-up with relation to getting the job done satisfactorily.

Senator HART. May I interrupt, Mr. Chairman, to ask whether or not Mr. Manly has also considered Senator Ball's bill and the May bill solution of the problem?

Mr. MANLY. No, sir; I have not given those the same consideration. I have read the provisions of those bills in substance as they came out in the papers, but I wouldn't say that I have them in mind. I think my memory could be very easily refreshed. I have a chart that compares the principal provisions of all three, which has been very helpful to me.

The CHAIRMAN. Perhaps, Mr. Manly, this might be helpful. The May-Johnson bill, as I recollect it, provides—and you have your chart there—for a nine-man Commission to be selected by the President, who would not be full-time Commissioners.

Mr. MANLY. Serving on a part-time basis; yes, sir.

The CHAIRMAN. And there would be a Director and Assistant Director who would be the actual operating heads of the Commission, subject to the meetings of this Board of Directors.

Mr. MANLY. Yes, sir.

The CHAIRMAN. I think that is a fair statement, isn't it, Senator Hart?

Senator HART. Yes.

The CHAIRMAN. Whereas the bill that I proposed provides for five full-time Commissioners to be appointed by the President.

Mr. MANLY. On that point of full-time as against part-time service, I have no question in my mind of the wisdom of providing for full-time service of the men who are to be held responsible for carrying forward this most important matter. I base that to some extent on my experience in relation to the Federal Power Commission. The Federal Power Commission when originally created in 1920 consisted of three Cabinet members—the Secretary of War, the Secretary of Agriculture, and the Secretary of the Interior—who made up the Commission.

VP
So. Nat. Ex. Co.

Under them they had the executive secretary. That ran along for 10 years. It was not satisfactory; it was subject to criticism from the beginning.

Finally, during the administration of President Hoover, it was changed and provision was made for a full-time, five-man Commission. I don't think it is necessary to go into detail on that, but what happened is what will inevitably happen in a situation of that kind where very busy men are expected to come in from time to time and get information and approve or disapprove matters that are brought before them. The executive secretary, the administrative head, the full-time man becomes the actual control both of policy and results. I think it is inevitable. You can not run in and out of these big jobs and really keep your fingers on the important developments. So as to that aspect of the matter, I would have no question at all that your basic group, your policy-forming group, should be full-time members of the Commission, and I think a commission in matters of policy is wiser than a single administrator. I think the interchange of ideas, the clash of different points of view is always valuable. Even though not all of the men on the Commission may be as good as you would like to see them, still they contribute something from the point of view of experience, and so forth.

—It seems to me, however, that I would go one step further and say that the men who are going to make the decisions should be civilians. But I think that representatives of the War Department and the Navy Department, our defense forces as now set up, and probably a representative of the Department of State—either the Secretaries of those three Departments, or whoever they designate—should sit with the Commission without vote at all of their meetings. They should participate in the discussions in their initial stages so that the Commission has not pushed forward along a line which may affect either the international relations or the military problems to the point where it is becoming crystallized in the Commission before the military, on the one side, and the Department of State on the other, knows what is going on and has a chance to get their voice in.

Very frequently a policy can be shaped in its initial stages by discussion, so that conflicts are avoided and a working arrangement is formulated; whereas, if it goes forward until it has been crystallized, particularly until some publicity has been given it, men's pride becomes involved, and various and sundry other things happen that make friction.

The CHAIRMAN. Why wouldn't you give them a vote?

Mr. MANLY. I don't believe they need a vote, in the first place; and I don't believe they will be in a position to devote continuing consideration to the matters that are coming before the Commission.

For one thing, I doubt whether they would be in a good position to make decisions on policy matters. They know the policy as affecting their own particular organization and the matters for which they are responsible; but you will have in addition a great many other matters, a great many other questions of policy on which I am not too sure that a vote on the part of the State Department, on the part of the Army or Navy, would be necessary or desirable.

The CHAIRMAN. In other words, you want to make sure they get their viewpoint in on matters that concern them?

Mr. MANLY. Matters that concern them, and get it in early and get it in behind closed doors, and not be in the position of coming before the Commission to present their views; but rather sitting with the Commission around the table and discussing the thing in the hatching period.

Senator MILLIKIN. Do you preface your opinion on the assumption that the energy as a weapon has a secondary place at that stage of the game, or do you still have the same opinion on the assumption that the weapon end of it is the most important end?

Mr. MANLY. Well, I assume that as far as the weapon end of it is concerned, if the Army and Navy are in a position to know what is going on at all stages of the procedure, and if this Commission is, as I think it should be, directly subject to the President with its members removable by the President on short notice, so to speak, the Army and Navy will be in a pretty good position to see that the interests of the country, as far as weapons are concerned, are carried out. The President, as Commander in Chief, and the military and naval forces, as far as my experience has gone, have always been able to bring their views very strongly to bear where matters of national safety were involved.

Senator MILLIKIN. Would you carry that to the extent of saying that we ought to submit our military affairs to a civilian commission in other matters, as far as other weapons are concerned?

Mr. MANLY. No. For the same reason that the Constitution, or rather, our customs, provide that the Secretary of War and Secretary of the Navy should be civilians, I would be inclined to leave the relation of the military and naval decisions to other phases of the policy in relation to atomic energy to a civilian commission.

Senator MILLIKIN. Passing the atomic bomb and the use of this energy as a weapon, do you think that in times not entirely times of peace—for in my opinion we are not entirely in time of peace yet—do you think that on that assumption there ought to be a civilian commission that would determine the use of weapons and the extent to which they should be used, and the productive plans for such weapons?

Mr. MANLY. Well, as to these details, I would hold a great deal of uncertainty as to just how that should be worked out. I should think it is certain in the field of devices for the military use of atomic energy that the development of those devices with the approval of the Commission would be left to the military and naval forces.

Senator MILLIKIN. If there is an uncertainty in your mind as to whether lesser weapons should be put under the control of a civilian commission, how can you escape the conclusion that this greatest of all weapons should be treated differently and put under the control of a civilian commission?

Mr. MANLY. Well, I don't believe that in the long run there is a great difference of opinion there, or a very great departure from what we have now, Senator, in this respect: The Army and Navy now have to come to Congress to get the money. In other words, they come to a civilian body to get the appropriations.

The CHAIRMAN. Through a civilian Secretary.

Mr. MANLY. And come through a civilian Secretary to get the money to carry forward their whole plan for military and naval development. They give to Congress a picture of their basic program,

without necessarily going into detail, although Congress, I think, requires a good deal of detail as to just how the money is going to be spent.

So it seems to me that your relation to your civilian body in the Atomic Commission would be very much the same, and the relation to Congress would be very much the same; namely, that the military and naval leaders would, I take it, privately present to the Atomic Energy Commission their plans for the development of military devices, naval devices, and that those programs would then in due course go to Congress for the necessary appropriations.

Senator MILLIKIN. I should like to suggest that there is no analogy to my mind; there are several distinctions. The Secretary of War, who is a civilian, is definitely attached to a definite job that limits itself to military considerations. He does not concern himself with the use of any energy involved in any type of munitions. As to its possible peacetime application, he has but one job and that is exclusively confined to the military, whereas this Commission has a comingled function of thinking of it as a weapon and thinking of it as peacetime energy.

Now, as to the congressional angle, our discussion suggests that instead of following the congressional tradition and the constitutional requirement of Congress maintained in supplying our military forces, we are making a rather far-fetched delegation of that function to a commission. It is true that these military men come to the Congress and ask in general terms for an appropriation of \$100,000,000 for the Navy, and possibly there might even be an explanation of the general type of munitions, ordnance, or ships that it is intended to fashion. Congress knows nothing about the innards of construction or the innards of any particular piece of ordnance or any powder or any of that sort of thing; and to complete my thought on the distinction that Congress knew nothing whatever about the particular power that we are talking about, it was done completely in secret.

Mr. MANLY. Well, that was during wartime. I am assuming that this is a bill looking forward into peacetime. If we were still at war, I don't think we would be considering this particular type of measure at this time.

Senator MILLIKIN. I think you have made a very sound distinction.

Mr. MANLY. I draw, Senator, another distinction, too, that I haven't quite been able to solve in my own mind. It seems to me, considering this whole situation, you do have to draw a distinction between the situation that will exist if there can be worked out international agreements, firm international agreements either under the United Nations, or bilateral, and the situation that will exist if such agreements prove to be impracticable.

Senator MILLIKIN. I think that is a very sound distinction, and that is what I was driving at a little while ago on what exactly you are premising your conclusion.

Let us assume—and I don't ask you to join in the assumption—that this committee were to conclude that while we say we are in peace, we are in a very uneasy armistice. That certainly would suggest a different line of procedure than if we should conclude that we now have a stable peace and fashion our future plans on that assumption. I think you will agree with me on that.

Mr. MANLY. Yes; I agree with you on that, sir; but I do think that the Navy doesn't in peacetime simply ask for \$100,000,000 to build up the Navy. They come in with minute specifications showing the class and type of vessel, the method of propulsion, the caliber of the guns, and pretty nearly everything else. There have been some cases, I believe, in the past, where Congress, against the advice of the experts in the Navy, have not authorized types of vessels which would have meant progress.

Senator MILLIKIN. I agree with that.

Mr. MANLY. I believe also that Congress had something to do with appropriating for a ship back in the old days that had one gun that was worked by compressed air and fired a dynamite bomb that wasn't exactly a howling success.

What I see is that this Atomic Commission, being the body responsible for having a continuing interest in all aspects of the problems relating to atomic energy, would screen for Congress the military and naval proposals in more or less the same way that a congressional committee now screens the proposals for appropriations; but it would have to go to Congress, as I see it, for implementation before you were through, unless the state of world affairs was such that it was handled behind closed doors, even in Congress.

Senator MILLIKIN. You would not suggest, in other words, that Congress should delegate to a commission its own constitutional power of deciding the matters of the type that we have been discussing?

Mr. MANLY. No, sir; absolutely not.

The CHAIRMAN. Well, you mean by that that you wouldn't turn over the appropriating power?

Mr. MANLY. I wouldn't turn over the appropriating power. Also you have practically the same problem, it seems to me, here with relation to the military and naval forces that you have with reference to proposed licenses for civilian manufacture. As I read the bill, I am not quite sure that I understood those provisions, but it seemed to me to provide that the particular license that was proposed to be granted should be submitted to Congress, and if Congress took no action within 90 days that the license should then become effective. It seems to me that that is not quite right. It seems to me that instead of submitting the individual licenses to Congress for approval, or rather for disapproval or nonaction, it would be much sounder to submit to Congress the rules and regulations, the specifications, practically speaking, under which the Commission proposes to issue a particular class of license.

Let us say one of the first applications of atomic energy would be for the operation of power plants, which would probably mean a licensing of General Electric, Westinghouse, and Allis-Chalmers, the only three of any consequence, to perfect atomic energy for the operation of power plants. It seems to me that if you had specified the basic conditions that would be embodied in licensing that group of manufacturers, that would be all that is really necessary in order to protect the public interest, and you would avoid clogging Congress up with a large number of individual licenses. This would also prevent the possibility of discrimination that it seems to me might without any intention arise if each license had to go before Congress and be there 90 days before it became effective. One man's license

or one manufacturer's license might go up at a time when Congress was busy with other matters, and his license would get by because Congress didn't get around to looking at it. The other fellow goes up, and when the pressure is not quite so heavy or someone raises a question about it, his license gets tied up for 90 days and may be rejected.

The CHAIRMAN. I can see your point. However, you are up against this: The Westinghouse might come in with a proposal, an application that would take 10 percent of the coal out of production, whereas GE might come along a year later with—again generically speaking—a heating device that would wipe out 90 percent of the coal overnight.

Now, that is what we were designing to give the Congress an opportunity to pass on.

Mr. MANLY. Well, I should think that that probably might be covered by submission of the rules and regulations under which licenses in that particular class of manufacture were involved. In other words, it would seem to me that one of the considerations that the Commission would indicate it would take into consideration in granting a license would be the extent of fuel displacement. It is the same problem that we have had over at the Federal Power Commission in relation to issuance of licenses for pipe lines which displaced a certain amount of coal.

The CHAIRMAN. The proponents of the May-Johnson bill have argued that it is impossible to expect that we will get for a full-time commission that caliber of men which is necessary to exercise the great powers that this Commission will have. Do you subscribe to that opinion? Have you noted the salaries provided?

Mr. MANLY. Yes. I think the Government salaries need a revision throughout their entire realm, especially in the executive and legislative branches; but I think you have been more generous in your provisions than Congress usually has been in making provision for full-time jobs of that kind.

Certainly it seems to me that the caliber of men you get will depend on their interest in the problem rather than on the exact number of dollars of compensation, provided that the amount that is carried in the salary is sufficient to keep a man from having to worry about his finances at all times, which is a real problem, I can assure you, and one of the reasons I left the Government.

The CHAIRMAN. Do you think from your observation that we have enough natural resources in the shape of men who would be interested in going on this Commission so that we would not need to be too fearful that we couldn't staff the Commission with suitable men?

Mr. MANLY. I don't think there is any question about the availability of men in this country, and I think you are more likely to find them out of the 130,000,000 or 140,000,000 outside of government than you are by picking them out of government service, or attempting to bring in men on a part-time basis.

Anyhow, I would rather have a man that wasn't necessarily the absolutely top man in the country working on a problem full time than to have the top-notch man dropping in on an occasional basis to attempt to decide matters of policy.

Senator HART. Mr. Manly, in your own company right now, does the board of directors have something to do with deciding policies?

Mr. MANLY. They have everything to do with deciding policies. Senator HART. They are all part-time men, are they not?

Mr. MANLY. In the case of our company they happen to be all full-time men, with the exception of one man.

Senator HART. Over the country, that is not very usual?

Mr. MANLY. That is not generally true, and I think possibly we are too far over in having a board made up of executives of the pipe-line company and its affiliated companies.

Senator HART. I am not sure I understand you now, Mr. Manly.

Mr. MANLY. I mean that the board of directors of Southern Natural Gas Co. happens to be made up primarily of the operating heads of the company and the subsidiary distributing companies.

Senator HART. But did I understand you to say you don't think that is a particularly healthy and good arrangement?

Mr. MANLY. I think we might be better off to have a certain number of additional men who have no relation to the company.

Senator HART. That leads me to ask you if perhaps that same principle might not apply in this legislation which we are thinking of. The board of directors, or call it what you may, composed in part of the executives who are full time and doing the carrying on of the work from day to day, and in part of men of broad experience who are part time, and those seem to me to be fairly well described under the terms of either Senator Ball's or Mr. May's bill.

May I ask you to tell us a little further your thoughts in that way? I am not sure I understand you now.

Mr. MANLY. Well, Senator Ball's bill is five Cabinet members and four public members.

Senator HART. I think it was the May-Johnson bill.

Mr. MANLY. The May-Johnson bill were all part time, and I have forgotten the specifications as to how they should be selected.

Senator HART. I merely use that reference to describe that. The question was the compensation of our top-line organization on the board-of-directors principle and composed in part of men similar to those contemplated by the May-Johnson bill, and in part by the full-time executives.

Mr. MANLY. Well, I thought the suggestion that I had made earlier about the participation by the representatives of War, Navy, and State in the deliberations of the Commission might meet that in part. It is true that I expressed the opinion that it was probably just as well for those representatives not to have a vote on the Commission. I see no objection to their having a vote. Normally the action of such bodies comes out of discussion in which a majority view prevails, and there may be one or two dissenters, or what not. Ordinarily you get the situation pretty well cleared, and I don't know that the voting question is too important, although it seems to me that it would be sounder if you are going to fix responsibility in a commission to give them the sole responsibility and let your five-man commission have the votes.

The CHAIRMAN. Mr. Manly, of course the organization as proposed by the May-Johnson bill, as far as I know, is unique in our Government. The Federal Power Commission, the Interstate Commerce Commission, and SEC—what other Government commissions occur to you?

Mr. MANLY. The only one that I know that was set up as a part-time agency was the National Resources Board.

The CHAIRMAN. That was a war situation?

Mr. MANLY. No; that was prewar. For whatever reason Congress had, Congress decided to get rid of it.

The CHAIRMAN. You see, I was practicing law before I came to the Senate, and I had quite a good deal to do with WPB for clients of mine, and I find the place in many instances was staffed with the part-time men. It was part time for the Government and full time for the bunch that they represented, and I could give you instance after instance of that from my own personal knowledge.

Now, you were Chairman of the Federal Power Commission during the period of the war. I haven't discussed this with you; as you know, our conversation was a very brief conversation. You had considerable to do with that organization, with the part-time men in that organization, did you not?

Mr. MANLY. You mean with the National Resources Board?

The CHAIRMAN. Were they in WPB?

Mr. MANLY. No; that was a separate agency.

The CHAIRMAN. I never ran into them.

Mr. MANLY. It was supposed to be a planning organization. Mr. Delano was Chairman of the Board, I believe, throughout its life. I think Professor Merriam, of the University of Chicago, was one of the members, and I have forgotten who the third one was now, but I was mentioning that not at all in criticism of them. I think they did about as good a job as could be done with the enormous problems given them, the almost unlimited scope of the field that they attempted to cover.

The CHAIRMAN. There were many men in the WPB—I don't mean to make any indictment—many men on a part-time basis that did really wonderful work; but there were others I know of my own personal experience whose work I didn't like so well.

Now, of course, the directors who are part time of a mercantile establishment or a manufacturing establishment are only interested in one thing, are they not—does the business produce profits?

Mr. MANLY. Well, they have got to be interested in a good deal more than that now.

Senator HART. Of course, the chairman does not mean to reflect upon their patriotism?

Mr. MANLY. I mean the making of profits and the continuance of business these days involve a measure of concern about your labor problems, which is a field by itself, problems in the utility field of relationship with regulatory agencies and other matters of that kind. When you get down to it, of course, the decision in a business institution is going to be controlled by whether or not it will produce ultimate profits—not necessarily immediate profits but ultimate profits for the institution.

The CHAIRMAN. That is the basis of our capitalistic system.

Mr. MANLY. Yes.

The CHAIRMAN. However, when we get in the field of government, of its very nature it has different considerations. Isn't that true?

Mr. MANLY. That is true, and I think you have the fact that men cannot have their primary concern in other interests, whether it is a professorial interest or a business interest—and come in every other

month, or something like that, and get themselves thoroughly oriented to the problems that come before a government agency.

Senator HART. I don't understand just what your thought is as regards the quality of men whom the Government can get full time. Now, I am sure that you are acquainted, for instance, with the qualifications of the men who are on that National Resources Board. Is it your thought that within any salary limitation that is practicable, that be gotten through Congress, the Government can obtain men of the requisite caliber for these committee members?

Mr. MANLY. I think so, Senator. I think the nature of your problems here will have a strong appeal to the interest and the patriotism both of men of first-class caliber. If you are able to fix a salary in the range of \$20,000 to \$25,000, or something like that, that would relieve men of their most pressing financial requirements, you will be able to get really first-rate men during the formative period. After 10 years from now or 15 years from now, when it settles down to a routine matter of administration, you may not be able to get men of first-rate caliber for those salaries.

Senator HART. Now going back to your suggestion regarding those three Cabinet officers sitting in on proceedings while policies were being formed but having no vote, in response to Senator Millikin you had considerable to say and you made your position clear as regards the armed forces.

Now, the Secretary of State has quite a different field. There is no question usually of coming to Congress for appropriations, so that is not a factor.

The atomic energy, particularly from the weapon standpoint, is a very important factor in our international relations. Do you think that it would be right to let the Secretary go before this Commission, state his case, and then be turned down on something that is very vital without having an opportunity even for a voice?

Mr. MANLY. No, Senator, I was decidedly not suggesting that the Secretary of State should go before the Commission. I was trying to avoid that situation. It seemed to me that he or his representative should be a participant by right in all of the executive discussions of the Commission rather than being placed in the position of having to appear before such a body and publicly state their reasons and considerations.

Senator HART. Do you not apprehend that under that set-up we would have a continuation on a very considerable scale of two bodies coming to the President in discord and the President having to resolve the difficulty himself?

Mr. MANLY. Well, Senator, I have watched them for a long time, and I have never seen any method of eliminating discords in public affairs.

Senator HART. Well, various Cabinet officers have been before the committee and expressed themselves as of the belief that either Cabinet officers or very high level men under them should be ex officio members of the committee, and their thought was the avoidance of that. I may not have stated it correctly; it may only have been implied.

Mr. MANLY. I would question whether you would improve that situation by giving them a vote on the Commission. It seems to me that the important thing from their standpoint is to know just what

is going on in the Commission first hand in all of its initial stages and be in a position where, if the policy that the Commission is formulating seems to be embarrassing either from a military standpoint or from the international standpoint, they can go before the President and bring whatever pressure, if you want to call it that, that seems to be justified by the facts rather than to have the situation develop to a point where some action has been taken, some policy has been formulated, that is embarrassing, and then have to go either before the Commission or the President and make an open break out of it.

The CHAIRMAN. Thank you very much, indeed, Mr. Manly.

Mr. MANLY. I am sorry that what I have had to say is, as you know, on very short notice and was not necessarily thoroughly considered. I have simply been trying to give you honestly my reactions.

(Whereupon, at 12:35 p. m., an adjournment was taken until 10 a. m., Thursday, February 14, 1946.)

ATOMIC ENERGY ACT OF 1946

THURSDAY, FEBRUARY 14, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington D. C.

The special committee met, pursuant to notice, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Austin, Millikin, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The committee will come to order.

We are honored this morning, gentlemen, by having Secretary Patterson with us.

Will you proceed, Mr. Secretary.

STATEMENT OF THE HONORABLE ROBERT P. PATTERSON, SECRETARY OF WAR

Secretary PATTERSON. By your leave, Mr. Chairman, I will go over this brief statement, and then I will be glad, indeed, to answer any questions.

Now, I am glad to express the views of the War Department regarding S. 1717 on which I have been asked to comment.

I might say at this point that I know of no more important piece of legislation that has come before the Congress during the 6 years that I have been in the War Department.

The possible military use of the energy released by atomic fission was brought to the attention of President Roosevelt in 1939. After preliminary development by the National Defense Research Committee and the Office of Scientific Research and Development, the project of producing atomic bombs was committed to the War Department in 1942. The project was pressed as a war measure with the greatest energy. The dropping of the two atomic bombs on Hiroshima and Nagasaki last August was followed within a week by the surrender of Japan. Meanwhile, the secrecy of the project had been preserved, a difficult matter in a program involving expenditure of 2 billion dollars and a scale of direct employment that reached 125,000 persons.

The enterprise was an unqualified success. Too much cannot be said in tribute to the scientists who developed the basic scientific facts and processes, to the industrial groups who with infinite skill translated the work of the scientists into the final product, to General Groves and his assistants who directed the vast enterprise, and

to the Congress for the trust reposed in the War Department in appropriating the vast sums that were necessary without insisting on disclosure of the details and thus risking premature revelation of what was being done.

Long before the bombs were dropped it was realized that there were unmeasured possibilities in the development of atomic energy for industrial and other peacetime purposes as well as for use as a war weapon. In May 1945 Secretary Stimson, with the approval of the President, formed a committee to consider the subject and to recommend legislation for the control and development of atomic energy. The committee consisted of Secretary Stimson; James F. Byrnes (prior to his appointment as Secretary of State); Will Clayton, Assistant Secretary of State; Ralph Bard, Under Secretary of the Navy; George Harrison, president of the New York Life Insurance Co. and special assistant to the Secretary of War; Dr. Vannevar Bush, Chairman of the Office of Scientific Research and Development; Dr. Karl Compton, president of Massachusetts Institute of Technology; and Dr. James Conant, president of Harvard University.

I know of no committee appointed during wartime or thereafter that had higher talent than that committee. The committee had the assistance of a scientific panel composed of four of the leading scientists in the project, Dr. J. R. Oppenheimer, Dr. E. O. Lawrence, Dr. A. H. Compton, and Dr. Enrico Fermi. Legislation was drafted under direction of this committee and with the cooperation of the State Department, Interior Department, and Department of Justice, the bill being later introduced as the May-Johnson bill.

Senator AUSTIN. These names given in this paragraph of your statement really represent the authors of the May-Johnson bill?

Secretary PATTERSON. Yes, sir. The draftsmanship was done under their direction. I think the actual draftsmen were Captain Davis, who is sitting here, who had a hand in it, and Mr. Marbury, a Baltimore lawyer who was then in the employ of the War Department, and Under Secretary Royall, who was then a brigadier general.

Isn't that right, Captain?

Captain DAVIS. That is right, sir.

Secretary PATTERSON. I will not at this time go into the details of the May-Johnson bill. The objectives, fully stated in the bill, are to promote the national welfare, to secure the national defense, to safeguard world peace, and to foster the acquisition of further knowledge concerning atomic energy. Responsibility was transferred from the War Department to a new civilian agency, to be known as the Atomic Energy Commission, to take over and manage all source materials of atomic energy, all stock piles of materials, and all plants and property connected with development and use of atomic energy. Full ownership and control are vested in the United States. It is provided that the Commission interfere as little as possible with private research, and employ other governmental agencies, educational and research institutions, and private enterprise to the maximum extent. The Commission is given power to adopt the necessary security regulations to control the collection, publication, and transmission of information on release of atomic energy, as required by considerations of national defense or military security.

The House Military Affairs Committee held hearings on the bill. It was freely criticized as a measure drafted by the military and

intended to perpetuate military control of atomic energy, although the true facts are that it was drafted by the committee of civilians named above, or under their supervision, and that it provides for transfer of responsibility from the War Department to a civilian agency. The House committee, after adding several amendments including those further emphasizing freedom of research and investigation, reported the bill favorably.

I should add that the President, since introduction of the May-Johnson bill, has indicated that he is of the opinion that a number of changes should be made in it. The War Department will, of course, advocate such changes in discussion of any detailed legislation.

It was also realized by the War Department, prior to the time when the bombs were dropped, that the means of producing the atomic bomb would not forever remain the exclusive property of the United States, that in time other nations would be in a position to produce weapons utilizing atomic energy. Secretary Stimson was one of the first to recommend a policy of international supervision and control of the entire field of atomic energy, with a view to outlawing its utilization in war and to fostering world-wide exchange of information on atomic energy in connection with industrial and other peaceful purposes. I have been and still am of the same opinion as Secretary Stimson.

These matters were formulated and communicated last September, just following the close of hostilities.

Senator AUSTIN. Will the Secretary permit a question at that point? Secretary PATTERSON. Surely.

Senator AUSTIN. Does the Secretary agree with the policy of the administration which has been publicly stated in connection with our international agreement between Britain, Canada, and the United States, that not until after—and I repeat it for emphasis—not until after effective security has been established against a destructive use of atomic energy shall we exchange reciprocally knowledge respecting the constructive use of atomic energy?

Secretary PATTERSON. I am in full accord with the policy as laid down by the Secretary of State on that subject; yes, sir; that not until there are effective safeguards should there be revelation of any of the secret techniques.

As the result of conferences on the international level, held last November and December and initiated by the President and the Secretary of State, the United States, Canada, United Kingdom, and the Soviet Union joined in recommending to the United Nations that a commission be set up to study and make proposals on exchange of basic scientific information, on control of atomic energy to insure its use for only peaceful purposes, on elimination of atomic weapons from national armaments, and on effective safeguards by inspection and other means to protect complying states against violations and evasions—the work of the commission to proceed by separate stages. The United Nations last month passed a resolution establishing such a commission.

Senator MILLIKIN. May I interrupt?

What do you mean by "proceed by separate stages"?

Secretary PATTERSON. There were four features to the program. The meaning is that those four stages should be taken up separately and progressively.

First, the exchange of basic scientific information with safeguards at each stage; and, second, the control of atomic energy to insure its use for only peaceful purposes; and so on through the four stages.

The Secretary of State has pointed out, in this regard, that the provision as to safeguards in the resolution is intended to apply to all phases of any plan recommended by the United Nations Atomic Energy Commission—including the first stage.

The CHAIRMAN. Do I understand, Mr. Secretary, under the policy of our Government as it is now laid out that it would be possible to proceed with an exchange of basic scientific information, or to proceed to exchange scientists before an effective inspection system has been accepted by each country involved?

Secretary PATTERSON. I don't think the policy on that has been yet thoroughly worked out. I understand that the Secretary of State, with the aid of some advisers, is now considering what measures should be advocated by our representatives on the Atomic Energy Commission of the United Nations Organization. That is my understanding.

The CHAIRMAN. I think it has been pretty well worked out as far as this committee is concerned. I think we pretty well agree on how we feel about it.

Secretary PATTERSON. I was speaking of the advisory committee to the Secretary of State on the subject.

The CHAIRMAN. Yes; I understand.

Secretary PATTERSON. I don't think the work of that committee has yet been completed. They are still meeting, I think.

I would like to speak for a moment on the need of prompt action. The President, in his message to Congress of October 3 on atomic energy, gave warning against postponement of decisions and urged prompt action in passing legislation to cover domestic policy. Prompt action, as I see it, is needed for the following reasons:

1. For lack of a defined national policy, the organization that was built up during the war to carry forward the development of the atomic bomb is disintegrating. To allow this effective group of scientists, executives, engineers, and skilled workers to become lost to the field of atomic energy development would be nothing short of a calamity.

Senator MILLIKIN. Mr. Secretary, do you appreciate the difficulty in the finding of a national policy until we have some information as to what the international policy may be?

Secretary PATTERSON. I think we have to phrase our national policy and make it flexible so that it will be at all times consonant with international policy; but I think we have to go ahead with the adoption of legislation for national policy, bearing in mind the consideration that at all times it must be in step with international policy.

Senator MILLIKIN. Well, you would not say it should be in step with international policy if, from a national policy standpoint, we considered that international policy did not properly protect our own security?

Secretary PATTERSON. I cannot conceive of our being a party to international arrangements that the executive and legislative branches of the Government did not agree with. I cannot conceive of that.

Senator MILLIKIN. It is difficult in advance of knowing what that might be, I suggest, to define a rational domestic policy.

Secretary PATTERSON. There are certainly a great many matters, in any event, as to which our national policy should be laid down and declared that couldn't possibly be in collision with any international undertakings.

Senator MILLIKIN. I would agree completely on that.

Secretary PATTERSON. 2. Before this Nation proceeds any appreciable distance toward any specific international program it should put its domestic house in order. As we move forward along the lines of the Agreed Declaration of the President and the Prime Ministers of the United Kingdom and Canada of last November and the subsequent Resolution of the United Nations, other nations will look increasingly to us for guidance in working out a secure system of international control. The sooner we establish domestic policy and an organization to carry out that policy and gain experience under peacetime conditions in supervising and controlling this field at home, the sooner we can help effectively to lead the way in shaping any international system.

3. Only by a vigorous program of fundamental research and the furtherance of basic knowledge and application in this field can we hope to advance adequately the usefulness of this new science. At present, the War Department has full control over the entire field. Continuation of this situation is not calculated to advance fully the research and development of peacetime uses of atomic energy, for it is not the primary mission of the War Department to do so. The present uncertainty as to future policy should be cleared up without delay in order to prevent any hindrance to full development of peacetime uses of atomic energy.

I should say here that it has been the policy of the War Department since last September, 6 months ago, as soon as the war was concluded, that in the view of the measureless possibilities in the line of atomic energy for peaceful and humanitarian purposes, this project should be turned over to a new civilian agency. There has been no disposition whatsoever on the part of the War Department to keep control of this project. On the contrary, we have recommended at all times that it be turned over to a board or agency for the full development of this enormous source of energy for all purposes.

Senator MILLIKIN. I should like to ask the Secretary whether he believes that the war phase of this weapon energy has now passed and that we can put our full energies into the development of peacetime use?

Secretary PATTERSON. I do not think that the military significance of atomic energy has entirely passed.

The War Department is in accord with the policies outlined by the President in his letter of February 1 regarding legislation on this issue of critical importance:

1. A civilian commission for control of atomic energy, a three-man group devoting full time to the activity.
2. Government ownership of fissionable materials.

Senator MILLIKIN. Mr. Secretary, what is the meaning of "Government ownership"? In speaking of Government ownership of fissionable materials, do you mean the raw material in the group?

Secretary PATTERSON. No; I mean the enriched or processed materials. I think the bill before us calls the other material "source materials," and that means the ores as they come out.

Senator MILLIKIN. I believe you have answered my question, but let me ask you categorically, do you believe the Government should own or take ownership of material in the ground, or raw material on top of the ground, in connection with this control?

Secretary PATTERSON. My belief is that the Government should have full power to acquire the ore in the ground and to explore for it, and own all source materials so mined, as well as fissionable materials, as to all sources within the continental United States or territory subject to our jurisdiction.

Senator MILLIKIN. I suggest that would be very impractical, considering the system under which we develop our mining resources. This particular type of mineral is usually associated in complex ores. The mining business, therefore, could not progress in the way it has been working if there were a threat over its head that it would come under the ownership of the Government.

We have had testimony, for example, by the Vanadium people, who point out how intimately associated uranium ores are with other types of ores. If because there happened to be a uranium element in any ore it came under the threat of Government ownership, we would have a very devastating effect on the development of our mineral resources.

In that connection, I suggest it is not necessary to own it. You can exercise adequate control once the thing has been discovered and has been brought to a processing plant.

Secretary PATTERSON. I say full power. I don't mean automatic ownership just by the fiat of a statute, but full power to acquire either by purchase or condemnation the ores in the ground that contain appreciable or practicable amounts of the source materials. That I think the Commission should have power to acquire.

Senator MILLIKIN. The difficulty there, Mr. Secretary, is that you don't know whether it has a practical amount of this particular energy-producing ore until after you have mined it. There is no way in God's world to look over an area and say, "This area contains ore of the kind we are interested in in appreciable quantities."

It is a gophering proposition. You find it at this point in a mining operation; it disappears at that point, and it might not appear for miles and miles and miles.

Secretary PATTERSON. I realize that and that is the reason why I would give the Commission control in the shape of power to acquire.

Senator AUSTIN. You hold the view, apparently, that this source material would not be a subject of the general power of eminent domain to take private property for public use. Do you hold that view?

Secretary PATTERSON. I would certainly give the Commission that power as regards all source materials containing substantial percentages.

Senator AUSTIN. If the Government has that power constitutionally, it wouldn't be necessary to give it by statute, would it?

Secretary PATTERSON. I think the act ought to provide that, Senator—the power of eminent domain.

Senator AUSTIN. Then it is on the theory that it is not the type of property that can be taken for public use. However, we won't carry that discussion out. That is more of a technical discussion than anything else.

Secretary PATTERSON. Well, when you think of the properties that can be taken by eminent domain for public use, of course upon payment of fair compensation, for use by railroads and all kinds of public uses, possibly highways, property is always subject to acquisition by eminent domain for public purposes of that sort, but there is nothing very startling in it.

Senator AUSTIN. As a matter of fact, we have been taking property already appropriated for public use for another public use, have we not?

Secretary PATTERSON. Yes; where it is a superior one.

Senator MILLIKIN. You are referring to the preservation of a right which in one form or another already exists, but you are not advocating a policy that shall be universally applied. It is a right, the policy to be determined if the necessity should arise?

Secretary PATTERSON. Yes, sir. I think there would be difficulties if you vested absolute ownership in the Commission as to all uranium-bearing ores in the ground. You wouldn't know where you were at. But the Commission should have full power to acquire them either by purchase or by exercise of eminent domain.

Senator MILLIKIN. You would have to buy several of our States and parts of 10 or 12 others, because the ores have a trace of uranium.

Secretary PATTERSON. I think a practical formula for that could be worked out that would get for the Commission all of the power and authority that they reasonably need, and yet exclude from them matters of the extent that you mention.

Senator MILLIKIN. But you are preserving a right, if policy should indicate the need for the exercise of that right, as distinguished from laying down a policy of acquisition?

Secretary PATTERSON. Yes, sir. I was speaking of the points covered in the President's letter to Senator McMahon of February 1.

3. Availability of devices utilizing atomic energy by means of compulsory nonexclusive licenses under private patents and regulation of royalties.

4. Adequate provision for independent research and development.

5. Ultimate use of atomic energy for exclusively peaceful ends, by means of safe, effective international arrangement.

Senator HART. Mr. Secretary, turning back to your first point, in which you say the War Department is now in accord with a considerable change as regards the top level control of the new organization. The May-Johnson bill, formerly advocated, sets forth one method and now you say that the War Department advocates a three-man group devoting full time to the activity:

I would like to discuss that with you a little, Mr. Secretary.

In the first place, is it your feeling that the Government can acquire the full-time services of three men who are fully competent to be charged with that highly important activity?

Secretary PATTERSON. I believe so. Initially we advocated the appointment of a nine-man board as provided in the May-Johnson bill, not to be full-time people. That was under a plan that provided that the executive or administrative matters under the supervision of the Commission should be in an administrator, and I believe provision was made for a deputy administrator. There was a great deal of discussion as to that matter before the House Military Affairs Committee. Some members thought that a better plan would be for, I believe, a three-man group. I am not sure; they may have said five; but at any rate a full-time commission.

The matter was discussed in the Office of War Mobilization with quite a number of executive agencies represented, and also with the President, and the preference of the President was for a three-man group full time.

It was also a closely debatable matter as to which plan would work best, and the War Department is in accord with the decision finally made. I think it was the consensus of opinion of most of those who participated in the conferences at the Office of War Mobilization that that would be a preferable organization; and although we were initially of the other viewpoint, we support a civilian commission of a three-man group full time.

A good deal can be said on both sides, Admiral.

Senator HART. Are you yourself of the belief that those commissioners should serve at the pleasure of the President or for stated terms?

Secretary PATTERSON. Well, there, again, I think the provisions were originally recommended were for a 9-year term, removable prior to the full expiration of that. That was also discussed in full before the Office of War Mobilization, and at the White House, and considerations to make the Commission fully responsive at all times to the policy of the President were pressed at those meetings, I thought with a great deal of force, and our views on that subject have been modified as well in the last 6 months.

I am in accord with the provisions that the members of the Commission should serve at the pleasure of the President.

Senator HART. Mr. Secretary, under that arrangement, how do you visualize the future as regards calling into the picture men of the caliber that was contemplated when the original provisions of the May-Johnson bill were decided upon?

Secretary PATTERSON. I believe that there would be a response to a call by the President for three full-time members of the Commission, a response on the part of men most qualified for those positions, and that there would be acceptance by people of the post realizing the tremendous importance of it and the influence that they would have on the national welfare for years to come. Those details of structure, both as to the number and as to the term, are closely debatable; there is no question of that.

I have listened to contentions pro and con on these things for quite some extensive period, and there is no final conclusive answer. It is a matter of which plan appeals to a man's individual judgment.

Senator HART. Mr. Secretary, you have been carrying on a tremendously large business during this war, and the work under this Commission bids fair to be vast, as I am sure you will agree.

Secretary PATTERSON. Yes, sir.

Senator HART. Do you visualize under the terms of the bill that you are discussing that that Commission of three men would be able to carry on all of the administrative work which will devolve upon them, and at the same time be sufficiently free to seriously think over the questions which will arise on policy on high-level matters?

Secretary PATTERSON. I believe that a commission of three or five or nine would find it advisable to have an executive manager, call him what you may, to handle the administrative matters, and to do a lot of supervisory work.

Senator HART. I have just one more question, Mr. Secretary.

S. 1717 provides for an advisory committee to assist the Commission. What has been your experience during the war years as to the probable status and the probable power that such an advisory committee would be able to exercise?

Secretary PATTERSON. My experience has been that we have had in many instances invaluable assistance from advisory committees. I have in mind the experience of the Ordnance Department on its ordnance-industry integrating committees along special lines, shell production, and things of that sort, where the experience of many producers was pooled and made available to all. I think they perform a valuable function.

Senator HART. Did you have full hope that as good a situation in that respect would exist during years of peace as they have during war periods?

Secretary PATTERSON. No.

Senator HART. Thank you.

Senator MILLIKIN. Am I correct in assuming, Mr. Secretary, that your recommendation that the matter be turned over to a civilian commission is premised on whether Congress reaches the conclusion that the world is really postured for peace?

Secretary PATTERSON. No; it is not premised on that, wholly. As I have pointed out, it was our view last September and October that the matter should be turned over to a civilian commission. That does not mean that the military aspects of the matter should not continue to receive the attention of the armed forces.

Senator MILLIKIN. Would you favor turning over to a civilian commission, on the assumption that Congress might conclude that the world is not postured for peace, the rest of your military activities—the Navy, the Army, and the Air Force?

Secretary PATTERSON. I think we have hopes of world peace on a permanent basis, of course. Nevertheless, we have to maintain an Army and a Navy on the sense that that hope will not be fulfilled; and in the same way here, I think that while this is a matter of vast importance to the Nation in time of peace on account of the vast possibilities, it has its military significance, too, and those matters having to do with military significance must be borne in mind, and as I hope to point out later in the statement, the contact of the armed forces with that phase of the matter should be preserved.

Senator MILLIKIN. Let me ask you again, Mr. Secretary, on the assumption which I made that Congress should conclude the world is not postured for peace, regardless of the technicality of the situation, regardless of whether we have a technical state of war, or don't have a technical state of war, assuming that the Congress concludes that the world is not postured for peace, why should we turn this, the greatest of all weapons, over to the control of a civilian agency any more than we should turn over to a civilian agency the rest of the energy of the Army, the Navy, and the Air Force?

Secretary PATTERSON. I believe that the turning over of it to a civilian agency does not foreclose contact of the armed forces with the matter. It should not foreclose that contact, and that consultation, advice, and participation by them in the military features of it.

I don't think, in other words, that there is any reason why you cannot have the project as a whole turned over to a civilian agency and at the same time continue research and development along the lines of

military weapons, provided you have the proper contact between the new civilian agency and the armed forces.

Senator MILLIKIN. The same thing would be true as to the lesser weapons which the Army has under its control, and the Navy has under its control, and the Air Force has under its control?

Secretary PATTERSON. Yes, sir.

I think the development of atomic energy, however, is an integral. I don't believe you ought to split it up among various Government agencies. It is sound, I believe, to commit the development and the fostering of it along the soundest lines to a new civilian agency, and at the same time make sure that the armed forces have close and intimate contact with the military features of it.

Senator MILLIKIN. Mr. Secretary, I am not advocating a position; I am just trying to get as far to the bottom of this thing as I can through my own thinking processes.

Let's look it right in the face. If Congress should conclude that the world is not postured for peace, why should this energy be turned over to a civilian energy?

Secretary PATTERSON. I believe that it has manifold possibilities of a civilian character that it is necessary to press forward with. A civilian agency can do that better than the War Department. I think that the development of it should be handled as an entity, and that the military aspects of it can perfectly well be taken care of under such a set-up as long as those military aspects are of importance, which they are today, by virtue of provisions in your act insuring that the military development be carried on by the Commission in close cooperation with the armed forces.

Senator MILLIKIN. Mr. Secretary, doesn't that come down to a decision as to what is the predominant use for this energy at the moment? If we should conclude that its predominant usefulness at the moment is a possible war usefulness, does not that put in a secondary position the peacetime use of it?

Secretary PATTERSON. That is so; yes.

Senator MILLIKIN. And that is the assumption on which my basic assumption was made, that Congress should conclude that we are not postured for peace.

As to the civilian usefulness of it, we have had testimony that divides the usefulness roughly into two categories, one for power, electrical energy, and the other for medicinal purposes. Now, you have suggested that we should push forward in those fields, and I quite agree with you. But we need not push forward in those fields, I suggest, as long as the imperative overriding consideration has to do with the energy as a military weapon, for medicine is covered in a more inadequate fashion by existing remedies. The same use that has been suggested in the way of power is covered at the present time by, let us say, a less efficient method.

Could we not lock the whole thing up, if security required it, for a year or 2 years without damaging our peacetime life in any material respect?

Secretary PATTERSON. That may be. I would not be here advocating the turning over of it to a new civilian agency if I thought that the national defense of the Nation would suffer from that.

Senator MILLIKIN. I understand that thoroughly, but that again suggests that our basic decision is: What is the state of this world;

can we assume now that we are off on the road to peace and that therefore we are ready to give this a full play in peacetime development? Or are we brought to the conclusion that the world is not in that highly desirable state, and that this thing should be protected for a time as a weapon?

Secretary PATTERSON. But I do not think it is necessary at all that the national defense would suffer by the turning over of that to a new civilian agency under proper safeguards and proper provisions in the basic act.

Senator MILLIKIN. Then I suggest, Mr. Secretary, unless you believe that the world is postured for peace, the same line of argument would warrant or would call for turning over to a civilian agency the control of all our armed forces.

Secretary PATTERSON. Well, this is a unique weapon.

The CHAIRMAN. Mr. Secretary, this assumption about the world being postured for peace—to adopt Senator Millikin's suggestion—rather contemplates that there is some esoteric concept quite outside of whatever this country may do in the international field which postures the world for peace.

Does it occur to you that the fact that we might turn this over to a civilian commission, with such controls and such modifications as you may feel necessary to protect the military security, would that in itself have anything to do with posturing the world for peace?

In other words, if this country indicated that it regarded the potential monster as probably something that could be used for peaceful and constructive purposes rather than holding it back and ready for destruction, do you think that might have some effect on the peace of the world?

Secretary PATTERSON. Yes, it might. I think the turning over of this project to a new civilian agency is in line with our national policy on other matters, our national policy, as I see it, to promote world peace.

At the same time, certain safeguards, such as the maintenance of an Army and Navy on the terms that we may not get world peace—we certainly haven't attained it to date, but we have hope of a better day.

Senator AUSTIN. May I ask a question, Mr. Chairman, after you get through?

The CHAIRMAN. Certainly.

Mr. Secretary, I believe there is hardly any weapon of war that doesn't find its basis now in electricity. Isn't that true?

Secretary PATTERSON. You are going to have electric power to have any munitions production; that is clear enough. You have got to have coal, and you have got to have iron and copper.

The CHAIRMAN. Following that argument, assuming that the world is not—again, to use Senator Millikin's very descriptive word, which I think is a good one—postured for peace, there might be some argument that could be made that all electricity in the country should be turned over to the War Department for its safekeeping.

Secretary PATTERSON. Well, I don't propose that.

The CHAIRMAN. No—but why? Because it would destroy the fundamental civilian character of our Government, would it not, Mr. Secretary?

Secretary PATTERSON. Well, as I say, I am not advocating any such proposition, and never have.

The CHAIRMAN. Whether for my reason, for others, or for your own, at least you don't advocate it.

Secretary PATTERSON. No; I do not.

The CHAIRMAN. Senator Austin.

Senator AUSTIN. Mr. Secretary, you made a remark a moment ago in passing that this has to be considered with reference to many other activities of Government. I just want the record to show a well-known fact, I think, and that is that the Congress is considering a new structure, the Department of Common Defense, and that whatever this legislation may produce in the way of civilian control would probably be fitted into that department in such a way as to establish the proper relationship between civilian activity and purely military activity, and the whole will be attempted to be coordinated in such a way that for pursuits of peace the civilian activity will be provided for, and for pursuits of war the military activity will be provided for.

That is something that we have in the background, as we consider this, is it not?

Secretary PATTERSON. Yes, sir.

Senator MILLIKIN. I think the chairman's question to you, Mr. Secretary, carries clearly a theory which I don't know whether the chairman holds or not—and that isn't important for present purposes—that we can get peace by gestures; that we can get peace by giving a civilian aspect to our most powerful weapon.

I suggest that it follows in logic, that if that is a useful gesture, then we cannot escape making the same gesture as to our lesser weapons, to wit, the Navy—we could turn the Navy into plowshares—and the Army and the Air Force. Certainly we shouldn't lessen that gesture in our less important weapons.

Secretary PATTERSON. Well, it is a matter of policy for Congress to determine, and Congress does do it. In time of war you have a very large Army and Navy, and then according to the outlook taken by Congress, which determines the funds—and that is where it all comes from every year—the size of the armed forces is diminished; and our experience in the past has been that it gets to a very low level; indeed, far too low a level, in my opinion, and then, as trouble looms, Congress appropriates more funds for the raising of larger military forces. The thing is always determined by the will of the people as expressed by Congress.

I am speaking along very broad lines, and not with particular application to this bill, but it has its bearing on this, I think. We have here a vast new source of power. There is no use in my trying to predict where the range of it will go; not even the scientists that I have discussed it with could do it, and if they cannot, how could I?

However, we have that new source of power, believed to have vast importance along lines not yet developed—as a source of power and energy, and aid to medical science, and I am sure many other things that we haven't even envisioned yet. They are of great importance to the welfare of the Nation along lines of everyday, ordinary life, I believe, of civilian character.

At the same time, the only development of it thus far that has been brought right to the final product has been military, as a weapon.

I would say the policy of Congress on that matter would be to make sure of the development of both, as long as there is the need.

When the time comes that you have firm, steady international controls that you in Congress have confidence in, of course then the military aspect of it sinks to insignificance.

Senator HART. Mr. Secretary, following Senator Millikin's line of reasoning, but not going so far with it as the entire Army and Navy, I read one of the clauses that appears in the Moscow agreement which preceded the international arrangement, where it says that the powers concerned there at Moscow agree to sponsor this thing, and I quote, "for the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction."

Now, Mr. Secretary, the heavy bombers, the large planes, are clearly included in that, are they not? They are major weapons of mass destruction. Is that not true?

Secretary PATTERSON. It may be. My attention had been directed to that resolution bearing, as it does, on atomic energy. That is the primary subject. I read those words that you have just quoted. It may be that they have a broader significance.

Senator HART. It says, "all other major weapons." Now, it certainly has been claimed, possibly in the right, but I don't think so, that the area bombing of both our enemies was tremendously effective in the mass destruction that was accomplished there by it. So I ask you, Mr. Secretary, would it not be—if we meant what we said—rather necessary to put under the control of the Commission that particular weapon, also?

Secretary PATTERSON. That weapon, the long-range heavy bomber, I would say—one single weapon, one bomber—was probably not capable of bringing about that mass destruction. The heavy forces employed by us, for instance last year, certainly did bring about area destruction or devastation, but I should not suppose that the Atomic Energy Commission of the United Nations would have that in mind.

Senator HART. Well, Mr. Secretary, you will agree that it is a weapon of mass destruction, and when you get down to cases the only difference is that in one instance we will use one plane, and in another you would use some hundreds, but you would accomplish practically the same thing in the way of mass destruction.

Secretary PATTERSON. It is not comparable to the power for mass destruction that is released by an atomic bomb, not on the same scale at all.

The CHAIRMAN. You don't agree with Seversky, then. Did you read Seversky's article? We are going to have him in here tomorrow, you know.

Secretary PATTERSON. Yes; I don't know that I disagree with him. He believes, I think, that the destruction by one atomic bomb at Hiroshima and by one at Nagasaki was very significant indeed, that it would take a very large force of planes employing any other weapon to bring about anything the equivalent of it.

Senator MILLIKIN. I should like to ask the Secretary to tell us the results of our past experience in endeavoring to gain peace by self-immolation with special reference to the disarmament conference at San Francisco, the Naval Disarmament Conference, with respect to the matter the Secretary referred—to wit, the congressional reaction to reduce our arms to a practical point of impotency, and to any other illustrations of that kind that he can think of.

Secretary PATTERSON. The past results have been discouraging, indeed, Senator. There is no question of that. We hope that we have a more effective organization and a better will for peace at this time than ever before; and I am not without my hopes.

Senator MILLIKIN. If we don't have the will to peace, we have nothing.

Secretary PATTERSON. That is certain, and if others don't, too.

Senator MILLIKIN. So we must have a will to peace in our deliberations.

Secretary PATTERSON. Yes, sir.

I hope that the day is not distant when international controls for elimination of atomic weapons as instruments of war, together with effective safeguards to insure compliance by all nations, can be devised and put into operation, under auspices of the United States. That day has not yet come, however, and in the interval we are faced with the fact that the atomic bomb is the most potent weapon of war yet devised by man. It is plain that in the interval the place of the atomic bomb in the armament of this Nation cannot be overstated.

S. 1717 contains a recognition of the military aspect of atomic power. Section 6 provides that the Commission shall do research and development in the military applications of atomic power, subject to international agreement in the future, shall have custody of all atomic bombs and other atomic weapons, and may produce them in the future to the extent directed by the President. In other words, while recognizing the military aspects of atomic energy, this bill does not recognize the direct concern of the armed services in atomic weapons.

The War Department cannot subscribe to these provisions which virtually exclude the armed services from all phases of military application of atomic energy. Under the bill the Commission would have sole responsibility for all further research and development in the military field. The Army and Navy would be utter strangers to what was going on, as much so as the army and navy of a foreign power, although they might be called on to operate the weapons so developed, on short notice and without knowing what they were. There are no provisions requiring, authorizing or even suggesting any consultation or contact with the War and Navy Departments on the many problems of national defense that are necessarily involved in the control of atomic energy.

The War and Navy Departments are charged broadly with responsibility for the national defense. Unless it is proposed to relieve them of this responsibility or to cripple them in their performance of it, adequate provision should be made for their activity, in conjunction with the Commission, in the military part of this field from which has come the most devastating weapon in existence, a weapon for which no defense is foreseen. Legislation in the field of atomic energy, under present-day conditions and until there is firm assurance of effective international controls, should, in my opinion, provide for direct participation by the War and Navy Departments in the military applications of atomic energy. The War Department has developed this point more fully in its formal report on the bill and will submit specific provisions along this line if the committee desires to have them.

The CHAIRMAN. I think we ought to have them, Mr. Secretary.

Secretary PATTERSON. Yes; I can provide them.

Any other policy, in my opinion, is taking the greatest risks with the safety of the Nation.

The War Department is also concerned about that portion of section 6 which provides:

The Commission is authorized and directed to have custody of all assembled or unassembled atomic bombs, bomb parts, or other atomic military weapons, presently * * * produced.

The War Department urges that present stocks of atomic bomb components should remain in the hands of the military forces. Atomic bomb components have been produced by the Army and constitute a vital and integral part of the Army's ordnance, which should not, at this time, be removed from the Nation's arsenal. Changes would, of course, be made in the event of disarmament of atomic bombs by effective international arrangement.

Senator MILLIKIN. I would like to ask the Secretary whether he would consider a mere paper agreement an effective international agreement?

Secretary PATTERSON. No.

Senator MILLIKIN. That would have to be supplemented by works and deeds, as distinguished from just a lot of noble-sounding words; is that correct?

Secretary PATTERSON. Yes, sir; there have got to be safeguards for it, of course.

There is one other matter relating to the national security on which I should like to comment.

The CHAIRMAN. In view of Senator Millikin's comment, lest I be charged with any naïveté, I think I should say I join in your last statement. I wouldn't be satisfied, either, with mere words, Senator.

Senator MILLIKIN. The thought never crossed my mind that the Chairman would.

Secretary PATTERSON. I firmly believe that scientific research and discovery must be actively encouraged if we are to remain strong in this field. The highest interests of the Nation require that our knowledge of nuclear phenomena must be greatly expanded. To this end I feel that any legislation that is adopted should lay down a policy of minimum interference with small-scale private research which does not involve the release of atomic energy in large amounts and that such legislation should not contain provisions which negate that policy. While S. 1717 announces a policy of "assisting and fostering private research and development on a truly independent basis to encourage maximum scientific progress," it contains, perhaps unintentionally, a series of severe restrictions on such research and development. It is submitted that S. 1717 should contain provisions similar to those of the amended May-Johnson bill which guard against interference with small-scale or university research. I consider this point of direct interest to the War Department, for we must advance if we are to remain strong.

Among the more important restrictions imposed by S. 1717 on small-scale independent research, which the War Department deems unnecessary, are the following:

1. All research is subject to reporting and inspection requirements;
2. All fissionable materials, however minor in amount and wherever

used or produced—even in small-scale laboratory research—are owned by the Commission and subject to its control.

3. All uses of source materials, however minor, are subject to regulation and control by the Commission.

4. All experimental devices utilizing fissionable materials are subject to Commission license.

It is of great importance that as much information as can be made available without prejudice to the national safety should be freely circulated. At the same time it is of vital importance that adequate means be provided for holding information secure in all cases where the release or communication of it would plainly be prejudicial to the national safety. In determining what information would endanger national safety if released, common prudence requires that these agencies of government charged with responsibility for national defense—the armed forces—should be consulted. The announced policy of the United States is that the technical secrets of atomic bomb manufacture should be held secure. Security provisions of domestic legislation should reflect this policy and provide adequate means of protecting such information as long as circumstances require. There should not be a shadow of doubt on the Commission's authority and power to safeguard information of a secret character that is vital to the national defense.

S. 1717 places reliance on the Espionage Act. We are convinced that the Espionage Act is an inadequate instrument in this instance, and I say "in this instance" because of the extreme importance of the matter we are dealing with. The Espionage Act does not clearly prohibit the transmission of military information orally or by personal written communication even by present or former government employees unless actual subversive intent can be shown; nor does it prohibit the communication of information of military value that is discovered or developed by private persons. Prosecution under significant portions of the Espionage Act having to do with national-defense information faces the difficult task of proving that the defendant obtained the information with intent or reason to believe that it would be used to injure the United States or to aid a foreign nation. Standing by itself, the Espionage Act is not enough for this particular purpose here.

The CHAIRMAN. What law on the books, Mr. Secretary, protects developments in radar or bombsights, or the most vital national-defense secrets?

Secretary PATTERSON. The Espionage Act is doubtless the act that is most relevant, but careful reading of the Espionage Act shows that not all the communications of information of importance to the national defense is covered by it, and I believe that the power of the Commission to adopt security regulations where they believe it necessary for the national defense and the national safety should be utterly undoubted.

The CHAIRMAN. Well, I am not disagreeing for the moment with you. I just want to explore the possibility of following your suggestion of closing this door to the barn, a wide door, it may be true, and leaving all the other entrances and exits open.

Let us take the cryptogram machine, or whatever you call it, that broke down the "winds" messages, so-called. I, among many other people, regretted that information was disclosed that we had that

machine. Now, forgetting for a moment that the existence of that machine was disclosed in this Pearl Harbor committee, what protection did the Government have on that piece of machinery?

Secretary PATTERSON. Well, you have the protection afforded by the Espionage Act, and the provisions of it, and in time of actual war, of course, there is a fairly broad provision in the Espionage Act, the concluding provision.

But the other ones deal with specific cases, and I think the statement I made a few moments ago is true, that it is hard to find anywhere under the Espionage Act anything dealing with disclosure of information unless it is with actual intent or reason to believe that it will injure the Nation, or advance the interest of a foreign nation, because certainly the first five clauses of it are all qualified with the existence of that intent.

The CHAIRMAN. Now, bacteriological warfare has been referred to in the press, and in various articles, and also, I believe, by members of our Department. If we decided to write into this bill great power to issue such regulations, as an astute commission might deem necessary, and make them crimes, all I am pointing out is that we would leave great fields untouched, such as bacteriological warfare.

Secretary PATTERSON. I would make the regulations subject to the approval of the President.

The CHAIRMAN. Wouldn't it be better to try to design a general statute to cover all military information rather than to work out on this particular problem?

Secretary PATTERSON. I appreciate, Senator, that an effort was made in the draft to handle the subject, but it contained some language the meaning of which is not clear to me, something like "adopt administrative interpretations of the Espionage Act." I don't know what that means. The Espionage Act, itself, has nothing to do with administration.

The CHAIRMAN. Wouldn't it be well, Mr. Secretary, if the War Department was to recommend to the Congress amendments to the Espionage Act?

Secretary PATTERSON. In handling security under this measure, I would put it right in the measure, itself, and would give the Commission authority to adopt the security regulations, in line with the general basic policy of having the freest possible circulation of information in this field, and subject to the provision that they be with the approval of the President.

The CHAIRMAN. Of course, after you did that you would leave wide fields of valuable information protected only by the act, itself, wouldn't you?

Secretary PATTERSON. This matter is of such urgent importance that I would put it right in this act.

Now, you have a provision in there somewhere that the classification of information for release shall take it out of the Espionage Act, but the failure of the Commission to do it shall not bring it within. I don't know what the meaning of that is.

Senator AUSTIN. I think the Secretary's attitude in the matter is justified by the history of the many attempts to tighten up the Espionage Act. I used to sit in the Judiciary Committee, and I was a member of the subcommittee for enactment of the Espionage Act.

We just couldn't amend that act to cover the whole field. We encountered all kinds of obstruction and objection because the attempts did cover such a broad ground that there was a fairly reasonable claim that it interfered with freedom of speech and publication, so there was a very powerful bloc against it, and it has been utterly impossible to take that act and amend it into the condition that would protect the military secrets of the United States.

Secretary PATTERSON. As I read the Espionage Act, each division of it deals with a specific case. It is not in broad coverage except as you add them all together, and even then there are plenty of empty spaces. The first has to do with entry on or flying over or getting information about a fort with intent, and so on. Then they have a provision about copying or making a sketch or photograph of plans or papers, and then there are four or five more; but they are a series of specific provisions against particular things, and for most of them you have to prove the intent.

The CHAIRMAN. Which, in itself, is a pretty sound protection of the Anglo-Saxon system.

Secretary PATTERSON. I quite agree, Senator. It is all a question of how important you see it.

Take the technique of the actual bomb manufacture, for instance. The Commission ought to have the fullest power to protect that information. There shouldn't be the slightest doubt about it. If anybody just saw fit to exercise free speech about it, is it thought for a minute that that should be done?

The CHAIRMAN. Now, there are other fields in which it is just as important?

Secretary PATTERSON. No, sir; not as important as this weapon that I know of.

The CHAIRMAN. You don't regard bacteriological warfare as important?

Secretary PATTERSON. I don't regard anything as important under present conditions as the atomic bomb. I think I said here "the most potent weapon yet devised," and that is true; there is no question about it. There ought not be the slightest doubt about the security of that part of it.

It is strongly recommended that the Commission should be empowered to adopt whatever security regulations are found to be clearly necessary in terms of the national security. Basic scientific information should be freely disseminated, but the Commission should be empowered to define by reasonable regulations what is included in this concept, having due regard for the national interest.

The CHAIRMAN. Let's see if I understand it. You mean the Commission should decide what is basic scientific information?

Secretary PATTERSON. I think they should outline the boundaries of it; yes, sir. I don't think there would be much doubt about most of it.

The CHAIRMAN. Do you advocate any veto power by the military as to what constitutes basic scientific information?

Secretary PATTERSON. No, sir.

The CHAIRMAN. Do you contemplate that the Commission, before releasing basic scientific information, should submit it to the War Department for its review?

Secretary PATTERSON. I see no harm whatsoever in having consultation before that, but the matter should be in the power of the Commission subject to approval by the President.

The CHAIRMAN. Now, of course, on technical know-how—

Secretary PATTERSON. I think the Commission should, of course, consult on a matter of that sort with the Army and Navy to get their ideas, but not to be bound, however, by what they say.

The CHAIRMAN. Thank you.

Secretary PATTERSON. The part about this bill that concerns me is the exclusion from every consultation of the people who are responsible for the national defense—even from consultation.

The CHAIRMAN. There is a Division of Military Application, Mr. Secretary.

Secretary PATTERSON. But it doesn't mention anywhere any contact with the War Department or Navy Department. I don't think the names appear in the bill anywhere. There is nothing there to suggest that the division you mention would have any contact or connection or speaking acquaintance with anyone in the War Department or Navy Department.

Domestic security policies and procedures should be consonant with whatever action is taken by the United Nations concerning the exchange of information. To make sure that security regulations are not excessive, they should be subject to approval by the President.

I appreciate the concern that is felt by people in excessive security regulations, and you have got the two interests that I think anyone who studies the matter must concede exists: A policy of the freest dissemination possible in order to exploit any possibilities of this power, and at the same time, certain facts that must be protected by security regulations. I know of no better way than to vest it in the Commission. They, of course, should consult with those in the armed forces as to their ideas, too, and their regulations, I believe, should be subject to approval by the President.

The CHAIRMAN. Of course, I suppose it has occurred to you, when you stated that you measured the two diverse considerations, that any setting up of extreme secrecy provisions here would be likely to bring about the same action in foreign countries on limitations of scientific information.

Secretary PATTERSON. Everything I have said is subject to the international situation and to the international engagements that we are committed to.

The CHAIRMAN. Well, do you think that there is any possibility that this country might lose a war or weaken its national defense if it set up airtight secrecy restrictions on the dissemination of scientific information, more than it would if it adopted a more liberal policy?

Secretary PATTERSON. Well, we come right back to what you said a moment ago, Senator. I can imagine no useful purpose to be served by revelation of the technique of bomb manufacture. Can you?

The CHAIRMAN. I can't, either, no.

Secretary PATTERSON. I can imagine very harmful effects from it, extremely harmful, and I can imagine nothing useful.

The CHAIRMAN. But I can also see, Mr. Secretary, considerable harm that might come, because of scientific progress, by a continuation of the Manhattan district's philosophy as to the security and as to how they are operating the project.

Now, I fully appreciate that you can say that we are trying to get rid of it—at least I am going to do my best to see that that comes about, but I can see—

Secretary PATTERSON (interposing). It was pretty useful in time of war, wasn't it, Senator?

The CHAIRMAN. Yes, of course it was. I can see, however, Mr. Secretary, that from talking with the scientists, many of them, who furnished the essential ideas under which this was made, they will not continue under the same kind of secrecy restrictions as they did under wartime. I think you can agree that will have its influence.

Secretary PATTERSON. Of course, I am interested in their views on it. They are of value.

There are many other points in which it is believed that S. 1717 should be amended and clarified if it is to carry out effectively its announced objectives. They have no direct bearing on national security, however, and I should prefer not to discuss them in this statement. They are covered in the report that the War Department has prepared in response to the committee's formal request. The report is now being processed through the Bureau of the Budget.

Senator MILLIKIN. Mr. Chairman, has the Navy Department been asked for a formal report?

The CHAIRMAN. They have, Senator.

Senator MILLIKIN. Has it come in?

The CHAIRMAN. Not yet.

Senator MILLIKIN. Has the Air Forces?

Secretary PATTERSON. That is covered in the War Department report.

Senator JOHNSON. Will the War Department report reflect the viewpoint of General Arnold? I notice that he made a public statement yesterday, I think it was, with respect to the atomic bomb. Will the War Department report reflect that viewpoint?

Secretary PATTERSON. The War Department, Senator, will reflect the views of the head of the Department; but, of course, the views of the head of the Army Air Forces are considered in formulating the opinion of the War Department to be embodied in its report.

Senator JOHNSON. Well, I hope it will be possible in the report that is submitted by the War Department to reflect the viewpoint of the Army Air Corps, the Army Air Forces.

Secretary PATTERSON. It certainly would.

Senator MILLIKIN. Mr. Senator, I wonder if it might be convenient for the Secretary to furnish the committee with the full text of General Arnold's remarks?

Secretary PATTERSON. Yes. When were they made?

Senator JOHNSON. Yesterday the press reported them.

Secretary PATTERSON. I can get the text, and would be glad to furnish it. Of course, if you want his individual views it might occur to you to call him up here, Senator.

Senator JOHNSON. I would like to have General Arnold appear before this committee and give his views.

Secretary PATTERSON. He might have individual views as to certain features of it that were not in accord with the views as stated by the War Department.

Senator JOHNSON. General Arnold has made a considerable study of the postwar defenses of the United States, and I think his views would be very important.

Secretary PATTERSON. He is in the course of retirement and not active any longer in the War Department.

Senator JOHNSON. He did have much to do with outlining the defenses of America as the plan worked out.

Secretary PATTERSON. His views would be of value on anything relative to the national defense, of course, particularly about the employment of air power and weapons that were launched that way.

The CHAIRMAN. Do you know where he is now, Mr. Secretary?

Secretary PATTERSON. I think he is right here in Washington. He was up in Philadelphia last evening, I think, or is going there tonight.

The CHAIRMAN. I was afraid he had gotten to the west coast.

Secretary PATTERSON. I think he is going to be around here for the remainder of the month.

The CHAIRMAN. We will see that he is called, Senator.

Secretary PATTERSON. In conclusion, the War Department stands with those who desire the establishment of a sound and effective national policy for the development of atomic energy geared to the highest interests of the Nation and of the world. Knowledge in this field must be greatly expanded, and to this end the War Department favors minimum interference with independent fundamental research consistent with requirements of national safety. We look forward to the day when this tremendous force may come to be used solely for peaceful purposes. We are convinced, however, that until such time as international arrangements and safeguards to make this goal effective have been worked out, stage by stage, legislation relative to atomic energy should make provision that the War and Navy Departments be consulted and take part in those phases of atomic energy relating to military application. We are also convinced that the power of the Commission to adopt adequate regulations for protection of information vital to the national defense should be stated in terms that admit of no doubt or debate. We urge that S. 1717 be amended to cover these essential matters.

That concludes my statement, Mr. Chairman.

The CHAIRMAN. Are there any questions of the Secretary?

I take it, Mr. Secretary, just to emphasize the story, that you approve of the bill, with some exception. I want to make certain—I don't know how long it will take us to get your report out of the Bureau of the Budget. I assume that we can hurry it out of there. When we get it, I take it that the report is pretty well synthesized in your statement here.

Secretary PATTERSON. We have a number of matters commented on in the report that are not covered in this statement. They are in some respects details of draftsmanship.

The CHAIRMAN. Of a minor nature?

Secretary PATTERSON. Well, they don't interfere with any of the main objectives covered in the President's letter, those five that I mentioned. We are in accord with those.

The CHAIRMAN. I take it that what you are essentially interested in is a great power of participation by the armed forces in the weapon side of it, plus a tightening up, as you see it, of the necessary security regulations?

Secretary PATTERSON. Yes, sir.

The CHAIRMAN. Those are two things you wish to emphasize?

Secretary PATTERSON. Yes, sir; until such time as we have international arrangements supported by effective safeguards.

The CHAIRMAN. Thank you very much.
We have with us Dr. Jewett.
Will you come forward, please.

**STATEMENT OF DR. FRANK B. JEWETT, PRESIDENT, NATIONAL
ACADEMY OF SCIENCES**

Senator HART. Mr. Chairman, I think it might be well for the record to show Dr. Jewett's qualifications.

Dr. JEWETT. I am president of the National Academy of Sciences, which is a corporation set up by Congress to advise government on matters of science and technology.

Until last year, and for 40 years, I was director of research for the American Telephone & Telegraph Co., the Bell Laboratories, so my whole life practically has been spent as an industrial-research director, although I started as a fundamental scientist.

Is that enough of a qualification?

Senator HART. There is one more thing. I have a feeling that the doctor also has high attainments as an engineer. We heard yesterday something about the engineer-versus-scientist argument. Is that not the case, Doctor?

Dr. JEWETT. Well, yes. Of course, it is largely incorporated as an industrial-research director; but I have been president of the American Institute of Electrical Engineers, and I am rated as an engineer by engineers, and as an industrial-research man by scientific people. I suppose the industrial-research people think I am a good engineer, and the engineers think I am a good industrial-research man.

There is, Senator, a bit of qualification in this prepared statement. I would like to make a preliminary remark. I had no thought of asking to be heard at this meeting, and, consequently, I have paid only general attention to the forms of these various bills, or to the testimony. I have been busy on other things.

Consequently, when, through Mr. Boland, I received word last week that you thought some of my views might be of some importance to you, I had very little time to consider the several bills that are under consideration.

When I came to look them over in the little time that I had, I found that they were so voluminous in amount and so involved with an intricacy of minute police powers for an undetermined future, that it seemed to me about the only thing I could do which might be of any value to you would be to try to analyze from my own point of view the problem which confronts you, and all of us, in this sector, and to see if I could find out what the fundamental things were, and then what answer I would myself try to give if I were in your place.

That I have attempted to do, and I have not attempted to consider the bills in detail, although having set down my own conclusions on what seemed to me the fundamentals, I have gone over the bills again to see how far my own conclusions confirmed, or were at variance, to those conclusions. I think possibly what I have done is more by way of a philosophy than it is a detailed consideration of pending legislation. In looking over the bills after I had done this, I found that many of the points that I had in mind have been covered in one or another of the bills. I have some general conclusions about the legislation which I will give at the end.

I listened to part of Mr. Patterson's testimony, and the questions which you asked of him, and they indicated some interpolations which I might make in my prepared statement; but I think possibly it would be better to wait until the end.

Much of this may seem a bit trite, but it seemed to me to go down, from my point of view at any rate, to the grass roots of this thing.

While I have read the bills for the development and control of atomic energy which are now before the Commission, S. 1557, S. 1717, and S. 1463, revised H. R. 4280, and some of the published testimony which your hearings have developed, I have not until the past few days made any serious attempt to formulate my ideas as to the specific form of legislation which it seems to me the situation that confronts us demands. Further, in the few days since I learned last week that you felt my views might be helpful, I have not had time to compare the specific provisions of the several bills critically.

Although I was trained and am rated as a physicist, I am not an expert in nuclear physics. For more than 40 years I have been an industrial-research director. As such, I have been compelled to keep abreast of the advances in fundamental science and to appraise and develop their practical possibilities. This appraisal and development has involved not only civilian usage but military usage as well. Both in World War I, during the interval of peace, and in the recent conflict, I have been largely concerned with military research and development problems.

So far as this particular subject is concerned, I had intimate contact with the atomic bomb development project in the early stages through the selection and appointment of the National Academy of Sciences Committee, which reported on the feasibility of the project, and later as a member of the National Defense Research Committee when it was responsible for the preliminary development work.

With this background, it seems to me that if my views are of any value to the committee they are concerned primarily with the basic factors which should govern the provisions of any legislation which Congress may ultimately enact.

Because of the possibilities for future development in nuclear physics and of the great dangers to the Nation which inhere in these developments if they are not wisely directed, it seems clear that Congress must concern itself with this sector of science and technology in a way it has never before been called upon to do. Further, it should do so as promptly as possible if matters are not to get out of hand both domestically and in our international relations. Until we have a definite policy and one which we can enforce reasonably well within our own boundaries, we will continue in a weak position in our dealings with other nations. For the moment we have won the atomic bomb race and if we had a definite domestic policy as to the future development of atomic energy and a clear picture of how that policy should fit into a world pattern, we could use our commanding position with great power in an endeavor to bring other nations to a common point of view.

In passing, it seems to me that one of the most difficult problems which confronts us, and Congress in particular, in its consideration of proposed legislation, is to decide which side of the street to play.

If we are convinced that the world is sincerely minded to seek to abolish global war, legislation of the kind here under consideration

can take on one pattern. If, however, we are not so convinced and feel that we are likely to be entering an armistice period at the end of which the Nation is likely to be plunged suddenly into a catastrophic fight for its existence, the pattern may be quite different.

The provisions and phraseology of any law enacted will, I think, almost certainly indicate our present judgment as it is difficult for me to see how we can play both sides of the street fully and safely simultaneously.

What are the primary factors with which we must be concerned in legislation designed to implement a policy designed to be in the best over-all interest of the United States? They are, I think, four in number, namely:

1. Fundamental science.
2. Technology, i. e., applied or industrial science as it relates to the use of fundamental knowledge in either the physical or biological fields.
3. Military applications of atomic energy.
4. The incidental hazards to life in the carrying on of experimental and development work; of manufacture and use of highly lethal materials.

FUNDAMENTAL SCIENCE

Some hundreds of years of human experience have shown conclusively that science progresses best and most rapidly when there is complete freedom of intercourse among scientists and full publication of the results of research. This is true not alone within a nation but for the world at large, since no one can foretell where or by whom important advances will be made and each step forward is an aid to all.

This freedom is of importance not only to fundamental science per se but to the technologies which have their roots in fundamental science. Whether they be the technologies of peace or war they cannot go beyond the limits set by their root structure.

Until recently, notably until the military possibilities of atomic energy broke on a war-torn world, few, if any, questioned the validity of this basic principle of scientific research.

If we could be sure of a return to the scientific freedom which existed up to 1939, our course in this sector would be clear. Our national interest would impel us to stimulate prompt publication and interchange of all new knowledge and to keep at a minimum in any legislation anything which tended to hamper it.

Whatever our judgment of the future, it is still a goal we should strive for and strive to have other nations follow. Anything by way of legal prohibitions in this sector is detrimental to the Nation's interest since they limit us to what we ourselves can do in a field where experience has shown that no nation and no people are self-sufficient. Further, any prohibition by us or any other great nation is a breeder of reprisal and suspicion.

If national isolationism in fundamental science had been the rule in the past few decades, there would have been no atomic bomb—certainly we would not have had one. Five years ago it was possible because of a stock pile of fundamental knowledge internationally accumulated for us to embark with assurance of probable success on the technological development of the bomb. Ten years ago no amount of effort or money could have given us or anyone else this assurance—the stockpile of basic knowledge was not complete.

Full international freedom in the dissemination of fundamental research knowledge is, therefore, in the interest of all, no matter what restrictions nations may put on its technological use.

If, however, some powerful nation elects to follow a different course while future wars are still in the picture, it will be a serious matter to legislate for full and free publication. Such a course would mean that the United States would always have less than a complete stock pile of fundamental knowledge with which to build.

If we could have complete freedom within the Nation and complete prohibition otherwise, the situation would be mitigated. This, however, is an impossibility in any save a totalitarian government having drastic powers of regimentation.

To attempt it in our form of government would probably be worse than useless—it could not succeed and the attempt would undoubtedly raise grave international questions as to our intentions. Anything less than free intercourse among our own scientists would be an added serious handicap.

Whatever the final decision of Congress as to the phraseology governing this particular item in a law for the control of atomic energy, it seems to me that Congress should not delegate authority of modification to any board or commission created to administer the law. A matter which affects the future interests of the Nation so gravely in so many different directions seems to me too great a responsibility to entrust to a small group of men no matter how capable.

The CHAIRMAN. Doctor, I don't quite understand your point. I understand that you advocate as free a dissemination as possible of scientific information.

Dr. JEWETT. Yes. Here is what I really meant, Senator. This was hastily written.

Suppose that the Congress should decide that free dissemination of the kind we had a few years ago was in the interest of nations. Suppose they decide that today, and we had created a commission. The situation changes tomorrow or the day after. It makes it appear to some people that that is an unwise provision, that we are doing ourselves damage by telling all and sundry of our creations in fundamental science and that another policy, a policy of restriction, should be imposed. I think that the decision to change from a policy of free dissemination to one of restriction is something which Congress itself should decide and not delegate to some small body of men, no matter how capable.

The CHAIRMAN. We are faced now with an immediate problem.

Dr. JEWETT. That is right.

The CHAIRMAN. We have atomic energy and the necessity for continuing research in the field. We can all agree on that.

Dr. JEWETT. I am talking, you understand, about dissemination of fundamental knowledge to all and sundry. That is what we did before 1939, before the war came on. That was the rule of science—free publication, free discussion internationally.

The CHAIRMAN. Do you think we should restrict it now by law?

Dr. JEWETT. I do not.

Senator JOHNSON. Mr. Chairman, I think it is unfortunate that Dr. Jewett has not read my bill, wherein I hold back some of the delegation of this authority and keep it in the Congress instead, for the reason which he has given—that we don't know.

Dr. JEWETT. You understand that what I am reading here, Senator, was my analysis of the problem, as I saw it, and then I have tried to relate it.

Senator JOHNSON. I understand that, but I wanted to call the attention of the chairman to one of the outstanding merits to be found in the bill which I have recently introduced.

Dr. JEWETT. My point simply is this, that the restriction—whatever you do in technology, whatever you do in connection with war preparedness, and I will cover some of those later—free dissemination of scientific knowledge the world over has been proven to be the surest way of building up the maximum stock pile which the ingenuities of people can use. The minute you try to restrict that, and particularly if it brings about reprisals, then each nation is, in the last analysis, dependent upon what it alone can produce without benefit from anybody else.

If you have been living in a world of free dissemination of scientific knowledge, and a nation suddenly decides to alter that policy, it immediately not only limits itself to its own things, but it immediately raises questions as to why it has done it. So it is a dangerous thing to alter a policy once it has been established by Congress.

The CHAIRMAN. Not established by Congress; Congress simply has never legislated in the field.

Dr. JEWETT. Assuming that it had, and some of these bills indicate the desire for free dissemination of fundamental scientific knowledge. Having expressed that, anything that changes that picture is a serious matter, and I say it is so serious a matter that it should be retained in Congress and not delegated to a small group of men.

Senator JOHNSON. Thank you, Dr. Jewett, for putting a little water on my wheel.

The CHAIRMAN. I don't think the Doctor really has.

Senator JOHNSON. I hope the chairman won't take all the comfort that the Doctor has given me away from me.

Dr. JEWETT. I think before I get through I am going to be like the Kilkenny-cat fight; I think I am going to hit you all. I hope I haven't put any grit on the wheels.

The CHAIRMAN. Senator Johnson's proposal, Dr. Jewett, just came in the other day. You may not have seen it. It proposes the substitution of a 10-man congressional commission to operate this situation, 5 from the House and 5 from the Senate, rather than an executive commission.

I might say parenthetically, I can sympathize with Senator Johnson's point of view. It raises, however, some constitutional difficulties, because we are a nation of division of powers between the legislative, the judiciary, and the executive.

Dr. JEWETT. It seems to me to raise a very practical difficulty, too. Every one of you is liable to get left out in the cold at the next election.

Senator JOHNSON. We will be replaced by others.

Dr. JEWETT. But they wouldn't carry over your wisdom as members of the Commission.

Senator JOHNSON. It will still protect the country, and the control will be left in Congress.

The first paragraph of my bill is very short, and I want to read it into the record at this point, if the witness will not object:

The Congress hereby declares that the problems involved in the regulation and control of atomic energy are s
dependent for their solution

upon developments which will occur in the near future in the fields of scientific research and development and of international cooperation and upon the results of tests with respect to the military application of atomic energy that it would be inadvisable at the present time for the Congress either to legislate with a view to the permanent regulation and control of atomic energy or to vest the powers of regulation and control in any agency other than one directly representative of and responsible to the Congress. It is therefore the intention of the Congress, in the enactment of this legislation, to provide temporarily for the regulation and control of atomic energy and to vest the powers of regulation and control in a Congressional commission composed solely of Members of the Congress.

That is briefly what my bill attempts to do, and it is for the reasons which I have understood the witness is advocating that there are so many imponderables, so many "ifs" in this whole question of control that Congress ought not to delegate too rapidly its authority, and especially its right to make changes as changes seem to be indicated.

Dr. JEWETT. I had not seen this S. 1824 you have been reading from.

Take, for example, on page 2 of S. 1717, the second of the express purposes of the act, what you are attempting to do. It says:

A program for the free dissemination of basic scientific information and for maximum liberality in dissemination of related technical information.

That is an expression of a point of view on the part of Congress, and all I am saying is, that having seriously considered and taken that as a definite point of view, it is not the type of thing that I would delegate to a small group of men. If the Nation's needs require a change, then it is something that the legislative body which passed the original legislation ought, in my judgment, to take cognizance of, whether it does it the way Senator Johnson has in mind, or some other way. All I am saying is, I wouldn't give a commission the authority to modify a point of view expressed by Congress.

Senator MILLIKIN. If you are going to have a free exchange of scientific information, of course, it follows from the statement of that, that it must be truly free among scientists who are not under any sort of coercion. Is that not correct?

Dr. JEWETT. Yes. Practically through all my life, and up to the beginning of this war, fundamental science—I am not talking about technology, now, but fundamental science—operated, and had operated, for a couple of hundred years, on the basis of complete free international interchange of information. Men got together and talked; they formed themselves together in societies; they published papers; they had international congresses; and what we did was to build up an enormous stock pile of fundamental scientific information which the ingenuity of each nation made use of as it saw fit.

On this atomic bomb, of course, our contribution to the fundamental stock pile was small—quite important, but nevertheless small—a different rule obtained, and had we been dependent upon our own contributions to fundamental science, we never could have had an atomic bomb here.

Senator MILLIKIN. In those days, to the extent we had police power states, that power was not exerted on the true scientist, was it?

Dr. JEWETT. No; very little; and the evidences are these international associations and congresses. People get together and talk, and every time a new bit of information comes out which is valid—and the scientists are pretty careful not to publish stuff they don't think is valid—it is published and disseminated broadly.

Senator MILLIKIN. Is it not conceivable that scientists in police power states might be under such coercion that what they put out

by way of exchange might be a slanted type of goods rather than a free and honest and uncoerced type of goods?

Dr. JEWETT. Yes; it might even go further in a completely power state and have them pass out no information. So, then, what you have got, if you have that sort of situation—and we are following a different philosophy—is that they have all that we have, plus what they have; and we have only what we have, ourselves.

Senator MILLIKIN. We are getting the short end of the swap?

Dr. JEWETT. Sure.

Now, if I may interpolate, if I had to make the decision at the present time with regard to this, despite the fact that I am very skeptical about the world's ability to abolish war, although at any rate we are making an attempt to do it, I think that rather than take the horn of the dilemma of saying we will not disseminate fundamental scientific knowledge, and raise all the suspicions as to our motives why that occurred, I would try to bring about free interchange again, and be guided in the future by what the results were.

Senator MILLIKIN. Of course, you are aiming at a goal of free interchange of science, and I assume that you mean free interchange of science.

Dr. JEWETT. That is right.

Senator MILLIKIN. Up to the time that you achieved that, of course you do not have a free interchange of science. You either have no exchange, or a partial exchange, or a slanted exchange. Is that not correct?

Dr. JEWETT. Correct.

Senator MILLIKIN. From that may we not conclude that until you also have a free interchange of all kinds of information, that you cannot isolate this particular type of exchange?

Let me put it another way: Must you not evaluate what you are getting against the background out of which it comes?

Dr. JEWETT. I think the answer to that is "yes," but when you say "free interchange of information," I don't think you can or ever should or ever will have a free, completely free, interchange of all technological information. I don't think you will ever have that within the Nation, itself, because that represents the skills and techniques which men in a competitive world, or nations in a competitive world in peace, use. They won't pass that kind of information out.

Senator MILLIKIN. I quite agree. I was speaking of the general liberty of the press; the general free interchange of information, political information, all kinds of information.

Dr. JEWETT. I think it is all tied up with the same thing.

Senator MILLIKIN. Yes; it is; and unless you have that you do not have the factor against which you can evaluate what you are getting.

Dr. JEWETT. Let me see if I can state my personal point of view again.

If I had to make the decision, we, as a Nation, have set our hands, rightly or wrongly, to the idea of making this UNO work. Now, having done that, as the lesser of two evils in a world where I may be suspicious of the motives or intents of other people, I wouldn't compromise my decision by an act which indicated that I didn't believe that the thing that I was shouting about was going to work; but I would be darn well prepared to make a change if I found the thing wouldn't work.

Senator MILLIKIN. In other words, if you were sitting up here, and had to make recommendations for the security of the Nation, you would look at the picture exactly as it is and govern yourself accordingly, would you not?

Dr. JEWETT. Yes; that is right.

The CHAIRMAN. Doctor, as I take it, you don't want any legislation now of any kind giving anybody the right to pass upon what kind of scientific information should be disseminated, and what kind should not be disseminated?

Dr. JEWETT. I think my answer would have to be "yes" to that, on the ground that in the over-all interest of this country, I think in the field of science the goal of free interchange is in our best selfish interest, because it tends to build up the greatest stockpile of knowledge. We are an ingenious people, and we think we know how to use information pretty effectively. I would hate like the dickens to go into another crisis X years hence with one hand tied behind me because of the lack of some information that was obtainable.

The CHAIRMAN. Of course I agree with your general philosophy, but in drawing the bill I also realized that we had to set down some guidance for the Commission in handling this very dangerous matter. I cannot reconcile your general philosophy with what I consider to be the broadest possible provisions to implement that philosophy with regard to this very explosive situation.

Dr. JEWETT. In that section of 1717 which I read, you did express the philosophy, a broad philosophy, and I agree with it.

Now, all I have been trying to say is that in this bill—and I didn't have this bill, or any other bill particularly in mind—having expressed that as the national point of view, as reflected through the Congress, I would certainly not give any appointed small group of men a power to change that view without coming back to Congress. That is the only point I was trying to make.

The CHAIRMAN. Today, the way the Manhattan project is operated, you realize that there is no information coming out of it at all, that over a month ago recommendations were made to General Groves for the release of certain scientific, basic scientific, information, and, so far, there has been no action on that matter at all. That is just being bottled up, you see.

Dr. JEWETT. Well, I don't know enough about what is in the Manhattan district project to know; but I suspect that the great bulk of the stuff that is in there is not basic scientific knowledge, but is technical knowledge, and that is quite a different breed of cat.

Senator HART. Doctor, is it your estimation that with the publication of the Smyth report, and what has gone on incident to that a little more, we already have given the world about all of the fundamental scientific secrets that we had in this project?

Dr. JEWETT. Well, I certainly think that with all that has been published and said so far, the proof positive of the fact that the problem can be solved was in Hiroshima and Nagasaki. If you gave out more in detail, you might shorten the period when somebody else so minded could solve the thing. The fact they know the problem can be solved, plus what has already been given out, makes it seem to me perfectly clear that anybody who wants to pay the price for it—it may be a big price—can do what we have done.

Senator HART. Doctor, you are talking about technological secrets?

Dr. JEWETT. That is right. Most of the fundamental facts were known before we started the project.

Senator HART. You don't think we actually had held back?

Dr. JEWETT. I simply don't know, but I know that the great bulk of the basic knowledge was the common stock pile with which we started. The situation at the time that I was asked to appoint this Academy committee to review this thing about 5 years ago was one which had to be judged on existing knowledge. The report of the committee indicated the probable feasibility of doing this thing, and was based solely on a common stock pile of knowledge which indicated that the thing could be done. It was a highly difficult technological problem, and it was very much of a gamble as to whether within the limits of a war you could solve the problem. But it looked as though you might if you were willing to pay a big enough price for it, and the end of the road was success.

Now, that situation no longer exists anywhere in the world. There is no question as to the ability to succeed; we have succeeded, we have proved it, so that anybody who wants to start now, even if they started with no more information than we had at that time—and they have a lot more—would know perfectly well that they could succeed if they were willing to pay the price for it.

Mr. Chairman, did I make clear the one simple point I had when I read that last sentence, that Congress having expressed a point of view representing the point of view of the Nation, I think it would be very dangerous for any lesser authority to modify that point of view.

The CHAIRMAN. Even the War Department?

Dr. JEWETT. I don't give a—yes; even the War Department.

Senator MILLIKIN. I wish you had finished that; it would have been very refreshing.

Dr. JEWETT. Senator, I have worn both uniforms, you know.

The CHAIRMAN. I think we understand.

Dr. JEWETT. Shall I go on?

The CHAIRMAN. Surely.

TECHNOLOGY

Dr. JEWETT. In some respects the ground rules governing technological employment of fundamental science are similar to those governing basic knowledge; in other respects they are different.

Industry has gradually learned that so far as possible it is in its best interest and the best interest of its individual units to foster publication of results and free intercourse among its scientists and engineers. It has four avenues for this, namely, publication in the scientific and technical press, the open discussions of scientific societies, the publication of patents and the evidence which the use of its products give to all who have access to them.

Patents are a peculiar form of publication which are open to technology but are rarely employed in fundamental science. They are usually more specific in their disclosures of new things than are ordinary scientific papers and they endow for a time the thing disclosed with a property right which can be legally maintained. Since they do not, however, prevent anyone from employing them for experimental purposes in a search for improvements or alternatives, they are in addition to ordinary scientific disclosures.

The principal fundamental in which technological development differs from basic scientific research lies in the field of techniques and skills. These represent the ingenuities of the technologist and determine his ability to survive in a competitive situation whether it be the competition of peace or the greater national competition of war. In varying degrees that are closely guarded—that is the techniques and skills—and so long as the question of survival and competition continue they will continue to be despite legislation to the contrary.

Experience, and our own experience particularly, has shown the wisdom of stimulating a free technology as widely as possible with a minimum of governmental restraints. This is true for both peace and war. Our astounding achievements in World War II were due primarily to the magnitude and power of our national technological structure and not to our preeminence in fundamental science or in our specific military preparations.

Nothing, so far as I can see, has developed during the war to alter our established attitude toward technology.

The coming of the atomic bomb has introduced a new factor—it has not destroyed the old ones. It requires a new appraisal and alignment and some modification of the rules. Whether the future is to be one of war or of long-continued peace, the best interest of the Nation will be served by the fullest possible development of this new sector of science. Every unnecessary legal restraint should be avoided since each restraint in one way or another deprives us of maximum ability to meet unforeseen crises when they arise.

MILITARY APPLICATIONS OF ATOMIC ENERGY

So long as war in the future and the maintenance of an Army and Navy are considered an essential part of our social structure, the age-old rules which govern military thinking and acting will persist. No legislation will change them, nor should it.

There are some military things deemed by military men to be of such importance to the Nation that even in the stress of war they are not willingly disclosed even to an ally. This is no narrow clannish thing—it is grounded in age-old human experience. The friend of today may be the enemy of tomorrow or the friend or ally of an enemy. We have recently had a vivid illustration of this in the quickly altered positions of Germany and Russia and of Russia and Japan.

It would, therefore, be hazardous in the extreme to enact legislation which tended to weaken the control of the military on maintenance of secrecy on the military technological developments of atomic energy. If such weakening is justified in this sector, there is little merit in trying to maintain it in other sectors.

In saying this I do not wish to be understood as advocating military dominance or control over the future of fundamental science or civil technology in the domain of nuclear physics, or any other domain for that matter. Quite the contrary.

While I am clear in my own mind as to the ultimate responsibility of the military in those fields of technology which are solely or primarily military, I am equally clear that they should not be in position to dictate in other fields. If restraints in such fields are needed because of military requirements, they should, in my judgment, be otherwise imposed.

It is in no sense a derogation of the capacity of professional military men to say that as a group they are ill qualified to administer fundamental science or civil technology. Their incapacity as a group resides in the fundamentals of their assigned task and in the influence of a lifetime of training for that task. Any of us in their position would be similarly affected.

Specifically, the factors are three: The requirement of implicit, unquestioning obedience in time of battle; the consequent deferring to higher human authority; and the necessity of making instant decisions for action on the basis of meager data, all three of which, I might say, are antagonistic requirements certainly for fundamental science and for civil technology.

If these views are valid, and I think they have merit, it seems to me that any legislation which is enacted should be carefully scrutinized to insure that the real interests of the military are safeguarded without putting them in position to impose these interests detrimentally on other sectors.

HAZARDS

There is little that needs to be said about this factor other than to mention the fact that experimentation in some sections of nuclear physics, some of the substances involved which have to be handled technologically and transported, are of a character which involve hazards to life or jeopardy to the functioning of other nearby essential things.

They constitute therefore a matter which involves the attention of government. That attention, however, is not different in kind from the attention which government gives to the employment of other hazardous things. It is the exercise of the minimum of police power needed to insure safety without unduly hampering individual or group initiative.

CONCLUSIONS

On the basis of the foregoing and other similar considerations which seem to me fundamental, I have tried to formulate my own views as to what legislation should seek to accomplish if we, as a nation, are to derive maximum benefit from future developments.

In the present state of our scientific knowledge all of the numerous prospective values of atomic fission are tied to the utilization of certain raw materials which must be mined, processed, and manipulated whether the end sought is in industry, the military, or the fields of biology and medicine.

It seems to me that government, the agency for all of us, should as a primary act take control of all such basic material and such of the secondary products as require control. This whether these are locally produced or imported.

Under this primary control, I would grant licenses freely to responsible men or groups for mining, processing, industrial, or other uses under conditions of strict accountability for all such materials and full reporting as to the use made and of adherence to such regulations concerning hazards as might be prescribed.

In a word, I would seek to have the legislation encourage maximum development with a minimum of restriction and a minimum of policing.

From the nature of the subject matter, I would make the penalty for willful violation of the license severe.

Because of the peculiar nature of the materials involved, policing of any major operations is simpler than for most other things.

In a way the pattern I have in mind is not dissimilar to the one employed in the control of narcotics and dangerous drugs. Any of us can get these things on a valid prescription but not otherwise. The control is in the control of the State through its licensing and reporting system. The doctor is licensed to issue the prescription and is under constant threat for violation; the druggist will honor the prescription and must make full accounting for all materials in his possession under threat.

Senator MILLIKIN. I should like to ask the witness how far he would go in the location and development of mining claims. I assume that the witness is familiar with the way in which claims are made, and the effect upon the public domain.

Dr. JEWETT. Fifty years ago when I lived in a mining country, Senator, or 40 years ago—

Senator MILLIKIN. It hasn't changed any; it is the same thing. Don't you think that a supervision over the mining—I am talking now about the prospecting and developing of mining claims—so long as you are dealing with the raw material would be sufficient?

Dr. JEWETT. Yes.

Let us talk specifically about a mining claim where the fellow is getting out uranium, if you like. All right, he has located a claim, gone through the necessary processes, and I think all I would do for that particular material would be to say, "Go ahead and produce all you can, but you have got to report everything in the thing." In a way, that is what we are doing with gold, at the present time, isn't it?

Senator MILLIKIN. Yes; and silver.

Dr. JEWETT. In other words, that particular material became a matter of national interest, which is peculiar to that particular thing.

Senator MILLIKIN. You wouldn't suggest that all the mining area of this country, because it might have some uranium content, should be subjected to Government ownership, would you?

Dr. JEWETT. No; I should think not; because I suspect that you could find a little uranium in almost any piece of soil.

Senator MILLIKIN. Testimony we have had concerns that.

Dr. JEWETT. So the question would then become a question of where do you draw the line in this thing. How much uranium is uranium?

Senator MILLIKIN. A fellow goes out and stakes a claim and makes a discovery, and he finds some ore that had some uranium in it. If he has to report that, the Government then has an opportunity to walk in and see what happens to it, and is that not sufficient at that stage of the game?

Dr. JEWETT. Personally, I think so, and I think insofar as you can put the controls back to the limiting things, you have exercised the greatest control you can without an enormous amount of police power.

Senator JOHNSON. Couldn't that then be controlled through some control of assaying, or sent in to be analyzed, and couldn't the assayer be required to report any important quantities of uranium, or other fissionable products? Couldn't he be required to report that so the Government would be on notice?

For instance, the amount might be very small, and the mining operation might desire to throw out the uranium; but it seems to me that this ore has become so important now that the Government should be put on notice that certain ores do contain this element, and it could be handled through the assayer.

Dr. JEWETT. Yes; it could be handled there. I had not tried to think the thing out. I would assume, if you adopted the reporting system as a means of control, it would apply to any links in the chain that were important. I don't know enough about the drug and narcotics thing, but my understanding is that a company producing morphine is compelled to report how much they produce, and where it goes, under penalty; the wholesaler, when he gets it, has to keep his records; and the retailer has to keep his records, and, finally, the physician's prescription, which takes a certain small amount of that out of stock, is the defense which the druggist has for accounting for the amount of material in his possession, and so it goes right on back.

And who is this fellow who finally gives the order which begins to take this out into the general population? He is the man who the State—not the United States; in this case, but the State—has licensed to do that very thing. Why? He has had a kind of training, has passed a certain kind of examination, and he is the unpaid agent of the State authorized to disseminate this very deadly thing.

But the whole thing has to match up, and if the controlling agency finds there is a big discrepancy somewhere along the line, it serves notice that you have to look for it.

Senator JOHNSON. In the production of carnotite ores, where vanadium is the objective, it might be much easier, and much less expensive to the mining company, to let the uranium part go on down the river and go in the dump to be wasted.

Dr. JEWETT. It might, from their standpoint, but if the control agency, commission, or whatever you have, felt that that material should not be wasted, then they could step in, if they knew about it.

Senator JOHNSON. Yes; of course, and the important thing is that they know about it.

Dr. JEWETT. That is right, and I don't believe that you can get that thing. I think if you start at the place where the factors are the least, you have the biggest change of control. The minute you try to get a policing policy that goes out and polices everybody, it is like OPA. I suppose it is correct that the British did a better job of rationing food during the war than we did. If that is so, the reason is quite clear. A large part of England's food supplies came in through a limited number of inlets, and they had control of the thing where the thing was easy to control. With us scattered all over a continent, we have thousands of inlets into the final stream, and it is almost impossible to control.

PATENTS

I would not attempt to incorporate special patent provisions in the basic law governing atomic energy. They have little or no place, so far as fundamental science is concerned. In the field of technology, they are not different in kind from patents in other fields and should, I think, be controlled by such general laws as Congress may enact. If experience indicates need for special patent treatment in this field, Congress will be in far better position to enact wise legislation as a

result of it than to make the attempt now when so much is conjectural and speculative.

CONTROL BODY

It seems to me that on account of the character of the problem an independent administrative and control board or commission with clearly defined duties and responsibilities and with definite limitations of power is indicated. Clearly at this stage such a board should be composed of men of the highest caliber and integrity.

Whether such a board should be full or part time, compensated or uncompensated, are rather secondary, I think, provided it is implemented with an adequate executive staff.

The board should be wholly or predominately civilian. If wholly civilian, it should have suitable liaison representatives from the military services. If partially military, I think such membership should be limited to a single representative from each service.

I am strongly of the opinion that secretaries of executive departments or heads of bureaus should not be designated as members of the board. This is not because I doubt either their ability or competence, although in many cases they may not have the specific competence for this particular job. Rather, it's because my experience has indicated that such men having heavy loads of other work are forced almost invariably to delegate their duties to subordinates.

In extension of that last remark, I would like to make a remark to show that it isn't just theoretical.

As president of the National Academy of Sciences, by law I am the chairman of a Federal independent agency which Congress set up, the board of which is composed of civilians, and the heads of three of the great departments—the secretaries of three of the great departments—and I have been in that position for 6 years. Not once in that 6 years have I been able to have a full meeting of the board, or any meeting of the board, except once, when any of the secretaries was able to be present. They were always represented. The board could operate because the majority were civilians who did appear, and the secretaries always concurred in the findings of the board. But the board was deprived of the actual presence at the discussions of the men who were designated by Congress to serve. Now, they were represented by their subordinates, and it wasn't because they didn't want to serve. It simply was because it was an additional load placed on already too busy men.

So it is a fallacy, I think, to assume that the designations of heads of great operating departments would mean that they could give the attention to specific things of this kind which they are or should be capable of giving had they the time to serve. That is why I am opposed to that sort of thing.

The CHAIRMAN. Do you think they are any busier than Senators?

Dr. JEWETT. I doubt if they are as busy.

I can conclude my remarks, Senator, very promptly.

After I got my ideas oriented that way, I went back and started to look over the three bills which had been sent to me, and these are the conclusions I came to.

I realize that you men are struggling to reach a common judgment and that what you do will not be exactly in the pattern of any one of these bills. From the very nature of things, the reason you are sitting

*President
Not Head
of Services.*

around here talking is that you are trying to find an answer which represents the best judgment of the group.

What I am going to say is no particular reflection on any of these preliminary bills. It seemed to me that taking them as a group they are far too long and too detailed about an unknown future. They put the wheels in motion of a delegation of authority, and the setting up of machinery that once set up is difficult to change.

I should think the thing to do when you get through with your hearings, which is probably what you will do, and which is a one- or two- or three-man job, is to boil this thing down and put the acid test on it against some fundamentals. What are we trying to do? What is the minimum of legislative action that we should take to insure doing that thing? What is the best machinery to administer the will of Congress on the thing?

I think you should come out with a much shorter statement than I have seen in any of these bills. I would start at the grass roots of the raw materials, and I would build my police power up only so far as it was necessary to insure what I wanted. I think I would insist that everybody who dealt in this field that Congress thinks is important should be under very strong command to make a full accounting for what he does.

Now, in going over the bills, and having listened to some of the questions you asked Mr. Patterson, and using S. 1717 simply as an example, as I went through it I made some notes here, and I have indicated what I would do.

If you are going to set up a commission subject to the observance of a minimum of restrictions, I would give practically everybody who is reputable, whether it be an individual or a group, who had the facilities and who was willing to observe the rules—I would give them a license to go ahead.

The military services are one of the parties that I would consider. I think the provision in 1717, for instance, for the control of the military, is not only a dangerous provision, but I think it won't work. Isn't it in 1717 where the Commission will take complete control of developments of military matters? I don't think any civilian body can or should usurp or take over the responsibility of the military.

As I listened to Mr. Patterson, I think that was his feeling, too. I would treat the military applications, as long as we have got to have an Army and a Navy, just as I would the applications of an industrial concern or a college. The Commission has full control, and should be fully informed as to the general use which is made of material which is turned over to any of its licensees; but when it comes to the development of the technique of using that material for military purposes, I think as long as we have an Army and the Navy and the Air Corps, we have got to lodge the responsibility for proper use in them, and I don't believe any group of civilians can take it away from them, or take it away from them safely. I would treat the Army and the Navy under your Commission just like I would treat anybody else. Sure, they will be the biggest ones. They will be operating in a peculiar field, and they will be under necessity of reporting to this body, which is the agent of Congress in the whole, as to what general use they have made without disclosing the technical military values, so your agents will at all times know how much material there is, about what it is being used for.

Personally, I certainly wouldn't put a military problem in the hands of a civilian commission.

The CHAIRMAN. Are there any questions?

Senator HART. I have one question, Mr. Chairman.

I am sure you have had lots of experience with security, Doctor. Do you think that on the assumption that we need to continue to keep secrets, that the Espionage Act is sufficient, or should there be something in this law?

Dr. JEWETT. It has been so long, Senator, since I have read that, that I am really not in a position to answer. My impression is that it is not enough.

May I make one other observation, Senator, which may or may not have any bearing on what you are considering. I think I wrote a note to Dr. Condon on it. It has to do with the power possibilities of atomic energy.

As I say, it might not have any place in this particular legislation, but it is a thing that I think ought to be borne in mind. In the last analysis, the utilization of energy from whatever source it is derived is not wholly a scientific or technical matter; it is an economic matter.

We use water power, we use steam power, or what not, if both are available, depending on which one is the cheaper for us. At the present time, we get practically all our power from the utilization or burning of some form or other of coal or oil or their derivatives. We know we are still far from the maximum of what we can do there.

If you come down to atomic energy, the kind we are talking about here, or any kind of atomic energy, you don't want to forget that the greatest manufacturing plant for atomic energy is outside the earth; the sun is the greatest atomic energy producer that there is. It does part of the manufacturing process, and sends part of its end product down here. What we are dealing with in this thing here is what the solar system did billions of years ago and left us some half fabricated materials in the crust of our earth, and we are carrying these things on.

But the sun is pushing down energy here all the time, and, of course, there have been all sorts of talk from time immemorial about harnessing the sun's energy, usually in a piffling way.

But there is one place where the sun's energy is harnessed continuously in large amounts, and that is in the growing things in the tropics. Now, we all know that hither and yon people have made attempts to get mechanical energy out of the results of growing things, notably in alcohol produced from sugar, or other wood products. But never has anybody attacked that problem in its entirety and on anything like the scale which the Manhattan district project attacked this particular one.

While nobody could say what the future has in store, I personally think that we, or anybody else who is able to do so, could pour hundreds of millions of dollars, and all the manpower in a coordinated attack on this problem involving the botanists in their modification of the species of growing things, the biologists, the chemists, physicists, and engineers on the thing. It is not at all inconceivable to me that in some distant time you will find atomic energy being put into the power field via the atom-splitting business in the sun through this kind of thing.

All I am saying is that insofar as that kind of a possibility has any influence upon the power and energy side of this thing, even

though it has no place in your present legislation, you want to remember, I think, that there is always the possibility that no matter what technologically we can get out of this by power, it may not be economically the cheapest kind of power that you could get from atom splitting.

The CHAIRMAN. Thank you very much, Dr. Jewett. We are delighted to have had you, Doctor.

The committee will meet at 10 o'clock tomorrow morning to hear Major de Seversky, and some other witnesses.¹

(Whereupon, at 12:55 p. m., the committee recessed until 10 a. m., Friday, February 15, 1946.)

¹ For the statements of Major de Seversky and other witnesses who appeared before this committee on February 15, see pt. 5 of the hearings on atomic energy. The hearing on that day was not part of the series of hearings on S. 1717.

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ATOMIC ENERGY ACT OF 1946

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

SECOND SESSION

ON

S. 1717

A BILL FOR THE DEVELOPMENT AND CONTROL
OF ATOMIC ENERGY

PART 4

FEBRUARY 18, 19, AND 27, 1946

Printed for the use of the Special Committee on Atomic Energy



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III

ATOMIC ENERGY ACT OF 1946

MONDAY, FEBRUARY 18, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to notice, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Austin, and Hickenlooper.

Also present: Dr. Edward U. Condon, scientific adviser to the special committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. Mrs. Stone is appearing for the League of Women Voters.

STATEMENT OF MRS. HAROLD A. STONE, DIRECTOR, NATIONAL LEAGUE OF WOMEN VOTERS

Mrs. STONE. I have with me Mrs. Allan C. G. Mitchell, director in charge of foreign policy for the League of Women Voters, and I would like her to present a brief portion of the testimony. I am Mrs. Harold A. Stone, a director of the National League of Women Voters.

In appearing before the Special Committee on Atomic Energy, the League of Women Voters would like to divide its testimony into three parts. First, we believe that we should express our preference for putting the new agency for the control of atomic energy under a single head and within the regular framework of the executive branch. Second, we should like to express our approval of many features of the McMahon bill, although pointing up several provisions which the League would like to see changed; and, third, we should like to state our opposition to the May-Johnson bill.

The league believes that the drama of atomic energy has confused both the leaders and the people of the Nation and caused them to overlook the tested and familiar pattern created by our Constitution for holding the administration of the most important aspects of government within the immediate framework of the executive.

Finding suddenly a new and infinitely greater kind of power in the possession of our Government, we have cast about frantically for some mechanism and some omniscience to assure its proper use. We have longed for some social invention, and wished for some supermen to assume this staggering new responsibility, which has seemed too much for ordinary mortals and mortal institutions to cope with.

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We have no new institution. We have no supermen. Several months of sobering reflection have led us back to what we have. We have a representative government with a legislative and an executive. These two branches have mutual responsibilities for the conduct of our Government. The legislative branch enacts the laws. The executive branch administers them.

The League of Women Voters believes that atomic energy should be controlled by our Government in the public interest and its benefits developed as rapidly as possible. It recognizes the immensity of the administrative problem involved in controlling the production of atomic energy, already a \$2,000,000,000 project, already functioning, daily adding to our supply of a vast new source of energy. We recognize that this is indeed something new—that never before has our Government held the responsibility from the beginning for a new source of power, which promises intimately to affect the daily lives of all of us within a few years.

The League of Women Voters believes that the situation calls for administrative skill of the highest order, that we should apply the best of our knowledge of public administration in setting up the new agency. We believe that authority and responsibility should be direct and simple, visible to the citizen. This can be done best, we believe, by placing the agency under the direction of a single head, appointed by the President with the advice and consent of the Senate. The importance of the agency would probably command for its head a position in the President's Cabinet. The League of Women Voters believes it of great importance that the work of the new agency be coordinated with the work of other Federal agencies through the already established executive organization. The ramifications of atomic energy will not be confined, but will inevitably reach out and affect the work of every major department of the Government. The league, therefore, believes that the new agency must be directly responsible to the President, who is in turn responsible to all of the citizens. It is the President, in our system of government, who alone can coordinate the work of the various executive agencies. To limit the authority of the President over the new agency for the control of atomic energy, would make it difficult, and might eventually make it impossible, for him to discharge his constitutional duty as Chief Executive.

The league believes that we should not place this great new function apart from the executive in the "headless fourth branch of government," responsible to no one and impossible of coordination with the general policies and work of the Government. Atomic energy is not something which may be kept apart, unsullied by the many other aspects of government with which it will inevitably be interrelated. That it is fraught with such significance to our citizens, is all the greater reason why the new agency should be directly responsible to our duly elected Chief Executive. We believe, therefore, that the Congress should create a new agency, with a single head, responsible to the President.

Because there are many new and unknown aspects of atomic energy, the league believes that the law should provide for a small advisory commission to assist the Administrator. This would be composed of eminent civilians serving on a part-time basis.

The CHAIRMAN. Pardon me a minute. Would you advise that the one-man administrator be a civilian or a military man?

Mrs. STONE. A civilian. I will come to that again.

Even though we differ with the basic structure, preferring a single administrator rather than a commission, the League of Women Voters believes other provisions of the McMahon bill are excellent and should be incorporated in whatever final legislation your committee recommends. The league agrees that control of atomic energy should be vested with the Government, and that it should be under civilian control. We believe that the provisions for licensing and control are excellent, retaining, as they do, national control over production of atomic energy, while allowing private-enterprise ownership of source materials, byproducts, and devices for the application of atomic energy.

The provisions for the free development of scientific research, with adequate safeguards of technical data where it relates to national defense, we believe to be good. It is wise that the new agency carry on research but have no monopoly on research. The provisions for inspection and for safeguarding health are also adequate.

Because of the league's deep interest in international cooperation we note with special approval the provisions which would assure that our domestic policies for atomic energy not conflict with our international policies. We are also especially glad to note in previous testimony preponderant agreement that the agency should be a civilian agency. We are pleased that the bill so provides.

The league believes that it is an extremely wise provision that the quantities of fissionable material to be produced should be determined by the President, and that the President should specify what atomic weapons are to be used by the armed forces.

With the provisions for the internal organization of the Commission, the league must differ emphatically. Divisions of the agency should not be specified by statute, nor should their heads be appointed by the President with the advice and consent of the Senate. We believe that it will not help the President to give him the power to appoint such division heads. Such appointments threaten the unity of an organization, and make it difficult for the head of the agency to be held responsible by the President. Such provisions do not make for good administration. They foul lines of authority and responsibility and make for confusion, buck-passing, and stalemates when important decisions are at stake. Specifying the internal arrangement of the organization makes for a rigid rather than a flexible organization.

The league believes that if the Congress does create a commission, a general manager should be provided and that the heads of divisions should be appointed by and be responsible to him, in order that he may in turn be held responsible by the Commission.

The CHAIRMAN. Mrs. Stone, theoretically there might be something to be said for your observation about making it too rigid. I have in mind, for instance, the Department of Justice, with which I used to be associated. The five Assistant Attorneys General are nominated by the President and confirmed by the Senate. As a matter of practice, the Attorney General nominates them.

Mrs. STONE. I realize that, and there is, of course, the possibility that it would work out that way.

Now, I would like to comment briefly on the May-Johnson bill. The League of Women Voters is opposed to the May-Johnson bill. We believe it unwise to create a large and unwieldy commission over which the President of the United States would have so little authority. We believe that the bill emphasizes military security, rather than the development of atomic energy for peacetime uses. We disapprove of the broad powers granted the Commission, particularly because of their implications for our foreign policy. It would be possible for the Commission proposed in the May-Johnson bill to cripple or run contrary to the foreign policy of the President and State Department, since it would have the power to determine the quantities of fissionable material to be produced, and how much should be made into bombs. We believe that to give the Commission power to issue restrictive regulations on the dissemination of scientific information might result in the hampering and restricting of the development of science. Finally, we believe that the Government must be the sole owner and producer of fissionable material, and that the provisions of the May-Johnson bill which would permit private ownership of such materials are loosely and dangerously drawn.

We should like to comment on another aspect and that is whether or not the proposed legislation would fall under the Reorganization Act of December 1945.

The league has followed with great interest the law providing for the reorganization of the executive establishments, which Congress so wisely passed in December 1945. We believe that the new agency for the control of atomic energy should not be exempted from the provisions of the Reorganization Act.

In summary, we wish to make it clear that the League of Women Voters is opposed to the May-Johnson bill. We support the McMahon bill in all of its important provisions for the control of atomic energy, although we should prefer to see the agency headed by a single individual, responsible to the President, rather than by a commission.

With me is Mrs. Mitchell who has a brief statement on the international aspects, and if it is possible, she would like to read that.

The CHAIRMAN. Thank you very much, Mrs. Stone. Of course, we are directing our attention now to the domestic aspects, but I am sure we would be glad to hear Mrs. Mitchell.

**STATEMENT OF MRS. ALLAN C. G. MITCHELL, DIRECTOR,
NATIONAL LEAGUE OF WOMEN VOTERS**

Mrs. MITCHELL. Senator, we realize that these hearings are on the domestic legislation. However, we feel that the two aspects of the problem will ultimately be closely tied, and we support the provisions in the McMahon bill so wholeheartedly because they seem adequate to enable the correlation between the domestic legislation and eventual international agreements. I have just a few words about the general philosophy of the international arrangements, when they come.

The league feels very keenly that the international program for the control of atomic energy must always be considered in the light of the

pledges which the United States and other United Nations have made for the establishment of a collective security system.

We feel that the whole success of the collective security system will to a large extent depend on the ability of the United Nations to devise a workable program for the control and reduction of armaments. I think it is quite obvious that any excessive or uncontrolled armament on the part of any of the United Nations, particularly a great power, would be a constant threat to United Nations system of joint defense. Therefore, the problem of the control of atomic weapons is a part of this larger United Nations problem of the control and reduction of arms as a foundation for the new world system of joint responsibility for security.

The League of Women Voters believes that the United States, as a permanent member of the Security Council and at present the sole producer of the bomb, should take the lead in bringing about United Nations agreement to reduce and regulate arms. In order to assure adequate control of atomic weapons—because that does, of course, present a very difficult technical problem—the Security Council should be responsible for supervising the production and use of atomic power.

The Security Council should control weapons derived from atomic energy as part of an international program of arms control under which all nations would submit to such agreed-upon controls as exchange of information, registration, inspection, and licensing.

The CHAIRMAN. Thank you very much, Mrs. Mitchell and Mrs. Stone.

Mr. John Parker, will you come forward?

It is nice to have you with us this morning, Mr. Parker.

You are vice president of the Consolidated Edison Co. of New York?

Mr. PARKER. I am.

The CHAIRMAN. You have a prepared statement?

Mr. PARKER. I have, sir.

The CHAIRMAN. Will you go ahead, Mr. Parker.

STATEMENT OF JOHN C. PARKER, REPRESENTING THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES

Mr. PARKER. My name is John C. Parker. I am speaking for the Association of Edison Illuminating Companies. I am a member of the executive committee of the association and chairman of its special committee on appraisal of atomic energy as a source of electricity supply.

The association is very glad, responsively to your request, to present before your committee a prepared statement authorized by the association, a 60-year-old association made up of operating companies serving the majority of the customers of the light-and-power industry.

The association was, as I have said, founded a little over 60 years ago and is made up of member companies who, since the beginning of the electric light and power industry, have served communities widely scattered throughout the country. The association is devoted to the advancement of electric service to the public for light, heat and power. It has consistently throughout its existence operated primarily as a conference of executives with the assistance of the technical and commercial personnel of the member companies for the

purpose of interchange of ideas and information looking toward high standards of dependability and flexibility in service and to the enhancement of operating economies and progressively and consistently lower charges to the consumers. Its member companies are not manufacturers of equipment.

That the association regards very seriously the possibilities of atomic energy in the field of electrical energy production and its responsibility to help in its development is evidenced by the fact that this is the first time in its long history, to my best knowledge and belief, that the association ever has made an appearance before a legislative or administrative body. It is now doing so through a special committee whom I represent, and which has been set up to explore and appraise both the favorable possibilities and the limitations that may affect the use of atomic energy in the field of electric power supply.

The committee consists of five members, all engineers and executives, each in one of the important utility enterprises of the country.

The membership of the committee is:

Alex D. Bailey, executive vice president of the Commonwealth Edison Co. of Chicago, formerly president of the American Society of Mechanical Engineers.

Kilshaw M. Urwin, who is present this morning, manager of the engineering department, Philadelphia Electric Co., formerly vice president of the American Society of Mechanical Engineers. For nearly 6 months during hostilities in Europe Mr. Irwin was in England and on the Continent serving as executive director of the London staff of the Public Utilities Committee of the Combined Production and Resources Board. He is at present chairman of the power generation committee of the association.

James W. Parker, president, the Detroit Edison Co., formerly president of the American Society of Mechanical Engineers.

John C. Parker, formerly president, Brooklyn Edison Co., Inc., more recently vice president, Consolidated Edison Co. of New York, Inc. (in charge of planning, development, and research), formerly president, American Institute of Electrical Engineers.

Philip Sporn, executive vice president, American Gas & Electric Service Corp., the recipient of the Edison Medal of the American Institute of Electrical Engineers for 1946.

Each of these men, during the war period, served as consultant to one or more of the defense offices, including the War Production Board and its predecessors, Foreign Economic Administration and War Manpower Commission.

The secretary of the committee, Ward F. Davidson, who also is present this morning, research engineer of Consolidated Edison Co. of New York, Inc., has devoted practically all of his time since early in 1942 to the work of the Office of Scientific Research and Development and is at the present time Deputy Executive Officer of the National Defense Research Committee thereof.

It is believed that the men who comprise this committee are (1) of such a character that they are able to appraise technical possibilities and at the same time to measure the economic and social results that can be obtained in a new technique; (2) well grounded in the tradition of the utility industry which continuously has sought to advance the results of scientific development into practical realization through

stimulating manufacturers to produce equipment embodying the latest scientific developments, through the assembly of such equipment into generating and transmission systems, and through the persistent supervision of its operation into successful realization; (3) well fitted to contribute to the development of atomic energy along engineering or practical lines and to guide the work of others so that, to the extent that atomic energy can be developed in the electro-power field on a practical basis, it will be done with a minimum of waste and in the shortest time.

The instruction under which this committee is acting is to be utterly objective in its appraisal and not to approach the multitude of difficult problems involved with any predetermination arising from any conception of any industry policy other than the exploration of the probabilities of a better service to the community.

Neither this committee nor the Edison Association seeks to probe into matters which both freely recognize must, for the moment at least, be restricted from general dissemination. More specifically the committee proposes to avoid inquiry into the specific technique of the processing of fissionable materials or their utilization in fields other than that of heavy power generation. It goes without saying, however, that the committee of appraisal would be immeasurably aided in its work by such knowledge of the economic factors surrounding the materials involved in energy production by atomic fission as can properly be made available to it. Indeed such knowledge, which we do not now possess in more than the most rudimentary degree, is quite essential to any competent appraisal of the possibilities.

With that in mind and subject to a clear understanding with them that the committee does not seek to go beyond the limits of propriety, the members of the committee are conducting conversations with various scientists and engineers who are believed to have knowledge in this new field. The committee fully believes that such conversations, carried out under appropriate restrictions, are conducive to the advancement of the national welfare.

The mere technique of utilization poses questions of the first magnitude. The ability to transform nuclear energy into heat in unconventional boilers--which, with quite incomplete knowledge on the committee's part, seems to be the most probable process--and to do that without risk either to plant personnel or to the general public; to develop efficient systems of control; to find the materials most suited to such operations and to carry them through engineering development and construction will require a high degree of collaboration extending well beyond the abilities and the available time of any committee of five men. The committee therefore will seek, subject to their approval and willingness to cooperate, the assistance and advice not only of scientists and engineers but of the departments of government so far as it appropriately may be extended. It will also seek to enlist the design and other technical talent of manufacturers.

The CHAIRMAN. Mr. Parker, as far as your committee has gone now in its studies, have you been handicapped very much by the restrictions on the dissemination of information?

Mr. PARKER. Categorically, I would say "No," sir. Possibly that is because we have been at great pains not to probe more deeply than propriety had indicated. There have been no official barriers placed

in our way so far. On the contrary, we have met a very understanding spirit of cooperation.

The CHAIRMAN. Are there some things that you would like to know in order to continue your studies that you thought you had better not inquire about at this time?

Mr. PARKER. We have not as yet undertaken to explore one question which is of the very essence of practicality, and that is the economics of procurement of fissionable materials.

The CHAIRMAN. Cost of production?

Mr. PARKER. Cost of production. That, sir, I think we have stayed away from on the assumption that first we would better determine the technical feasibility and then come to that later when the cost facts probably are known to the people who are most closely related to production.

The CHAIRMAN. Thank you.

Mr. PARKER. Returning to my prepared statement:

It appears now that the two most likely fields of energy utilization are to be found in marine propulsion and in large land power plants. The committee, therefore, proposes to offer to the United States Navy such collaboration as the Navy finds to be consistent with the purposes of national security. There is no doubt that such collaboration would make available to the committee important technical information. On the other hand, it is believed that the committee can, through its familiarity with the problem of power-plant design, construction and operation, be of some appreciable service to the naval authorities. It is quite possible, as was the case with higher-pressure and higher-temperature steam development, that large land installations may afford an excellent proving-ground for the exacting requirements of the naval service.

The Senators are aware, of course, that not only the operating costs but the investment in new types of boiler equipment are important to the successful service of the public. It will be necessary, therefore, for the committee to estimate the minimal costs at which equipment may be provided for transforming nuclear energy into the heat in steam or perhaps other media for use in heat engines.

Beyond this there is a remote possibility that, at some future date, some fraction of the energy available within the atom may be released directly in the form of electrical energy with the intervention of equipment other than heat engines. This and the way in which such direct transformation may be correlated with thermal processes require open-minded investigation.

However, regardless of the route by which it is achieved, anything that will reduce the cost of production of electrical energy is none the less of benefit to the national economy, and will become an object of assiduous research and investigation by this committee. It is proper to point out, however, that zealously though the industry will seek to develop the possibilities, revolutionary results in the cost of supplying the public are not to be expected but rather sober, level-headed betterment. The reason for that is worth pointing out.

Most of the investment and much of the operating cost of present systems lie outside the generating plants—for example, in the distributing systems and in the multifarious services to customers. There is no present indication that atomic energy will relieve that major

element in cost. Much of the investment in generating stations will remain as at present. At present it seems probable that steam turbo-generators and their extensive auxiliary equipment, the electrical switchgear and the housing of this equipment will be retained, that the boiler plants of some parts of the stations will be retired, and be replaced by a new type of boiler involving some probably heavy investment and using a possibly—hopefully—cheaper fuel than is now available.

It is evident, if this preliminary hypothesis proves correct, that the primary advantage to the national economy through such use of nuclear energy will be in the service of that part of the utility load in which fuel costs play the relatively biggest parts, namely, industrial and heavy traction load, and that the economies here will probably be not much greater than the difference in fuel cost.

Limited though those economies may be, the committee and the Edison Association which it represents believe them to be of importance to the industrial development of the country. They believe that whatever body is set up to administer the distribution of fissionable materials will require that such economies be passed on to the consumers conformably with the determinations of the local regulatory authority. Such economies, of course, should be the net economies giving due weight to new investment occasioned by a new type of boiler or other conversion equipment.

There has been some popular misconception as to the amount of energy that would become available through atomic processes. A clear perspective in this matter is to be had from a realization that never at any time has the country suffered from a deficiency in the amount of power available. Indeed it seems clear that the ultimate supply of energy available from coal and from water power is more than sufficient for all the probable needs of the country for centuries to come. All that is necessary vastly to expand the availability of electrical power is the construction of plants, transmission and distribution systems. Even more significant, however, are the much more expensive plants and devices for utilization. All this will be the case whether the source of energy is the newly understood atom or the more conventional sources. It is true that some expansion of electric energy use may result from the development of atomic energy insofar as such development brings about a reduction in cost of generation, and therefore makes possible the electrification of certain large-scale chemical or metallurgical processes now carried out on a directly thermal basis. But that, if at all, will occur only after an extended period of time and as it proves economical.

Another popular misconception which must be mentioned in order to make clear the attitude of the public utilities is the thought that they might be unduly apprehensive of the incipient obsolescence of their plant and property by a new technique. If the present probabilities develop, namely, that nuclear energy will be used in the production of steam for high-temperature turbines, the process will be highly analogous to a current one quite common to the light and power industry, namely, the use of so-called topping turbines. When new and more efficient heat cycles, using much higher steam pressures and temperatures, became available, the utility companies recognized the possibility of removing some or all of their older boilers, of pro-

ducing steam at high temperature and high pressure and then, in new turbogenerator sets, while doing useful work, degrading it to the level formerly produced in the lower-pressure, lower-temperature boilers and further using it in the existing turbines. A strictly analogous process seems quite probable when and if the technical and economic problems of atomic energy utilization are worked out. Old boiler-plant and combustion equipment may be removed, giving place to the newer type of boiler, with or without its own high-pressure, high-temperature turbine. Thus steam would be produced for use in the present turbogenerators either directly or through the intervention of an atomic Topping turbine.

Even should some appreciable part of the atomic energy ultimately be found capable of direct conversion to the electrical form it would work as one horse of a two animal team, the other being the heat process, both in parallel supplying power to central station bus bars. But this prospect does not appall either the committee or the industry. On the contrary, the industry will welcome and seeks to aid the development of any attractive possibilities in nuclear power production quite as it has the development of improved combustion processes and more favorable steam cycles.

When it becomes reasonably certain that sound economic advantage will result from atomic sources it is fully expected that the rate of increase of central station energy utilization will make possible the introduction of atomic "toppers" for base load purposes, that is for energy production round the clock so that the fullest operating advantage may be had from the replacement of the current conventional practices. On the other hand it seems equally probable that the cost of new equipment will not be warranted or if so only in lesser degree by that part of the load which is of short duration. Thus, much of the unconverted present conventional equipment will represent the most realistically economical method of meeting the requirements of the community and will therefore have an undisturbed usefulness throughout its natural physical life.

For these reasons combined with the necessity for continuing our present and highly significant systems of transmission and distribution there is no reason why the industry should be alarmed by any considerations of obsolescence. Indeed, were the economic attractions of atomic energy in the course of time to prove so great that even peak load and reserve equipment would be forced into the scrap heap, that fact in itself would say that there were advantages sufficient to warrant—indeed to make welcome—the processes of supersession. The committee thus feels that there are no obstacles, tangible or otherwise, to its full and open-minded exploration of the possibilities inherent in atomic energy to develop a more economical system of electric energy supply and more widespread use of electrical energy to enhance and stimulate the national economy.

In this connection the public-utility industry of the country has only one reservation and that is that atomic materials should be available for industrial use without differentiation as to the type of utility to which it is made available and with the single collateral requirement that any resultant net economies be passed on to the consumers under the supervision of regulatory authorities on the local level.

As an association we completely endorse the theory that the processing of such material must be under the control of some such

commission as it is proposed in the bill (S. 1717) under discussion. The possibilities of misuse under any other scheme of production are too ghastly to be contemplated. As a collateral of such control, licenses for use seem quite inevitable. Such licenses for all uses whatsoever obviously must be surrounded by safeguards against injury to life and health. These safeguards quite clearly must be uniform and effective. The greatest measure of effectiveness is, in our judgment, in the denial of release of materials to those who do not comply with the prescriptions.

The Association of Edison Illuminating Companies regards as of distinctly minor significance any question of patent rights that may result from the studies of this committee or subsequent development committees. It is none the less speaking for itself as an association, very glad to say here that all of the results of the association's developmental work will be widely disseminated. Insofar as they are reflected by any patents granted, they will be made available to others on a reasonable, nonexclusive licensing basis. It would consider it proper, and would be glad to agree, that such licensing processes and fees be regulated by an appropriately constituted governmental agency. In making this declaration of policy the association does not, of course, assume to control the otherwise legal conduct of individuals, particularly those engaged in the manufacture of apparatus and machinery.

In brief summary, the industry, for whose oldest association I speak, is keenly and constructively interested in the peaceful uses of atomic energy for the benefits of the users of electrical power throughout the country whether on the systems of its member companies or otherwise; is at the present time, like most of the American public, not sufficiently informed of the basic facts to be able to make any sound forecasts; seeks such fuller knowledge as may properly come to it; and is committed to the aggressive prosecution of all favorable possibilities by the application of its technical and economic resources.

The association does not at the present time offer comment on minor details of the bill before you which it assumes will somewhat be modified, but regards the general structure of the bill as being most favorable to the orderly development of peaceful uses of a new technique which can be of great service to mankind.

Senator AUSTIN. I wish you would explain what you mean specifically by "topping."

Mr. PARKER. When the metallurgic arts and the art of design became such that it was possible to build steam turbines with their associated generators operating at temperatures of the order of magnitude of 950° to 1,000°, and at pressures running up to 2,500 pounds to the square inch, relatively small turbines of that character were produced which, after having done useful work in driving the electrical generators, exhausted their steam at more moderate pressures and temperatures, generally at the temperatures and pressures previously used in the stations into which these new turbines were to be installed. These turbines were high-speed, relatively small units with their boilers, and where they were installed did about half of the useful work of making electrical energy, discharged their steam—still capable of doing a great deal of useful work—into the older equipment which didn't any more have boilers for supplying them directly, and

then roughly an equal amount of work was done in those lower-pressure, lower-temperature turbogenerators.

Senator AUSTIN. Does that process correspond to the superheater engine found on locomotives?

Mr. PARKER. To some degree, sir, yes; though not in technical detail. The superheat engines used on locomotives are designed as these Topping turbines are, to use a considerably more efficient cycle of heat conversion. In that respect they are similar but in more minute technical respects quite dissimilar.

Senator AUSTIN. I wish you would define "supersession" as you have used it.

Mr. PARKER. "Supersession," as we conceive it, is the process by which older equipment must be replaced when the advancement of the arts of design or of material production makes possible more efficient processes under which the operating costs are reduced to the point warranting discarding the old equipment.

Senator AUSTIN. Thank you, sir.

Senator HICKENLOOPER. Mr. Parker, do I understand correctly your association you are representing here this morning is something in the nature of a research association or a study association to study new methods or to explore new fields, and that you are not as an association directly interested in sales or the promotion of any specific type or kind of electrical energy, power, or equipment?

Mr. PARKER. As to equipment, we are not directly interested or even indirectly interested in the promotion of any specific type. The association is a conference of executives, which, during its existence, has sought to explore all of those things which would be beneficial to the industry and our member companies, frankly, sir, but also in that process to the customers of the member companies. That necessarily means that the association has been quite interested in exploring the possibilities of improved methods of utilization of electricity after it is delivered to the consumer.

Notably, for instance, it has done a great deal throughout its life collaborating with the manufacturers to bring about a better standard of efficiency and life for the simple incandescent lamp. That has been one of its major activities in its earlier years, the promotion of more efficient and better standards of lamp manufacture and the utilization of illumination.

Similarly, it has devoted itself to stimulating the production of more efficient motors. Primarily, I should say, however, through such committees as that of which Mr. Irwin is chairman, it has sought to study collaboratively among the members and with the manufacturers the methods of producing more efficient production apparatus.

Senator HICKENLOOPER. I see that the comic strips have now developed an atomic light. I don't presume that you have gone into that field yet.

Mr. PARKER. We haven't yet, sir.

Senator HICKENLOOPER. I merely wanted to be certain that your association was really an over-all study group that takes in the entire field and is not devoted to special promotion, primary promotion, of either equipment or service.

Mr. PARKER. That is quite right, sir. I think we are entirely objective in that respect.

The CHAIRMAN. I was especially interested, Mr. Parker, in the forthright endorsement of the proposition that the Government should produce this fissionable material. I believe you said in your statement that the consequences might be pretty horrible to contemplate if that was not done. Would you care to develop that, sir?

Mr. PARKER. Fundamentally, sir, it seems perfectly clear to me—I cannot say that the association has explored this minutely, but it has arrived at the conclusion that you have stated, that for any body of individual citizens without the most compelling restraints to have possession of the processes of production of materials which have demonstrated their capacity to two Japanese towns just would be a complete subversion of every element of public safety.

That would be the first thing. The second thing is that the large-scale technique of promotion of the scientific knowledge that already was under way had been at the expense of the people of the country as a whole. Two billion dollars of the resources of the country have been put into this thing. Now, it does seem perfectly clear that whatever may be the active agent in the further production of fissionable material, the control of a thing created by the people of the Nation must rest in the people of the Nation.

The CHAIRMAN. Thank you very much, sir.

Senator HICKENLOOPER. Would you envision the possibility in the future that private industry in some capacity might, under very rigid license and supervision, be permitted to produce at least up to the point of power production in this field, or do you at the present time think that it is more probable that the Government should produce this alone at all foreseeable times in the future?

Mr. PARKER. May I reply to that as an individual, and not speaking for the association?

Senator HICKENLOOPER. Surely.

Mr. PARKER. In response to the chairman's question, I spoke of controls by government. I think it would be most desirable that as much as possible in the active production be done under the thing that—for want of a better phrase—we call the free-enterprise system and by a plurality of producers, but subject to the most extremely tight controls.

Senator HICKENLOOPER. Mr. Parker, at this moment, I am in thorough accord with various expressed opinions that the Government should rigidly take this matter until they can see what the future holds for it. I am not advocating, nor do I believe we should turn it loose to private investigation at the moment.

When you start to make a bomb, the first 75 percent is the production of the material, and the remaining 25 percent is the technical production of the bomb. It was that division that prompted my question as to whether or not sometime in the future it might be possible to permit the experimentation and the development of that first 75 percent by private industry under rigid controls, but of course not permitting any private individuals to go the other 25 percent and tinker with the making of a bomb.

I presume that is not beyond possibility, nor beyond reason and probably would be desirable if proper safeguards could be worked out.

Mr. PARKER. To me it seems intensely desirable for the further purpose of getting a diversity of minds and philosophies at work and stimulating the competitive zeal of the different producers.

Senator HICKENLOOPER. In other words, it would be the same argument, I take it from your answer, as the scientists use when they say they must have friction of the mind in science and therefore freedom in order to develop. It would be desirable to have that same friction of the mind and friction of competition, for instance in free enterprise, providing safeguards could be established for the control and the production of large quantities of this material.

Mr. PARKER. I feel that very fully, sir.

The CHAIRMAN. Thank you very much indeed, Mr. Parker, for coming down.

Mr. PARKER. Thank you, sir, for the privilege of being here.

The CHAIRMAN. This will adjourn the hearing for today.

The projected last hearing of this series of hearings will be at 10:30 a. m., tomorrow morning, and at that time, unless some other Senator has a definite witness that he wants to hear—and I think that possibility has been pretty well exhausted—we shall close the hearings tomorrow on the domestic phase of the question and go into executive session and resume on the international phase of it a little later.

(Whereupon, at 11:40 a. m., an adjournment was taken until 10:30 a. m., Tuesday, February 19, 1946.)

ATOMIC ENERGY ACT OF 1946

TUESDAY, FEBRUARY 19, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10:30 a. m. in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon, Johnson, and Hickenlooper.

Also present: Dr. Edward U. Condon, scientific adviser to the special committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The hearing will come to order.

Dr. McDonald, you may proceed.

**STATEMENT OF DR. RALPH McDONALD, EXECUTIVE SECRETARY,
DEPARTMENT OF HIGHER EDUCATION, NATIONAL EDUCATION
ASSOCIATION OF THE UNITED STATES.**

DR. McDONALD. Mr. Chairman, I am Ralph McDonald, appearing before your committee as the authorized representative of the Department of Higher Education of the National Education Association. The National Education Association is the voluntary professional organization of educators in the United States and its Territories. It is composed of the 48 State education associations and 1,425 local education associations throughout the Nation, having a total dues-paying membership of 733,409, or more than 70 percent of all persons professionally engaged in education in the Nation and its Territories. In addition to this membership affiliated through its constituent associations, the National Education Association has 331,605 direct dues-paying members. Membership of the National Association extends into every State, Territory, city, and county, and into practically every school, college, and university in America. Founded in 1857, the Association has as its purpose the advancement of the cause of education. The department of higher education is composed of the members of the National Education Association who are engaged in teaching or administration in colleges and universities.

On behalf of our members I should like to thank the chairman and members of this committee for the epochal service you are rendering not only to our Nation but to the world. By your earnest and intelligent approach to the foremost fact of our times you have succeeded in removing the consideration of atomic energy from a narrow and fearsome military atmosphere to the broader and more constructive realm of science and public welfare.

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The CHAIRMAN. Under some difficulties, Doctor.

Dr. McDONALD. You have conducted one of the most thorough-going and open-minded studies ever made by a congressional committee, driven by a realization that the action taken by this Nation with respect to atomic energy may determine the future for all mankind. As educators we have admiration for your procedures; as citizens we are deeply grateful to you.

There are two major areas of your committee's subject matter on which we do not care at this time to offer any comment, feeling that discussion of those areas on our part is unnecessary.

First, this statement will not deal with those questions on which there has developed no major controversy, as, for example, the question of whether there should be a Commission on Atomic Energy, or the question of whether there should be through the United Nations Organization a world policy to prevent atomic warfare.

With respect to these broad areas of general enlightened agreement I should like, however, to go on record as endorsing the provisions and the implications of S. 1717.

Second, this statement will not deal with the details of administration or policy which must, in the final analysis, be worked out carefully by the committee with its experts and later with the Atomic Energy Commission and its experts, giving due consideration to the recommendations of those most competent to testify with reference to the various matters involved. Examples of what I have in mind are: Detailed administration and policy on patents; internal organization of the work of the Atomic Energy Commission; other matters of similar level.

In order to keep within the proper sphere of competent interest for educators and to be as helpful to the committee as possible, this statement will go directly to some of the fundamental issues which we deem of great importance.

For convenience and clarity, I shall discuss these issues in the order with which they are dealt in S. 1717, the Atomic Energy Act of 1946.

Section 1 of S. 1717 meets with our strong endorsement. Because of the manner in which atomic energy first became generally known to the world on August 6, most of us are still inclined to recognize only the destructive possibilities of atomic energy. The statement of purposes contained in the bill gives complete recognition to the necessity for control to protect the national security, but it goes further and proposes a constructive program pointing to the development of atomic energy as a source of great good for mankind.

It is clear to us that atomic energy holds the awful threat of utter human destruction. It is also clear that, with decent and enlightened direction, atomic energy holds the promise of vast new developments which can lift the lives of people everywhere to a high and hitherto unimagined level.

We endorse the establishment of a Commission as set forth in section 2 of S. 1717.

While the Commission will have both policy and administration functions, it is clear that the most crucial responsibilities of the members of the Commission themselves will be in regard to policy. According to the terms of the bill, the Commission is fully authorized to employ expert administrators for the various activities which they will direct.

The tremendous import of atomic energy makes it unthinkable that one Administrator with an advisory committee be put in charge of our national policy respecting it. Mr. Harold Smith, Director of the Budget, was probably right in suggesting that there be a single administrative head for the production and other administrative machinery, but such a central administrator should be, in my judgment, appointed by the Commission and be responsible to it.

I believe Mr. Smith pointed out that probably the administrative heads ought to be directly responsible to the Commission, which in turn would be responsible to the Congress, rather than by creating a division of authority there by having them directly responsible to the President.

As to whether the membership of the Commission should be three, five, or seven—either number would seem acceptable.

It has been suggested that the best men might not be obtainable at the salaries specified, \$15,000 a year for other members and \$20,000 for the chairman. This argument is based on a misconception of the motives which govern the actions of men of principle and competence. Men of the type to whom the tremendous responsibilities of this act should be entrusted would not be concerned about personal income above the level specified. Certainly, there could be no objection to higher compensation as a matter of right, but it would be a tragedy for any person to hold such a post if he were for one moment concerned over financial compensation beyond the requirements for maintaining a satisfactory economic standard for his family. The universities of the Nation have literally thousands of men who have deliberately chosen their present careers in preference to positions which would have paid them much more money. Up to the income level necessary for maintaining an adequate standard of living and security, compensation is vitally important to anyone. Beyond that point, financial compensation would be relatively unimportant to any person of the caliber who should even be considered for an appointment to the Atomic Energy Commission.

The CHAIRMAN. Doctor, I am very grateful for your statement in one paragraph where you express what I have felt about the objections that have been made that we couldn't get the right caliber of men for this Commission. I am grateful to you, at least personally grateful, for having put the argument so succinctly.

Dr. McDONALD. There are so many examples that fall within the observation of all of us to indicate that the men of the type of whom the responsibilities of this Commission should be entrusted are not primarily concerned with building up large estates for themselves beyond what would be necessary for security and satisfactory standards for their families, in my judgment.

Senator HICKENLOOPER. Doctor, at that point may I explore that with you? It is my impression—and I don't know that anyone has testified here that any appointee would want to make money out of this as a commercial proposition—that the testimony has mostly gone to this point: First, people of the caliber that you want to get will have established their economic standard of living which because of their past means that they would require, for their peace of mind, comfort, and family responsibilities a substantial salary, the amount being subject to argument within reasonable limits.

But this question was raised the other day, that on a full-time basis no salary would command certain men who might be very desirable to have on this job; that is, there are many men in the country who have a tremendous capacity, but who have some other field of general advancement that would preclude their accepting exclusive employment on this Commission, regardless of salary. That was advanced by one witness, I believe, in supporting his argument that we might well consider a rather mixed Commission; that is, provide for certain men on a part-time basis who would devote all the time that would be necessary on their part, but who would not want to leave entirely other fields of activity that they had spent their lives in building up. There are other individuals who would be willing to devote their entire time as members of this Commission.

I am frank to say that that is an intriguing argument to me because it would open up the field for the acquisition of the best possible men in this country, regardless of salary or anything else, if you could get one or two of them on a part-time basis or on a voluntary basis, you might say.

Dr. McDONALD. That is one of the features, Senator, that I like particularly about S. 1717, in that while the main responsibility would rest in the hands of those Commission members who are full-time and that seems to me to be essential—at the same time, through the machinery of advisory boards, such persons as you have indicated could give their fullest and most advantageous service to the Government in that relationship.

Senator HICKENLOOPER. This goes a little beyond that. The thought behind my suggestion was that these part-time people would have equal authority with the full-time people on any decisions of policy, but some provision where we might gain their cooperation and the advantage of their experience and judgment might well be worked out.

Dr. McDONALD. I should think, Senator, that with a force that is potentially so free and that actually, even according to its present stage of development, is so fraught with possibilities of destruction that it would be absolutely essential for at least as many as three persons to be completely disassociated from any other major and dividing interest that would require the use of some of their time and effort in order that they might devote their full time. I think it would require not only their full time in terms of regular office practice, but I think probably the proper type of men would be studying about this thing night and day, as no doubt the members of this committee are at the present time, using the major portion of their time in the consideration of this very matter. In the long run it would seem to me that it would be absolutely essential to have people who could concentrate their interest exclusively.

Senator HICKENLOOPER. I think I agree with that, at least at this moment, that it is essential to have at least a portion of the Commission—the percentage is more or less immaterial—that is full time, devoted exclusively to this, but I am rather intrigued with the suggestion that, in addition to that, some people with equal authority as members of the Commission might be available for part-time service. I haven't made up my mind on it finally at all.

Dr. McDONALD. My fear in that connection, Senator, would be that the time for decision on a very important matter might arrive,

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and that the persons who would make that decision would of necessity have to have complete and full and thorough understanding of all other matters related to it; if part-time people in such an instance had given only a part of their time, they probably would not have had opportunity to have full and complete understanding, and consequently the votes of such people in a close vote in the Commission might actually turn the decision of the Commission one way or the other, whereas it would not be a lack of capacity to judge on their part, but a lack of full, complete, and detailed information.

Senator HICKENLOOPER. Of course, there is that phase of it. My thought on the other side, however, would be that any part-time individual who might be chosen as a member of this Commission should be of such caliber and capacity that he would not only realize his own reservations of possibility in this field, but would be of such capacity to devote all time to completely familiarize himself. I think there are many such men in the country. I don't know what the committee will decide on the matter.

Dr. McDONALD. I can see very well the point that there may be individuals who could make a real contribution to our national thinking and to our national policy on this important subject who might not be free to disassociate themselves completely in every other undertaking and devote full time to it; but I should think that there are such men you would be able to find equal in mental ability, in background and experience, who would be able to disassociate themselves completely, in which case you could use the full-time available man as the decision-making member of your Commission, and use your other individuals as members of an advisory committee or board, which would give you the full advantage, it seems to me, of both minds.

Senator HICKENLOOPER. Thank you.

The CHAIRMAN. Well, the answer to that, Doctor, that has been made is this: That the man who is selected as a full-time member becomes, shall we say, bureaucratic; and the advisory member who is the fullest, maybe of some wisdom and light on a specific proposition is disregarded by these "bureaucrats" who go ahead and disregard the advice of the advisory board. That has been the argument that has been made against that.

Dr. McDONALD. I think definitely there is a danger of the development of bureaucratic ideas and attitudes on the part of the members of any commission which is given charge of the vast enterprise that will be involved here; but it seems to me that there are safeguards proposed in S. 1717, and also suggested by other persons other than the authors of this bill, that would permit some check against that bureaucratic attitude. For example, the members of the Commission are removable at the will of the President. Not only that, but there is a requirement that the Commission quarterly make complete and detailed reports to committees of Congress.

It would seem to me that the tendencies toward bureaucracy would be curbed much more effectively for this Commission than is the case in usual government commissions. I do think that is a very real danger, and I think it should be guarded against. I have a feeling it is guarded against by the provisions suggested in S. 1717.

S. 1717 in a subsequent section provides for the establishment of advisory boards to the Commission. Through such boards the Com-

mission would make use of the very type of people who are suggested for a part-time advisory committee to a single all-powerful administrator. I should like to make this comment in relation particularly to the point which was made just a moment ago, that as between the establishment of a single all-powerful administrator and the establishment of a board which would be composed of some part-time members and some full-time members, it seems to me the board would be far to be preferred above the single administrator.

Senator HICKENLOOPER. Now, would you care to express yourself on this? Manifestly I think in any activity of this kind there should be somebody to run it. Five or six people cannot run it; they have to have a general manager, or something of that sort, and manifestly with considerable leeway to carry out the policies of the board.

Now, do you think it would be advisable to have that administrator or general superintendent, or whatever you want to call him, appointed by the President or selected by the board, which in turn will be appointed by the President?

Dr. McDONALD. I think I would agree with the suggestion of Mr. Smith that that administrator should be responsible to the board. He should be appointed by the Commission, and his responsibility to the governing head of the Nation, it seems to me, will be taken care of by the fact that they in turn are responsible to the President, particularly since they are removable at the will of the President.

Senator HICKENLOOPER. In other words, if a general administrator is appointed by the President, he holds his appointment by the President and not from the board. He holds himself primarily responsible to the President and not to the board, and the board in turn is responsible to the President, but it gives a division of authority.

Dr. McDONALD. A division of authority; yes; I should think that would be the case.

Members of the policy-making Commission itself should by all means be full-time, paid servants of the Government, with no distracting or dividing interests whatever. The magnitude of the ultimate consequences of their action would impose upon the members of the Commission the heaviest conceivable burdens of study and decision, which would certainly occupy their full time. We hope that they may not only be full-time, but that they may be also the brainiest, most resourceful, and most public-spirited men who can be found in America.

Section 3 of S. 1717 provides a sound and productive policy for promoting the advancement of scientific knowledge.

Effective scientific knowledge can be carried on only under a policy which (1) makes widely available the equipment, materials, and other resources for endless experimentation, (2) gives complete freedom of study and experimentation to researchers, and (3) provides for full and unimpeded flow of scientific knowledge.

To assume that scientific knowledge can be advanced under conditions of secrecy is unrealistic. The advancement of knowledge is directly proportionate to the volume and efficiency of communication from mind to mind, from laboratory to laboratory, from nation to nation.

In the field of atomic energy we are dealing with a force potentially so destructive that secrecy would seem desirable with respect to every

aspect which can be kept secret, especially when there exist powerful national governments which are not responsive to the will of the people they rule. The fact is that in the long run there is probably very little, if anything in the area of theoretical scientific information which is or can be kept secret; our scientists testify almost unanimously to this fact.

American scientists desire only that a free flow of such basic scientific information as in its very nature is not and cannot be secret be promoted among our own scientists. My personal opinion is that knowledge of atomic energy in the hands of any government which is totalitarian and not fully responsible to its own people is dangerous to all mankind. Such knowledge in the realm of scientific theory is not and cannot be withheld, however.

Our wisest course, it seems to me, is to promote the widest dissemination among American scientists of such basic scientific information as the Commission may determine not to be dangerous to our national security. Granting that the free flow of such information among American scientists will permit a totalitarian power to acquire such knowledge, our best safeguard against such a nation in the event of an atomic war would be through the great progress our own scientists would make by continuous effective experimentation. If we do not have such wide dissemination of scientific knowledge, our own progress in atomic energy protection will be much less. The result would be that our very effort to maintain secrecy might permit an aggressive nation to go miles ahead of us in experimentation and development.

The CHAIRMAN. Doctor, I will make an argument now against a theory which you stated, which I believe in. Let's assume that through further experimentation we can develop an explosive releasing 5,000 times as much energy; you might say 4,900 or take any figure you please—but tremendously greater.

Senator HICKENLOOPER. I don't like to have you mention such things, Mr. Chairman; it scares me to death.

The CHAIRMAN. Take any figure you want that would show an advance. Now, if any other country reaches the point of having the Nagasaki bomb, what good is the fact that you have improved your bomb by any multiple that you want? What good does it do you? Do you follow my thought, Doctor?

Dr. McDONALD. If you are not here, the Congress is not here, the President is not here, and the military leadership of the Nation are not here by virtue of some explosion that took place before we realized we were about to get into war, I doubt whether our possession of those things would be of much value to us. They might permit us to cause a greater destruction to the enemy, and ultimately give to those people who remain in America after the destruction has been wrought all over the earth a better opportunity, we will say, to have a dominant voice in whatever remains of humanity. I do think that it would be advantageous for us to possess the most modern and the best knowledge that is possessed anywhere in this area, though I can see that there is only one real safeguard against ultimate human destruction, and that is for us to learn somehow either to live without war—which is really the only ultimate possibility—or certainly to remove completely from the realm of such wars as may be permitted to go on, like the one in China, the use of atomic weapons.

The second course seems to me to be very largely wishful thinking. Senator HICKENLOOPER. How are you going to prevent countries from using every last weapon they can get their hands on when it is a question of national destruction or national survival?

Dr. McDONALD. Frankly, Senator, I don't think you can prevent that and I think it is wishful thinking to assume that this Nation or any other nation could come through an atomic war with anything that is really worth having.

Senator HICKENLOOPER. In other words, there won't be any future wars fought by Marquis of Queensberry rules. They will use every method and means they can get hold of.

Dr. McDONALD. I think at the present time—and I am not just one of these boasting Americans, I hope—there is no nation on earth that is composed of more enlightened and humanitarian people on such things than the United States, and we did use the atomic bomb, so it would seem to me that a discussion of the possibility of having wars between great nations without their use of, as you say, the ultimate in weapons that they know about is just wishful thinking.

Senator HICKENLOOPER. Well, it is human nature when you get into war to lick the other fellow as quickly as you can.

Dr. McDONALD. When you realize you are going to be destroyed, then it is human nature to cause as much destruction to your enemy as you can before you are finally put out of existence.

Senator HICKENLOOPER. It is a very confusing situation.

Dr. McDONALD. I see no possible solution to this problem internationally except for the nations of the world to find out somehow how they can live without war. It is absolutely essential, and it seems to me that it is within the realm of possibility. I think this is, of course, the fundamental issue before all of us.

The CHAIRMAN. Doctor, I don't want to hold you too long, but if you believe that no other nation could develop the present-type bomb in any given period of time—I have concluded it is more or less anybody's guess. You can guess 2 years, you can guess 10 years, and of all the witnesses who have come and testified before this committee there hasn't been one of them that has really been able to substantiate their estimate with any facts; it is a guess.

Now, if it were to be impossible for any other country to duplicate our present-type bomb, you could make out quite a case for locking it up—that is, locking science up so that there would be no possible exchange of any scientific information. Isn't that the basic theory under which the people who want to restrict scientific investigation are proceeding, namely, the fallacy that it cannot be reproduced anywhere else, when I think the better judgment is that it can. Now, just how soon neither you nor I nor anybody else that has testified before this committee knows.

Dr. McDONALD. I think that is correct, Senator McMahan. It is utterly impossible for the basic scientific information which made it possible for our engineers to develop the bomb to be kept secret. That is a matter of utter impossibility. As a matter of fact, the knowledge did not develop even primarily in this Nation.

Senator HICKENLOOPER. Every nation knows it now, don't they, in your opinion?

Dr. McDONALD. Yes; as a matter of fact, they had access to the information beforehand.

Senator HICKENLOOPER. The basic knowledge?

Dr. McDONALD. The basic research. Now, with respect to the devices and the machinery by means of which you take this basic scientific information and convert it into a destructive device, it may be that within that area—and I think undoubtedly in that area at the present time—the United States may have certain processes that are not fully and completely known. I think that with respect to those things, Mr. Chairman, the problem is simply one of time during which the other nations will develop their own devices. They may not correspond to ours at all, but when the basic scientific information is known, then human ingenuity in any major area is such that it is just a matter of time until, if they desire to do it, they will convert that scientific information into devices and instruments of destruction. So I think these items of knowledge which may be possessed at the present time by our engineers and scientists are of such a nature that it is inevitable that in other nations they will produce comparable devices and techniques, though they may be different. They might even be better. The probability is they will not be so good, but they will—so far as turning out bombs is concerned—be just as effective in the final analysis.

It would seem to me that the only area in which we would be justified at all in thinking in terms of the possibility of having secrets is in the area of processes and techniques and devices for the manufacture of any particular instrument of destruction, and in that area it would seem to me that the Commission, as suggested in S. 1717, would have full authority to maintain whatever elements of secrecy exist.

Of course, there is a danger there and that is that the very fact that we demonstrate to the world by our efforts to maintain secrecy that we have something which we think is important in the way of destruction makes it inevitable that a network of spies will infest our country from any nation that might be in fear of us; and if we kill off a hundred or two, then that will not stop the process. There will be another network, because they, having been thrown into an attitude of fear, do not know what it is that we are holding by means of which we might destroy them, will take the only course open to them, namely, to send their own citizens or employees, or if they can get citizens of other nations, employ them to try to uncover these secrets, which in the long run would have great disadvantages.

I do think, however, that in the present situation of world insecurity, until this Nation primarily can take a leadership, and a meaningful leadership for peace, the Commission on Atomic Energy would be justified in drawing that line as sharply as it can. It seems to me that for the present, that should be done; but I do not think in the field of basic scientific theory there is anything that can possibly be kept secret.

Basic research, as contrasted with applied research and technology, is rarely remunerative to a scientist. Yet it is upon such basic research that practically all scientific advance rests. Therefore, the Atomic Energy Commission, as directed in S. 1717, should liberally subsidize research and developmental activities in colleges and universities, in laboratories and engineering establishments, and elsewhere.

Particularly appropriate and necessary is the promotion, through subsidies, grants, and loans, of studies in the field of social, political, and economic effects of atomic energy.

With respect to this dissemination of information by means of which experimentation may be encouraged, it seems to me that is fundamental even to the military defense of our Nation, because I do believe we have in the United States the brains which, if they are freed and given the opportunity, will give to this Nation as rapid advancement of its knowledge in this area as can be obtained anywhere, but they cannot do that if they are not free. It seems to me, for example, that in this whole area of the finding of devices by means of which we might protect ourselves from the bomb, that if we make research as free and widespread as possible we are in much better position to hope that at least some element of safety might be upturned in this process of research. It would seem to me the most dangerous thing for us to do in terms of our own future national safety would be to bottle this thing up and keep our own scientific minds from working on it fully, freely, and as completely as they will.

The CHAIRMAN. Doctor, it has been stated by every authority on this subject that there is no defense to the atomic bomb. It is pretty hard to foresee one. Do you think there would be any possibility in the nature of things of inventing one if you pursued a policy of smothering scientific investigation and research?

Dr. McDONALD. It seems to me that it would be impossible under such conditions ever to hope to achieve defenses against it. I do think, however, as I have talked to a great number of these scientists, I have gathered this as being their opinion: They do not know now of any defense, and they cannot, on the basis of their present knowledge, conceive of an adequate defense; but it certainly was true of me, and it was probably true of a great many Americans in 1940, that we had no way of conceiving the atomic bomb. I do feel that we ought to open the doors to the widest possible research in the hope that these brains which I know we possess in this Nation, freed and even inspired by the desire to do something about this thing, might find some means at least to reduce the ultimate damage that it could cause.

But I think if we establish a pattern of secrecy around this thing, build walls around it, it will be utterly impossible for those results to be accomplished.

Sections 4, 5, 7, and 8 of S. 1717 would seem to establish the Commission in complete control of all materials, devices, sources, and property having a direct relation to atomic energy.

We share the desire expressed by Henry Wallace and others that the restrictions of the Commission not be carried to the point of the trivial and unessential. We share also the wish expressed by certain leaders of industry that the greatest possible encouragement consistent with national security be given to private enterprise in the development and production of devices and applications.

Senator HICKENLOOPER. In other words, I take it you believe that there is as much advantage to be gained in that field of competition and section of the mind as the scientists believe to be gained in what they call the section of the minds of the scientists in that field?

Dr. McDONALD. Yes, and I think in each instance the line would have to be drawn in terms of the most intelligent policy of national safety that can be worked out.

Senator HICKENLOOPER. With adequate controls and safeguards?

Dr. McDONALD. Yes, sir. These desirable aims are secondary, however, to the absolute necessity of controlling atomic energy developments so as to insure national safety and promote world peace. If we are to implement effectively any international agreement on atomic energy, it would seem essential that all aspects and facets of atomic energy production be placed under the undisputed control of the Atomic Energy Commission. We dare not do less with a force so gigantic. Direct Government ownership and the right of seizure are strong measures, but there is no other safe course, it seems to me.

Perhaps as our knowledge of atomic energy is extended it may be possible to relax some of the strict controls proposed under S. 1717. For the present, however, complete and strict control is imperative, and I do not want to be understood as passing judgment with respect to details in that area. It is only on the principles that I think I in any sense would be considered a competent witness.

Section 6 of S. 1717 provides that the Commission shall have charge of all atomic weapon production facilities and shall conduct research and developmental work in the military application of atomic power.

A close liaison with the military branches of the Government would seem to be necessary in these matters. Such a close liaison is clearly practicable under S. 1717. The Director of the Division of Military Application could, if the President desired, be a military man. Certainly, through the Division the fullest kind of cooperation and integration with military plans would be possible.

Of course, if the committee were to amend this act in line with the corrections of Budget Director Smith and others giving to the Commission the authority to designate its administrative head, then that decision would be with the Commission rather than the President as to whether a military man would head this Commission.

A safeguard against unwise action of the Commission in military matters is afforded not only by the fact that Commission members would be removable by the President, but also by the fact that the direction of the President is specifically required in the manufacture and delivery of atomic weapons.

We concur with the opinion expressed by the scientists, implied by President Truman, and concurred in by Secretary of War Patterson, that the Commission should not be composed of professional military men. It is an error to assume that the military high command developed and perfected the atomic bomb. When the financial expenditures incident to the project became too great to be met from President Roosevelt's contingency funds, the money was channeled to the project through Army appropriations. Army supervision over the personnel was established to insure national security.

Civilian control—real civilian control, not generals in civilian clothes—is absolutely essential.

For atomic energy control to be placed in the hands of military authorities by the United States would, in my opinion, produce an atomic bomb race between nations and would at the same time probably hinder scientific advance in the improvement of the bomb itself.

The training of the orthodox military man is the antithesis of the training of a scientist. A general who has been successfully educated as a military leader would be unlikely by virtue of that training to

possess the point of view necessary to consider scientific problems sympathetically.

The trained military mind deals in fixed ideas; it is schooled to rest upon authority. The scientific mind is continuously fluid and questioning; it is schooled to critical examination of every dictum and datum.

Military training seeks to make soldiers think alike, act alike, so that many respond as a unit instantaneously and mechanically. Scientific training seeks to make the mind independent, exploratory, inquiring.

If atomic energy developments are subjected to military control, progress in scientific knowledge is less likely to result than is a vast secret production of more and bigger bombs of the type we know about.

We must recognize the possibility of war, and the fullest application of scientific discoveries should be made in the military field. It seems probable that greater advancement in military applications will be made if research is promoted by a civilian commission, with a military division operating under the Commission in liaison with military authorities.

It is my understanding that our atomic energy activities are now under military control, and that our plants are probably even now manufacturing more atomic bombs secretly. If that is the case, then immediate passage of a measure such as S. 1717 is urgently needed to establish a sound national policy on atomic energy.

One of the most admirable features of S. 1717 is its provision for wide dissemination of basic scientific information. By drawing a sharp distinction between such basic scientific information on the one hand and techniques and processes on the other, the bill would encourage the flow of useful knowledge and at the same time safeguard completely everything in the way of secrets which the United States now has or might later acquire, particularly of a military nature.

One of the most important agencies of the Commission would be the Board of Atomic Information, as proposed in section 9 (b). We are literally being ushered into a new age by the impact of atomic energy upon our society. As President Truman truly said, "In international relations, as in domestic affairs, the release of atomic energy constitutes a new force too revolutionary to consider in the framework of old ideas." To enable the people of the United States to adapt the framework of their ideas to this revolutionary force it will be necessary for an unprecedented job to be done in education, particularly in science. The Board of Atomic Information will have the resources and the responsibility for encouraging and hastening that education.

Section 13, requiring quarterly Commission reports of a very comprehensive and revealing nature, is one of the fundamentals of legislation in this field.

The best safeguard the people can have against the monstrous damage which might come from misuse of atomic energy is to establish complete control in the Atomic Energy Commission and make the Commission fully responsible and responsive to the President and Congress. Reports should be regular and complete, with no reservations whatever unless dictated by the President and the appropriate committee of Congress for reasons of national security.

Certain amendments could be made to S. 1717 which would strengthen or clarify some of the more important provisions.

The atomic scientists have suggested an amendment which we consider sound and desirable, namely, that a general section be added making it clear and specific that international agreements would supersede any conflicting provisions of the domestic act.

Another amendment proposed by Secretary Patterson would require rather than simply permit close liaison between the Commission and the military branches of the Government. For obvious reasons national security must be the most compelling immediate objective of our policy. Therefore, the Patterson amendment—to require rather than permit—seems to be sound, provided that such required liaison does not weaken the civilian control of our national policy on atomic energy.

We should like to call your attention to the relation which will exist between the work of the Atomic Energy Commission and the activities of the proposed National Science Foundation and those of the United Nations Educational, Scientific, and Cultural Organization recently established at London. Amendments may be necessary to insure liaison and cooperation in the work of these agencies.

The National Education Association takes an official stand on specific legislation only by action of its delegate assembly which met last in Pittsburgh in 1944 and will convene next in Buffalo July 2, 1946. No interim official position has been taken on the specific bills before this committee by the executive committee of the NEA. Such a position has, however, been taken by the executive committee of the department of higher education.

In presenting this statement I have appeared by general authority of the executive committee of the department of higher education and with the approval of Willard E. Givens, executive secretary of the entire National Education Association. The views presented represent not only the official position of the department of higher education but my best effort as an official of the NEA to bring to your committee the opinions of our leaders and membership as I am able to judge them.

Recognizing the experimental and fluid character of any legislation on atomic energy which may be enacted at this time, and recognizing also the urgent necessity of the immediate adoption of a sound initial national policy on this subject, I should like to urge the passage of a measure which fulfills as nearly as possible the purposes indicated by President Truman in his message of October 3, 1945—and emphasized in his letter of February 1, 1946—and as conceived in the statement of general purposes contained in section 1 of S. 1717. Above all, I hope that legislation in this critical interim period may be such as to provide the greatest possible safeguards for our national security while at the same time stimulating further research and promoting the movement toward world peace.

The CHAIRMAN. Doctor, I want to thank you very much indeed.

Dr. McDONALD. We are very grateful to this committee.

Senator HICKENLOOPER. That is a very fine statement. We could probably visit with you a whole day on these things.

Dr. McDONALD. I am at your service, Senator.

The CHAIRMAN. Mrs. Sibley.

**STATEMENT OF MRS. HARPER SIBLEY, PRESIDENT, UNITED
COUNCIL OF CHURCH WOMEN**

Mrs. SIBLEY. I am here, Senator McMahon, not as an expert on the details of governmental organization, nor as a scientist; you have already heard from both those groups. I am here as president of the United Council of Church Women, acting under a resolution passed by their national board meeting in Washington October 23 to 25—and you may perhaps remember that we were in your office that day, which was the day you received your appointment, Senator—and representing the moral conscience of great groups of Christian women organized in over 11,000 communities in the United States.

For the record, I will quote their resolution:

We reaffirm the principles involved in freedom of scientific research relative to peacetime uses of atomic energy. We oppose the May-Johnson bill (S. 1463) which forfeits democratic control of a power which should be used for the good of mankind. The May-Johnson bill makes it possible for a powerful administrator to gain control of atomic energy and the production of atomic bombs and not be removable even by the President. This could lead to complete military control.

We urge Congress to hold full public hearings so that people understand the issues before legislation is adopted on atomic energy.

On July 16, 1945, an atom—that tiny measure of the universe—was shattered, and at that moment history was split in two, so that old patterns lost their meaning; so that old men who would say that marching boys could save us from the bomb have failed to measure what happened that day in New Mexico.

In case you have forgotten, let me quote to you from the War Department's official release of the New Mexico test, July 16, 1945:¹

Mankind's successful transition to a new age, the atomic age, was ushered in July 16, 1945, before the eyes of a tense group of renowned scientists and military men gathered in the desert lands of New Mexico to witness the first end results of their \$2,000,000,000 effort. Here in a remote section of the Alamogordo Air Base, 120 miles southeast of Albuquerque, the first man-made atomic explosion, the outstanding achievement of nuclear science, was achieved at 5:30 a. m. of that day. Darkening heavens pouring forth rain and lightning immediately up to the zero hour heightened the drama.

Mounted on a steel tower, a revolutionary weapon destined to change war as we know it or which may even be the instrumentality to end all major wars was set off with an impact which signalized man's entrance into a new physical world. Success was greater than the most ambitious estimates. A small amount of matter, the product of a chain of huge specially constructed industrial plants, was made to release the energy of the universe locked up within the atom from the beginning of time. A fabulous achievement had been reached. Speculative theory, barely established in prewar laboratories, had been projected into practicality.

* * * * *

The entire cost of the project, representing the erection of whole cities and radically new plants spread over many miles of countryside, plus unprecedented experimentation, was represented in the pilot bomb and in its parts. Here was the focal point of the venture. No other country in the world had been capable of such an outlay in brains and technical effort.

* * * * *

Gen. Farrell's impressions are: "* * * We were reaching into the unknown and we did not know what might come of it."

¹ First Test Conducted in New Mexico, official press release by the War Department, issued August 6, 1945

It can safely be said that most of these present were praying—and praying harder than they had ever prayed before. [Continues reading:]

"If the shot were successful, it was a justification of the several years of intense effort of tens of thousands of people—statesmen, scientists, engineers, manufacturers, soldiers, and many others in every walk of life.

"In that brief instant in the remote New Mexico desert, the tremendous effort of the brains and brawn of all these people came suddenly and startlingly to the fullest fruition. Dr. Oppenheimer, on whom had rested a very heavy burden, grew tenser as the last seconds ticked off. He scarcely breathed. He held on to a post to steady himself. For the last few seconds, he stared directly ahead and then when the announcer shouted "Now" and there came a tremendous burst of light followed shortly thereafter by the deep growling roar of the explosion, his face relaxed into an expression of tremendous relief. Several of the observers standing back of the shelter to watch the lighting effects were knocked flat by the blast.

"The tension in the room let up and all started congratulating each other. Everyone sensed 'This is it.' No matter what might happen now all knew that the impossible scientific job had been done. Atomic fission would no longer be hidden in the cloisters of the theoretical physicists' dreams. It was almost full grown at birth. It was a great new force to be used for good or for evil. There was a feeling in that shelter that those concerned with its nativity should dedicate their lives to the mission that it would always be used for good and never for evil.

"Dr. Kistiakowsky threw his arms around Dr. Oppenheimer and embraced him with shouts of glee. Others were equally enthusiastic. All the pent-up emotions were released in those few minutes and all seemed to sense immediately that the explosion had far exceeded the most optimistic expectations and wildest hopes of the scientists. All seemed to feel that they had been present at the birth of a new age, the age of atomic energy, and felt their profound responsibility to help in guiding into right channels the tremendous forces which had been unlocked for the first time in history.

"As to the present war, there was a feeling that no matter what else might happen, we now had the means to insure its speedy conclusion and save thousands of American lives. As to the future, there had been brought into being something big and something new that would prove to be immeasurably more important than the discovery of electricity or any of the other great discoveries which have so affected our existence.

"The effects could well be called unprecedented, magnificent, beautiful, stupendous and terrifying. No man-made phenomenon of such tremendous power had ever occurred before. The lighting effects beggared description. The whole country was lighted by a searing light with the intensity many times that of the midday sun. It was golden, purple, violet, gray, and blue. It lighted every peak, crevasse and ridge of the nearby mountain range with a clarity and beauty that cannot be described but must be seen to be imagined. It was that beauty the great poets dream about but describe most poorly and inadequately. Thirty seconds after the explosion came first, the air blast pressing hard against the people and things, to be followed almost immediately by the strong, sustained, awesome roar"—

which warned of doomsday and made us feel that we puny things were blasphemous to dare tamper with the forces heretofore reserved to the Almighty. [Continues reading:]

"Words are inadequate tools for the job of acquainting those not present with the physical, mental, and psychological effects. It had to be witnessed to be realized."

Shall we add to their blasphemy by daring to try to keep for ourselves the results of this revelation for good or for evil and thereby endanger through suspicion our very survival?

We seem to be indulging in a state of psychological bigamy. We are entering into a new relationship of the most intimate and responsible nature with the rest of the world through the United Nations Organization, while at the same time attempting to preserve a defen-

sive nationalism by retaining exclusive control of this new powerful source of energy.

During the last quarter century and especially during the iron years of war the United States has achieved, or had thrust upon it, primary responsibility for world leadership. Rich, powerful, progressive, enlightened, relatively unscathed by war, the oldest republic, the oldest democracy, with long traditions of peace, federalism, and international morality, we, better than any other nation, are in a position to furnish that leadership. It is a responsibility we cannot evade.

Let us recall now and take to heart, Lincoln's admonition in an earlier crisis:

We, even we here, hold the power and bear the responsibility. * * * We shall nobly save or meanly lose the last best hope of earth. * * * The way is plain, peaceful, generous, just—a way which if followed the world will forever applaud and God must forever bless.

In addition, we quote from him:

Fellow citizens, we cannot escape history. We of this Congress and this administration will be remembered in spite of ourselves. No personal significance or insignificance can spare one or another of us. The fiery trial through which we pass will light us down, in honor or dishonor, to the latest generation. We, even we here, hold the power and bear the responsibility.

In closing, I have been given the privilege of reading a telegram which has just come from the Midwest Conference of Atomic Scientists and Religious Leaders:

The Midwest Conference of Atomic Scientists and Religious Leaders, representing churchmen and religious leaders from the Catholic, Protestant, and Jewish faiths, as well as natural scientists and social scientists who have given serious study to the problems arising out of the discovery of atomic fission, urges the prompt enactment into law of the principal provisions of S. 1717, known as the McMahon bill. We call attention to the following four principles which we earnestly hope will guide the policy of the Government of the United States:

1. That the production of atomic bombs and the control of the development of atomic energy be promptly placed under international regulations.
2. That the domestic development of atomic energy and the control of fissionable materials be placed in governmental rather than in private hands, so that it may be used in the public interest.
3. That the subject of atomic energy and its development shall be divested of the atmosphere of secrecy which hampers research and breeds international suspicion, and tension, and that there shall be adequate opportunity for public scrutiny of the action and policies of national and international agencies entrusted with the control of atomic energy.
4. That the agency to be created for the development and control of atomic energy shall be composed of civilians rather than military personnel.

Since the McMahon bill embodies these principles, we urge its passage and express our opposition to such amendments as are designed to undermine or vitiate these principles.

Rabbi Jerome P. Folkman, Rabbi Jacob J. Weinstein, Dr. Charles O'Neil, Dr. Leo R. Ward, Dean Charles W. Gilkey, Dr. Bernard Bell, K. S. Kole, Warren C. Johnson, R. J. Moon, J. E. Rose, K. Way, Louis Wirth.

The United Council of Church Women of the United States associates itself with this statement.

The CHAIRMAN. Thank you very much, Mrs. Sibley.

Senator HICKENLOOPER. May I ask Mrs. Sibley a question, Mr. Chairman?

The CHAIRMAN. Certainly.

Senator HICKENLOOPER. I am not quite clear from your statement, Mrs. Sibley, whether your association or organization advocates the

immediate disclosure to other nations, or the United Nations Organization, of all of the techniques of the atomic bomb before we get any reliable assurance that other nations will not use it.

Mrs. SIBLEY. We never had a referendum on that point. We are a very large organization, and we would not urge that the second steps be taken before the first; but we urge that that be the direction—that international control and sharing of secrets be the direction in which we progress.

Senator HICKENLOOPER. We have a problem facing us now as to what policy the legislation should take as to whether or not we should disclose fully to other nations before any reliable agreements for the maintenance of peace are reached, or whether we should keep our major secrets of atomic explosion, at least.

Mrs. SIBLEY. I can speak now only for myself, because we have had no referendum on that subject. But I ask which is cause and which is effect, and whether it is possible to create these assurances in an atmosphere of suspicion which secrecy engenders—as, for example, in our current handling of the Canadian situation. My own hope is that it will be made a part of the international knowledge as soon as possible.

Senator HICKENLOOPER. Yes; I think that is a desirable goal; but still my question is, and I don't care to have you embarrass yourself, do you as an individual, perhaps, not speaking for your organization, believe that we should now, under present existing conditions, disclose all of the secrets about the atomic bomb?

Mrs. SIBLEY. I do. Period.

Senator HICKENLOOPER. Before we get any reliable assurances of peace?

Mrs. SIBLEY. I think it is the basis of those. I don't think you can bargain with a thing like that in your pocket and expect any kind of assurances, because you are not keeping faith with the thing that you are trying to assure.

Senator HICKENLOOPER. I think history shows that we have kept a lot of faith in this country with peace and humanitarianism.

Mrs. SIBLEY. Not enough. You will remember, Senator, if I am not out of order, that after the last war you promised many things and the Senate prevented some of those things from happening.

I was in the League of Nations when the Germans were admitted. I was in Manchuria at the time the Lytton Commission was making its study. I was in Shanghai at the time of the first Shanghai incident, and I was in Berlin as the guest of Mr. Goebbels at the International Chamber of Commerce at the time the thing was building, and the fact that the United States was not a part of a great international organization at the time allowed those things to happen, allowed things to go on in both Manchuria and western Europe.

Senator HICKENLOOPER. That is a question of serious disagreement.

Mrs. SIBLEY. Granted, but it is our conviction.

Senator HICKENLOOPER. I wanted to get your opinion.

Mrs. SIBLEY. Thank you, Senator.

The CHAIRMAN. Commander Brunauer.

**STATEMENT OF COMMANDER STEPHEN BRUNAUER.
UNITED STATES NAVAL RESERVE**

Commander BRUNAUER. My name is Stephen Brunauer. Prior to my entering the Navy I was a research chemist in the Department of Agriculture. In the last 3 years I have been in charge of explosives research and development in the Navy Bureau of Ordnance. Perhaps it is obvious and unnecessary to state that I am not testifying here for the Navy; I believe that Secretary Forrestal, who appeared before you, gave you the official views of the Navy on atomic energy legislation. I testify here in the first place as a citizen of the United States, vitally interested in the fate of my adopted country and the native country of my children. In the second place, I speak as an officer of the Naval Reserve interested in preserving the military strength of my country, because I believe that that is the best safeguard for the peace of the United States and of the world.

Finally, I wish to speak as a research man, interested in the fate of science, because I believe that science if properly handled is capable of providing the foundation for greater spiritual and material welfare or my fellow citizens and for all mankind.

The views I advance here are my own views, but they represent not my views alone—otherwise I would not have had the courage to appear before you. I have discussed them with a considerable number of scientists, atomic and otherwise, with Navy officers and with friends in other occupations, including some Members of Congress, and the response I received made me feel that even if I may be wrong in some of the things I believe in, I cannot be wrong in all of them.

I do not intend to discuss here the international aspects of the problem. I am fully convinced that it is more important than the domestic legislation, but this tremendous problem cannot be solved by the United States alone, it has to be worked out together with the other nations in the United Nations Organization. One of the great contributions this Nation can make to the solution is to enact far-sighted domestic legislation that will serve as a model to all other nations which in the future will also produce atomic energy for peaceful and for military purposes. I further believe that I could not say anything on the international problem that has not been said here before by men better qualified to discuss this matter than I am, and I am convinced that any one of you gentlemen could give me far better counsel on the subject that I could give you.

I have studied all the bills introduced on the control of atomic energy, but I shall discuss only certain phases of three of them: the Johnson-May bill (S. 1463), the Ball bill (S. 1557), and the McMahon bill (S. 1717).

Although I believe that I can make a contribution of some value primarily on the part of the legislation that deals with the military applications of atomic power, nevertheless I shall take the liberty of expressing my opinion first on three other points: the composition of the proposed Atomic Energy Commission, the attitude to be adopted toward fundamental research, and the provisions regarding patents on the utilization of atomic energy for peaceful purposes.

COMPOSITION OF THE COMMISSION

Regarding the composition of the Commission, it seems to me that the Ball bill proposes the best system for carrying out the great task that confronts that body. It is a compromise between the Johnson-May bill which proposes nine members, each to serve for 9 years, and the original McMahon bill (S. 1359), which made up the Commission almost entirely from members of the President's Cabinet.

The Ball bill proposes five secretaries and four other members, the latter to serve for 6 years.

The new McMahon bill (S. 1717) proposes five full-time Commission members to serve at the pleasure of the President.

It seems to me that changing the entire membership of the Commission with every change of administration would be apt to disrupt the work of the Commission. The provisions of the Ball bill would insure continuity, since four of the members would remain in office. The objection that the task is so great that full-time members are needed for the Commission is solved in the Ball bill by appointing full-time assistants for each member of the Commission, whose principal duty is to keep each member fully informed on all atomic energy problems. These assistants are not to be appointed by each member individually, but by the Commission as a whole, and their appointment would not terminate with a change of administration. I look upon the Commission as a top policy-forming body, and believe that its prestige would be tremendously enhanced by the presence of members of the President's Cabinet. At the same time this would insure a close integration between the problems of the Commission, and all other important problems that face the Nation. I should like to touch on one other point in this connection, namely, the frequency of reports by the Commission to the President and to the Congress.

The McMahon bill proposes four reports per year. This provision, if enacted, might leave the Commission little time for anything except writing reports. The Johnson-May bill and the Ball bill propose annual reports, which would probably prove entirely satisfactory.

Incidentally, I haven't seen that any of the bills suggest military control, a Commission which would be composed of military men. As far as I can see, in all the bills the control would be in the hands of civilians, and in the case of the Ball bill it would consist of nine civilian members, and the armed forces would be represented only by the Secretary of the Navy and the Secretary of War, who would, of course, constitute a minority in a Commission of nine members.

FUNDAMENTAL RESEARCH

The Johnson-May bill established very severe security restrictions for fundamental research: the bill as reported out of the Military Affairs Committee of the House of Representatives toned down somewhat the severity of these restrictions. The Ball bill and the McMahon bill insure full freedom of fundamental research.

I believe, together with all my scientist friends with whom I have discussed this problem, that fundamental research should be free and unfettered. No scientist should need the permission of any agency to investigate nuclear reactions, or to publish his findings. There is a tendency on the part of scientists to flock into the most promising field automatically. It is certain that a large and continually increasing fraction of physicists and chemists will work on nuclear physics and chemistry in the coming years and decades, and that tremendous progress will be made—if the field remains free. If, on the other hand, a scientist faces a jail sentence for discussing his research with another scientist who is "not entitled to receive" such information, the result will be that scientists will leave the field and progress will be stifled.

* And yet, gentlemen, for all that, the problem is not as simple as it appears on the surface. When Hahn and Strassman discovered nuclear fission 7 years ago, some scientists began to see dimly the atomic bomb, and when shortly thereafter Fermi and Szilard discovered the chain reaction, some began to feel that the atomic bomb was in the bag. Three of these scientists, the three initiators of the atomic bomb project in this country, Szilard, Wigner, and Teller, testified already before you gentlemen.

The papers I mentioned were published freely in scientific journals, and these publications resulted in the atomic bomb projects in the United States, the United Kingdom, in Germany, and elsewhere.

It is quite certain that there will be fundamental scientific discoveries in the future that will have far-reaching military implications, and if there is some way to keep these out of open publications, they should be kept out as military secrets. I do not know how to solve this difficulty, but I am firmly convinced that much more harm would come from restricting research than from freedom of research. If there is no satisfactory way to solve this problem, I believe that we should accept the provisions of the Ball bill or the McMahon bill.

UTILIZATION OF ATOMIC ENERGY FOR PEACEFUL PURPOSES

I should like to make only one remark on this extremely complicated subject, namely, regarding patent rights. The McMahon bill makes all patents the property of the Government, giving just compensation to the inventor. I am afraid that this system would result in very slow progress in the development of atomic energy for peaceful utilization. Our big industrial organizations are not used to conduct research and development on the basis proposed by the McMahon bill, except in time of war, and I am afraid that their attitude would be lukewarm toward such nonprofit proposition in time of peace. On the other hand, I believe that great advances can be expected if our industrial organizations are allowed to develop freely their processes, patent them, produce them, and draw profit on them. The Johnson-May bill and the Ball bill both establish the policy of widespread distribution of licenses on equal terms to all qualified organizations, and discouraging the growth of monopoly, restraint of trade, and unlawful competition. Perhaps, if this policy is followed, the industrial corporations can be permitted to possess patent rights. What I said here is purely a layman's view, but I had a good deal of contact with the research organizations of the industries during the war, and I have some idea how their minds work.

MILITARY UTILIZATION OF ATOMIC ENERGY

I am coming now to the last subject, about which I should like to talk to you in somewhat more detail, because I feel that I know more about it and perhaps can say something that has not been said here before. I believe that military research, development, and utilization of atomic energy is vitally important; it may determine the continued rise or a cataclysmic fall of our country and of the type of civilization we believe in. A wise solution of this problem is essential. I believe that a simple and workable solution is on hand; it has been tried during the war, and it worked, and I believe it would work in peace.

The three bills I am discussing here present three different solutions of the problem. The McMahon bill proposes that all military research and development be conducted by the Commission and thus excludes completely the armed services from such activities, except I understand full well that liaison would be permitted.

The Johnson-May bill gives the authority over all military research and development to the Commission, but the Commission can authorize the Army and Navy to perform research and development. Indeed, this bill lays down the policy of utilizing existing research institutions to conduct experimentation in the field, and if this policy is followed, the research laboratories of the Army and Navy would probably be utilized. The Ball bill gives military research and development jointly to the Army, the Navy, and the Commission. This is the system that has been tried and found workable, and I shall attempt now to give you my reasons why I believe that it is vital that this system be adopted by Congress in preference to the others proposed.

To start with, I do not need to emphasize what disastrous effects another world war, fought with atomic weapons, would bring upon the United States and on the rest of the world. This has been emphasized here and elsewhere by outstanding scientists, men of public affairs and others, equally well or better qualified than I am to discuss that subject. I can only repeat on the basis of what I know that what they said was true. I can only add my firm conviction that the best safeguard to avoid a disastrous war is the military strength of the United States. This strength, combined with wisdom in handling the international problem, will give time and opportunity to the United Nations Organization to work out the infinitely varied and complicated problems of the nations and to lead us eventually into a better world in which there will be no need any more for individual, national armies and navies. But military strength is vital now, and will be for some indefinite and unforeseeable time to come.

The military strength of the United States will be built around atomic weapons. These will be not the only but the most important items of national defense. Since it is well known to all nations that the United States possesses atomic bombs, and that there are three large plants now, and possibly others later, that are manufacturing active materials, it is inconceivable to me that any nation would dare to attack the United States or any other nation that may be defended by the United States, unless that aggressor nation has an abundant supply of atomic weapons.

Therefore, I believe that if there will be another world war, it will be an atomic war. This does not mean that only atomic weapons will

be used. In this last war, the most modern of all wars, alongside radar-fuzed projectiles the fighting nations used knives and sticks and arrows, and I believe that another war would also utilize these ancient weapons. In fact, a scientist friend of mine risked the facetious theory that in the next war the opposing sides will demolish each other's industries completely with atomic-power-propelled guided missiles containing atomic explosives in the first 5 minutes, and thereafter the war will be fought with knives, axes, scythes, spades, and sticks.

If we accept the proposition that the military strength of the United States is essential for the welfare of the world, then I believe that the following three facts are self-evident:

1. That from now on atomic weapons will constitute the most important items of national defense.
2. That the security of the Nation will be primarily dependent on the effectiveness of its atomic weapons and of its countermeasures against atomic weapons.
3. That it is therefore of paramount importance that research and development of atomic weapons and of countermeasures against atomic weapons be conducted in the most efficient manner.

During the war military research was conducted primarily by three organizations: The Army, the Navy, and the Office of Scientific Research and Development. This system led to such milestones in progress as radar, VT fuzes, and the atomic bomb. Such independent research with close liaison and collaboration, I believe, would be the best system in peacetime, as it was in war, in all fields of military research. This is the system advocated by Dr. Vannevar Bush in his report to the President, entitled "Science, the Endless Frontier."

When I support Senator Ball's proposition that research and development of atomic weapons should be a joint responsibility of the Commission and the services, I do not mean, nor did he mean, I believe, that research should be conducted by Regular Army and Navy officers. What I mean is research done by civilian scientists and technologists working for and within the armed forces, in daily contact, consultation, and collaboration with the officers of the armed forces. Such close contact insures on the one hand that the scientist does not go off on tangents and develop weapons that cannot be used by the military; on the other hand it makes the officer thoroughly familiar with the weapons developed since he himself participated in the development from the ground up. It is a liberal education for both sides; it makes the scientist more practical and the officer keener and better trained. The other extreme is to have the weapon developed by a separate civilian agency, then dropped into the lap of the military in its complete and final form, to be used by them if they can.

The use of atomic weapons will inevitably revolutionize warfare. I should like to point out here only some of its implications relative to naval warfare. It is almost certain that atomic weapons will not be the only ones used by the Navy. For defensive purposes probably ordinary high-explosive weapons will be used for the most part. Thus development of a variety of weapons will continue, but all developments must center around atomic weapons. It is impossible to conduct intelligently the development of either atomic weapons or other kinds of weapons without a unified planning of the entire program. Furthermore, countermeasures against atomic weapons are

very intimately tied up with the nature of these weapons, and must be developed simultaneously and in close relationship. During the war, we always developed our countermeasures simultaneously, and often we did not put any munition into use unless we knew how to counteract it. Sometimes completed munitions were kept in reserve until we were able to counteract it, because the enemy can always capture a sample of the munition and can use it against us; if we have no countermeasures, then we are just as much out of luck as the enemy.

Along with the development of weapons, ships and airplanes must be built or modified to be able to carry these weapons and to combat the enemy's weapons by countermeasures. It is likely that certain types of ships must be eliminated; battleships might have to go if the cost of an atomic bomb is much smaller than that of a ship, unless very effective countermeasures are found. The tendency will probably be toward fast, smaller ships. The tactics of naval warfare may be changed. Convoys and any sort of bunching of ships may have to be avoided. Ships may have to be scattered to larger distances to avoid the sinking of several by one bomb; the scattering in turn would lead to greater vulnerability to submarines using ordinary torpedoes. Large harbors must be decentralized to avoid destruction by a small number of atomic bombs. Since ships, weapons, tactics, harbors will all have to change, it seems reasonable that all these developments should take place within the Navy, simultaneously and in complete harmony.

It is a very unsatisfactory procedure to have the center of all these developments outside the Navy in a separate civilian agency. It is not sufficient to have a few liaison officers in this agency, who come back with stories of the atomic research trying to influence other developments; the development of atomic weapons and their countermeasures must be the nucleus, the core within the Navy from which all activities radiate.

I should like to bring up, if I may, a few additional reasons why it would be undesirable to deprive the armed forces of the right to develop their most important weapons. During the war, under the pressure of war, civilian organizations performed wonders in military research, but during peacetime, with this pressure removed, I am afraid the main driving force would be lacking. Civilians working within the armed forces obtain the drive not from the control of the military, but from the daily contact with them; they talk, eat, live their daily lives with the users of their products, they know what is wanted, they know for whom they are working. Liaison is only a partial and very incomplete substitute.

A corollary of the above is that there is some danger that if all military research and development of atomic weapons is entrusted to a completely civilian organization over which the armed forces have no authority, it may happen that this organization will spend most of its time on fundamental research, or on research directed toward peaceful applications of atomic energy, and will neglect the military applications. Since the armed forces have no control over the situation, they can only complain to the Commission, which may or may not have any effect; even if it has, it would result in lost time and effort. Such situation could not arise if the military developments could be made the joint responsibility of the Commission and the services.

Even during the war, when scientists and engineers put everything into their work to help the war effort, the control of the atomic bomb project was handed over by the OSRD to the Manhattan district of the Army engineers. The procurement and engineering functions were taken over in the summer of 1942, the research and development in the spring of 1943. I gather that to this date the top men of OSRD, Drs. Bush, Conant, and Tolman, are convinced that this transfer was wise; at least I have not seen a statement to the contrary from any of them. You have heard here, gentlemen, and I have heard elsewhere, that the security system of the Army retarded the completion of the bomb by a year, or year and a half. Such statements are very hard to reconcile with the fact that the whole course of the project was planned carefully 3 years or longer ahead of time, and that everything came through on schedule or somewhat ahead of schedule. I do not mean to imply that the security system of the Manhattan engineer district was necessarily ideal. But it is unfortunate that certain atomic scientists, instead of suggesting merely improvements in the security system, suggest that the armed forces be thrown out of the development of atomic weapons completely. On the basis of what I said previously, I am convinced that the participation of the military in military research in peacetime is even more essential than in wartime.

It has been often stated that civilian scientists and engineers do not like to work for a military organization; that they would rather work for a civilian agency. This statement is partly true; the fact is that some of them prefer it one way, some the other way. Many scientists who worked with or for the Navy during the war are not only willing but anxious to accept intelligent guidance in their work by the men of the fleet who will use their products. Others think differently, but the Ball bill solves this difficulty; those who do not want to work within the services can find their place in the civilian agency set up by the Commission.

These are the main points I want to put before you, gentlemen. I deeply appreciate the honor of your request to express my views on the subject.

The CHAIRMAN. Thank you very much, Commander.

Senator HICKENLOOPER. May I ask the commander a question?

The CHAIRMAN. Surely.

Senator HICKENLOOPER. Commander Brunauer, I assume that your statement and your conclusions and recommendations are largely predicated upon the practical assumption that reliable assurances of peace among nations may not be reached?

Commander BRUNAUER. That is correct, sir. I hope they will be reached.

Senator HICKENLOOPER. I hope you don't misunderstand my question. I do not say you advocate they will not be reached, but your statement is predicated upon the necessity for this country in the future to defend itself, or be prepared to defend itself.

Commander BRUNAUER. If the United Organization fails and war will still come.

Senator HICKENLOOPER. Is it your thought that until such time as we get reliable assurances of peaceful intentions among nations that we should not discard or throw overboard the military aspects of research in atomic energy?

Commander BRUNAUER. That is completely true, sir.

Senator HICKENLOOPER. Now, let me ask you this further: Assuming that sometime in the future, either the near future or the reasonably near future, the nations of the world are able to get into such reliable guaranties of peace and the maintenance of peace, would you then think we would be justified in the discontinuance of purely military research in the atomic bomb field, providing all other nations agreed to that and we had proper inspection or proper safeguards that were satisfactory to this country?

Commander BRUNAUER. Yes, sir; I do feel that way. If the country feels satisfied that the safeguards are sufficient to prevent wars, then I definitely feel that way.

Senator HICKENLOOPER. But you still don't believe in throwing away your gun so long as you think there may be a prowler in the house?

Commander BRUNAUER. Yes, sir; more than that, I believe that to hold on to the guns at present will contribute to the eventual solution of the problems of the nations in the United Nations Organization.

Senator HICKENLOOPER. You feel that on any control commission or board that is set up, there should be some representation of the military field of atomic energy, temporarily at least?

Commander BRUNAUER. Yes, sir; not necessarily a military man. It would be perfectly satisfactory to me to have the Secretaries of War and the Navy represent the military of the country on such a commission.

Senator HICKENLOOPER. But is this the point I understand you are making, that during this immediate period of time, or while the threat or possibility of military action remains, that the military interests of this country in this bomb should be in some specific capacity represented on any commission that is set up?

Commander BRUNAUER. Yes, sir.

Senator HICKENLOOPER. Thank you very much.

The CHAIRMAN. Thank you, Commander.

The committee will meet in executive session at 10:30 tomorrow morning.

(Whereupon, at 12:15 p. m., the special committee recessed until 10:30 a. m., Wednesday, February 20, 1946, to reconvene in executive session.)

ATOMIC ENERGY ACT OF 1946

WEDNESDAY, FEBRUARY 27, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to notice, at 10 a. m., in room 104-B, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Johnson, Byrd, Austin, Millikin, Hickenlooper, Hart, and Vandenberg.

Also present: Dr. Edward U. Condon, scientific adviser to the special committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The hearing will come to order.

General Groves, you have been before the committee a couple of times before, the first time, as I recollect it, on the general information proposition, and then we heard you in executive session on some matters pertaining to the security provisions of a proposed bill. The committee, as I understand it, has decided to invite you to come back this morning to give us your personal views on proposed legislation.

Now, you go right ahead, General.

STATEMENT OF MAJ. GEN. L. R. GROVES, UNITED STATES ARMY

General GROVES. I had hoped to receive a letter from the committee or to have one sent to the Secretary of War outlining my position in appearing, because, after all, it is rather unusual for an Army officer to be asked to appear before a Senate committee to give his personal views as divorced from the War Department.

Senator VANDENBERG. No more unusual than atomic energy.

General GROVES. That is correct, but I have talked to the Secretary of War on the telephone and have received instructions from him, and I feel the only limitation which he has placed on me is that if I give any testimony which I feel is at variance with War Department views, I should state that fact, and so, from time to time, I will emphasize that it is a personal viewpoint and I am not speaking for the War Department.

At the outset, I would like to make it perfectly clear that I have never sought nor do I now aspire to any appointment on or under any proposed commission on atomic energy. Therefore, I do not have any more personal interest in the eventual details of any legislation than any other citizen should have. My only desire is to have the very best form of legislation enacted.

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I would like to talk about a viewpoint that I regard as most essential to adequate legislation in this field. First is the make-up of a commission and the duties of a commission.

If the Commission is to function—in fact, if the whole control of atomic energy and development is to function, as I feel that it should—anything in the way of security regulations or regulations affecting other citizens outside of the project itself should be made by the Commission and not by an administrator. There is nothing that can hurt good administration more than to have an administrator who gets to making rules and regulations that affect things other than the immediate operations of his own organization.

I think that any form of bill should avoid giving to an administrator or to any one other than the top commission the power to make regulations, and I refer particularly to security but also to any other form of regulation that might be necessary to adopt. I include in such things any support, and I believe that such support will be necessary to colleges and to universities, to scientific research. I think that should be in the hands of a commission so that the administrator is not put in the position of being someone who has too much power.

During the war that was not feasible. I was both the administrator and the commission, but I had very rigid instructions from the President of the United States and the Secretary of War and the Chief of Staff about security. All of the security measures taken by the Manhattan project during the war and to date are in accordance with the written instructions of President Roosevelt to me, emphasized by oral instructions from him, and by the very pointed verbal instructions of General Marshall.

The type of commission, I think, that you get in this legislation will control whether atomic energy is properly handled in this country or not. It is to me an important factor to get commissioners with the high qualifications that are necessary. The May-Johnson bill provided for nine commissioners who were part-time commissioners. There have been objections to part-time commissioners. I would like to review why I personally—and this is a personal opinion—feel that there are advantages to the part-time commissioners.

It is on two bases: First, that a commission which is made up of part-time people who have other interests will be a better commission. I feel that with the regulatory powers—that is, the power to make rules that affect so many people and affect the United States so vitally—it is important to have a number of men on the Commission. I think that nine is a satisfactory number. Seven would be all right, or 11. I think if you get too many, then it becomes a debating society or people who just sit there and vote "aye." That is not a War Department position at this time.

Senator AUSTIN. I do not understand that. You say the War Department does not favor a commission?

General GROVES. I think I explained before you came in that Secretary Patterson had given me verbal instructions to the effect that while I was to discuss this problem thoroughly with the committee and give my personal views, anytime that I felt that I was not representing the War Department's views I was to make a point of it, and I am making the point that this is a personal view and I am not

speaking for the War Department as to how many members should be on the Commission, or anything to do with that.

Senator JOHNSON. Do you know what the War Department's position is on that point?

General GROVES. Well, I don't know what it is. I prefer not to state what that is, because I am not certain enough of it.

Senator AUSTIN. They have not told you, have they, that they are opposed to that?

General GROVES. They have sent to the Bureau of the Budget a report, I believe, on the McMahon bill which would indicate that. I have glanced at that report, read it very hurriedly, and I did not prepare it.

Senator AUSTIN. Have you seen Secretary Patterson's testimony before the committee in that respect?

General GROVES. Yes, sir.

Senator HART. Insofar as I understand, that testimony does set forth the War Department's position.

General GROVES. Until it is changed, that would certainly be correct, sir.

Senator MILLIKIN. You did not write that report?

General GROVES. On the McMahon bill; no, sir, I did not.

Senator MILLIKIN. Would you be at liberty to say who did write it?

General GROVES. No; I don't think so, because I do not know exactly who wrote it all. I know it was prepared under the direction of the Secretary and the Under Secretary and that it was personally discussed as to the major factors with the Secretary.

Senator MILLIKIN. Can you say whether it was written by men who have worked with you in these matters, or by anyone who has worked in these matters in a military capacity?

General GROVES. It was not written by any such person. Our office was consulted and our views were given to them.

Senator HART. General, were any of the members of the original interim committee, whose work founded the original message from the President and the original bill, involved or included in that discussion which preceded Secretary Patterson's testimony?

General GROVES. I do not believe so, but I am not certain, sir. I have no knowledge that they were, and it is my belief that they were not. There may have been one or two who were consulted by phone, but I am not aware of it.

The CHAIRMAN. General, are you aware of a directive issued by the President to the various executive departments setting forth the Executive policy on this matter? Have you seen the memorandum?

General GROVES. Yes, sir; I have seen that.

The CHAIRMAN. And the Secretary of War testified after the receipt of that memorandum in conformity with the memorandum, did he not?

General GROVES. Yes, sir.

The CHAIRMAN. And the Executive policy as it was outlined was for a three-man full-time Commission. I believe that was the Presidential recommendation.

General GROVES. Yes, sir.

The CHAIRMAN. So that gives the official War Department position?

General GROVES. I think so.

Senator AUSTIN. There was supplementary to that an additional board, was there not, in the recommendation?

The CHAIRMAN. I think not, Senator.

General GROVES. I think not, sir.

Senator AUSTIN. I had the impression that there was a provision for an advisory board.

The CHAIRMAN. That is called for in the bill. The power is set up for it.

Senator AUSTIN. That is all right. I am not trying to get a wedge in between the bill and the President or the Secretary of War. I would like to find out whether it is the policy of the War Department to establish a permanent board of three men or three members accompanied by an advisory board.

General GROVES. I don't believe the Secretary testified to that, and as far as I know, the statement was made that it would be a three-man full-time board. What was said and what contact was had with the members of the interim committee I am not aware of in their preparation of that final statement. I believe that previously it had been discussed with them and the feeling had been expressed by some that they would not get as high-caliber men for this task by having a full-time Commission as they would by having a part-time Commission.

~~When the part-time Commission was originally selected the theory was adopted on the ground of trying to figure out how you could get a board that would be able to handle this matter. It was not felt that you could get men of the caliber that we needed in many fields to accept permanent positions.~~

It was also felt, and I think that that has been testified to before the committee by Mr. Smith, Director of the Budget, that the objection is to having a three-man Commission exert executive powers such as were exerted in the days of ancient Rome when they tried to have three men run a state administratively. ~~I think that we have examples of that in this country, and when we have a board which has executive powers, we soon have a situation where there is either turmoil or one strong man emerges, and from there on it is his board or his commission.~~

In this particular problem, the qualities of the men that are required to be on the Commission are unusual. It isn't anything that a man can just walk into and function perfectly, or even well, by being appointed by the President and confirmed by the Senate. I don't think that that is a full qualification. ~~I think it requires men who have background in many fields. That was one reason why the nine-man Commission appealed to me personally and my personal decision to say that that was the best idea was made by taking various sizes of commissions, both part-time and full-time, and trying to list people that I thought would make up a satisfactory Commission. That is the basis on which the nine-man, part-time Commission appealed to me.~~

Senator HART. May I pick that up a little, General?

In checking your idea, do I understand that you rather canvassed the field in the United States to see who, in your opinion, after this great wealth of experience, would be able to measure up to the requirements that you conceded would be necessary?

General GROVES. That is correct, and in some instances to make up this Commission, I made no effort where I was getting into a field that I was not certain of. All I did was to specify the qualities of the man, but to make certain that men of that quality could be obtained. For example, such a board or commission should have representation from science, and that means men who really know what it is all about. You cannot find nuclear physicists who are disinterested. They all will be very vitally interested by anything that is done by this Commission, and I feel very strongly that no one belongs on such a commission who is interested in any way in anything which will really cross swords with his duty as a member of the Commission.

If you take a man such as President Conant, of Harvard, or President Compton, of MIT, they are automatically barred in my opinion, although they would personally be ideal members, because their institutions are vitally interested in nuclear physics research.

I felt that to get men of that caliber, we would probably have to go to the smaller liberal arts colleges, not the universities, the ones that did not have a direct interest in nuclear physics and find a man there, presumably the president of a college such as Williams or Amherst or Lafayette, or something of that character, and that that type of representation was essential.

The CHAIRMAN. General, going over these names that occurred to you as properly qualified appointees on the Commission, you have said that you gave consideration to Mr. Conant and Mr. Compton but had to reject them for the reason given. Will you tell us some of the other names you thought about?

General GROVES. Well, I can give you the quality of the people. For example, I felt that Dr. Bush could be a member of such a commission without interference with other interests. I felt that another man who would be barred by reason of his recent appointment as president of Purdue was Compton, a very able man. You run down the line and you find that any scientist who is an academic scientist—and we need academic scientists on such a regulatory body—would fall into the class I spoke about. He would have to be a man who had taught science and then had become the president of a smaller college.

The CHAIRMAN. Have you any list of names prepared?

General GROVES. In that field we felt that we could get men of that caliber from the colleges. We also felt in industry that we could get men who were accustomed to big things in industry, but it would mean barring, for example, anybody who would be affected by this, and that would primarily bar men from companies which are working with us, companies which might have an interest in seeing us succeed or not succeed, or where the people might have some claim for saying, "Well, that company would like to see this delayed." For example, that would bar, in my opinion, any man who was an executive in either General Electric or Westinghouse.

The CHAIRMAN. Have you a list in your files, General, of these men whom you have thought about?

General GROVES. Yes, sir; I have a number of such calculations.

The CHAIRMAN. With specific names?

General GROVES. With specific names or qualities.

The CHAIRMAN. Would you please send those to me?

General GROVES. Yes; I would be delighted to.

Senator VANDENBERG. Does your idea of this nine-man Commission contemplate that it is totally civilian, or are the services represented?

General GROVES. I felt that the services would have to be represented, and I think that primarily for this reason, that at the present time this is the most powerful military weapon in existence. It is a weapon which can control all future warfare and can spell defeat or victory for a nation and I felt that, until a time should be reached when we knew that the thing could be controlled and could be inspected and could be handled so that we knew we would never be subjected to an attack by this weapon, the Army and Navy would have to be represented.

The CHAIRMAN. You mean on the Commission itself.

General GROVES. On the Commission itself, or in some capacity that would insure that the Army and Navy views were not overlooked.

Senator VANDENBERG. You mean men in active service now?

General GROVES. Men in active service or men on the retired list, although I have always felt that with this length of time which was proposed of 9 years—and that was proposed because it was felt it would take at least 2 years before the man really got into the swing of it if he was not in the field to start with—you would have to have a man who was young enough when he went on the Commission so he could serve his full 9 years and be physically and mentally fit at the time he went off.

Senator JOHNSON. Why should not the Air Force be represented also?

General GROVES. I have always considered the Air Forces as part of the Army or Navy at the present time, and when I say "military representatives," I include land, sea, and air.

Senator JOHNSON. Then, you do include the Air Forces?

General GROVES. By all means, sir.

Senator JOHNSON. Senator Austin may know a great deal more about the trend of things in that direction than any of the rest of us since he is working on the new unification bill, but it would seem to me that all three of the armed forces should be represented on this Commission.

General GROVES. That is correct. As soon as they become three instead of two, or as soon as they become one, as far as I am personally concerned, I would like to see from two to four men on that Commission who were either active or retired, and I would like to see at least one of those from the Air Forces, and I am not particular about the others, except that I think there should be one from the Navy and one from the Army Ground Forces. As long as there are from two to four, I think that the Army and Navy interests, which are essentially the defense of the United States, would be properly taken care of.

Senator VANDENBERG. You said that you were interested in the age level so that you wouldn't lose capacity. Your view and Senator Hart's agree on that subject?

General GROVES. I am afraid I might be younger than almost anyone here except the chairman, and maybe I am younger than he is, so maybe it wouldn't be right for me to say as to that.

The CHAIRMAN. General, I take it, when you say service representation you mean service personnel, not the Secretary of War?

General GROVES. I do not mean a civilian head of a department and I do not mean a man who has to go to the Secretary of War or the Chief of Staff to be told how to vote on anything. In other words, what I want, and feel is absolutely essential, is a man who has the background and who is not going to forget for one minute that, as long as this is a prime, or the prime, military weapon of the country, defense must come first and other things will have to come afterward until the international situation is resolved so that we do not have to worry about this as a military weapon.

Senator MILLIKIN. Do you think, General, that the bill that comes out of this committee should conform itself to the fact that the weapon angle of it is the predominant angle at the present time?

General GROVES. I think so, but I do believe that the bill as it comes out should recognize that while it is a predominant angle at this time, we are prepared for the future and the bill should prepare for the future and not intimate to anyone that we are thinking of this only as a weapon.

Senator MILLIKIN. That would be a matter of mechanics?

General GROVES. I think it is a matter of wording the bill so that it is clear that we are not as a Nation embarking on a policy that we are going to have this as a weapon for all time and that is all we are interested in.

My view is that we are interested in it as a weapon as long as we have to be, and on the day when we can say we can forget this as a weapon, that will be fine.

Senator MILLIKIN. You agree that the weapon is the predominant thing at the present time?

General GROVES. At the present time; yes, sir.

Senator MILLIKIN. Do you see anything on the horizon that leads us to believe that within, say, a year or two it will lose its predominancy?

General GROVES. As a weapon?

Senator MILLIKIN. As a weapon.

General GROVES. No, sir; I cannot see anything.

You are thinking, I suppose, primarily of defense against this, and I see nothing, and I have yet to be told by anyone in whom I have any scientific confidence that there is any possible angle which could be attacked that might result in a defense.

Senator MILLIKIN. Aside from the defense angle, that is, a specific defense to this specific weapon, do you see anything in the world situation that leads us to believe that we may get into such a state of stable peace within the next year or two that we could shift the predominancy of the energy from a war weapon to that of peacetime exploitation?

General GROVES. I don't believe that we can ever shift from the predominancy of this as a war weapon so long as we are unable to make certain that there will be no war.

Senator MILLIKIN. Then, until that time the bill, in your judgment, should reflect that fact?

General GROVES. Yes, sir.

The CHAIRMAN. General, I may be in error, but I seem to remember upon a number of occasions—I am not sure whether you did it before the committee when you were here before, but I seem to have read in the paper at least, accounts of some speeches that you made in which

you indicated that you believed that the War Department wanted to get out of this just as quickly as possible. Do you regard your recommendation for War Department generals to be members of this Commission to be in harmony with that former statement?

General GROVES. Yes, sir; because at the present time and in the past, the War Department has had sole control, and it is the sole control that I feel it should get out of.

I think also that when I said from two to four men with military experience on a commission of nine, that means the majority will be in the hands of civilians, as I feel it should.

The CHAIRMAN. Now, General, let's see if we can harmonize that viewpoint with your answer to Senator Millikin's question that you regarded this thing primarily now as a weapon. If that is the major emphasis at this time, would it not follow logically if you adopt your theory that there should be a majority of military on the Commission?

General GROVES. No, sir, because I believe that the Commission should be primarily civilian. It is the feeling of the United States and of all the Anglo-Saxons, dating from the time that Cromwell went into Parliament, that you cannot have an organization with the powers that that organization will have that is not definitely subject to a civilian majority. I believe that the Secretary of War should be civilian and should have civilian assistants for the same reason, and yet that does not keep the Chief of Staff, who is the military adviser to the President, from exerting a great deal of influence on military matters. At the same time, it leaves it to the Secretary of War as the head of the War Department.

Likewise, on this Commission I feel that the Commission must have a civilian majority, and I feel that very strongly because of certain things that the Commission must be responsible for, which are primarily security matters, and these regulations which they must frame and adopt. I think it would be most adverse to the future of atomic energy and to the future of the country to have the action of the Commission attacked on the ground that it was a military commission.

The CHAIRMAN. Do you think that you would obviate that crime by having a 5-4 representation?

General GROVES. I think you would, and I would like to recall that I said from two to four.

The CHAIRMAN. Four more desirable than two?

General GROVES. I think the actual number on it, Senator, depends a great deal on what Senator Austin is going to do. In other words, if we have a unified service, if we have two as we have at present, or three, that will determine really what you should have on that Commission.

I would hate to see a commission or anything established in the law that said the President had to appoint a definite number of military men. I would not object personally to having it stated that he can appoint or should appoint not less than two or more than four.

The CHAIRMAN. Now, I seem to have read an interview with General Eisenhower, and I have called the interview to the attention of the Chief of Staff, in which he advocated an all-civilian commission. Have you discussed that with the Chief of Staff?

General GROVES. I don't recall that.

The CHAIRMAN. I read it in the Christian Science Monitor, a story by Mr. Roscoe Drummond.

General GROVES. I don't believe I discussed that particular thing with General Eisenhower, although I do not recall—I may have.

The CHAIRMAN. That is the way he was quoted in this story, as believing there should be an all-civilian commission.

General GROVES. Now, I would like to repeat what I said before, that I felt that none of these active or retired officers who were on this Commission should be serving as representatives of the War and Navy Departments; that they should be serving as individuals, with that background and that ability to see that side of the picture.

The CHAIRMAN. You have always exercised becoming modesty, but it seems to me you have drawn a bill of particulars here which you could fit pretty well.

General GROVES. Well, I do not want to fit it. I think there are others that could fit it. I think that initially—I don't know how long the transition period will last—there are others that can fit that bill today, and I still stand by my statement of neither seeking nor aspiring. As a matter of fact, while formerly it would have been a question of doing what I was asked to do, I think the experiences of the last 4 or 5 months have taught me that it would now take very strong urging. I would have to be told that it was a must and not just "we would like to have you" or "we think you should." Somebody has got to do some arguing now.

Senator JOHNSON. General Groves, would you see any objection to a requirement in the law that the President shall appoint someone from the military branches as recommended by the Chief of Staff of the particular military branch?

General GROVES. No; I would not see any objection to it.

I have always felt, however, that the less strings that were tied to the President in the matter of appointment the easier it was, but I have no real objection to it.

Senator JOHNSON. He would probably do that anyway?

General GROVES. He would do that anyway except for good and sufficient reason, and I do not know just how it could be done if it were done that way. It would be difficult to make it legal and it would be awkward, and I think it would be something that you could depend on the President. After all, if he loses confidence in the Chief of Staff, he has a very easy remedy.

Senator VANDENBERG. In any event, when one of these officers is appointed, he severs himself permanently from the Military Establishment?

General GROVES. As long as he is a member of that Commission.

Senator VANDENBERG. That wouldn't be long enough.

General GROVES. It would be 9 years, and that means that he severs it permanently really from a practical standpoint.

Senator VANDENBERG. "Permanently" is the word.

Senator JOHNSON. Of course, our Army officers have retirement privileges and you might, if you tried to circumvent that too closely, disqualify a great many very able men who would be very desirable on such a commission because their retirement is a matter of great importance to them. If you are going to sever them from such privileges, certainly you are going to have to do a lot of coaxing.

Senator VANDENBERG. I wouldn't sever them from those privileges, Senator, but as generally indicated these men have got to be absolutely free from domination. If they contemplate a return to the service, they are not free from domination. I do not want to interfere with any of their rights; I just do not want them to come back later and capitalize on what they have done.

Senator HART. Senator, after a military man drops out of his own branch for 9 years, he is not likely to be again actively employed in any case, but if he may return to the service pay roll as a pensioner, then his rights are looked after somewhat like one in uniform becoming a Senator and going back.

General GROVES. I think that has given you my views on the proposed nine-man Commission.

Now, there were other types of commissions proposed. I would like to state that my experience has never made me a believer in ex officio members of such commissions who are busy heads of Government departments, because we want men who can spend whatever time is necessary and, particularly, can attend meetings; we want a man who cannot send some assistant over there to sit for him and have the assistant come back and not be able to tell him even what went on at the meeting.

Now, that may be at variance with the idea of a part-time man, but a part-time man to me is not a man who sits 1 day a month and then comes down and sits and forgets it in-between time. He is working in-between time on problems. He is able to take trips of 2 or 3 weeks at a time, at his convenience, of course, and it can be arranged.

As to the permanent type of commission, I think the real objections that I see to it are first, that I cannot picture that permanent commission as a group of three or five running an executive agency, unless one man becomes dominant. I think also that I would like to see very much the regulatory features of the Commission separated from the executive and the administrative. It will make it much easier for the administrator if all he is doing is executing the rules established by the Commission.

*Separation of regulatory
from administration.*

I think one of the other duties of the Commission, besides passing on regulations, and not only passing on them but, as it means to me, really determining what they will be, is to serve as a board of directors on the general administration by the executive, the administrator. I think that is essential. I think there has to be one top administrator, and not, as was proposed in Senator McMahon's bill, four different departments, each of which would report to the group of three men. I don't know just what qualities those three men would have. I have tried to figure out just what they should be.

If you have one man with military experience and you have one with industrial and one with academic science, you have got just about a bare framework. I don't know whether there should be someone with legal ability in there or not, but you would at least have to have those three—the military, industrial, and academic—and that leaves out a number of things. It leaves out more than one military man, for example, who would either have to be air, ground, or sea, and you have problems involved in that.

Senator JOHNSON. You are leaving out an engineer, also.

General GROVES. It would leave out an engineer. You would have to make your choice between an engineer and an operating man, and these big industrial operations are not easy. They involve labor problems that are most complex; they involve management problems, and they involve a tremendous number of problems where you want the advice of those men.

Now, I would like to recall for you for a few moments what the military policy committee did for me during the past. The military policy committee, as I viewed it, had one primary purpose, and that was at any time that they lost confidence in me they were to tell somebody, and that somebody would then say, "You are through."

Senator MILLIKIN. May I interrupt to ask who made up the military policy committee?

General GROVES. It was made of Dr. Bush as the chairman, with Dr. Conant as his alternate, and with General Styer and Rear Admiral Purnell. Now, actually Conant sat with every meeting of that military policy committee. I also sat with it—that was required in the set-up.

In addition to keeping their opinion on me up to date so that they could report to the proper authorities—that is, the Secretary—and say, "You had better get rid of him," they also passed on major decisions in advance. I didn't embark on the construction of Hanford, for example, without the full concurrence of that military policy committee. I presented the facts; I answered all the questions. Styer and Purnell could handle the military part of it. Bush and Conant could handle the scientific part, and we didn't have any industrialists on that, although I often wished that I had a man to go to for advice; but I had plenty of other industrialists. We went to them for advice constantly. Dr. Conant was an adviser to me from the start. As he puts it very modestly, he said that he was a "kibitzer" on this project. He was the type of kibitzer that tells you what you had better discard and how many cards to draw, too. While he didn't interfere in any way, it was always advice, still it was very sound advice, and that was true also of Dr. Bush. If a problem came up that was essentially chemistry, then Dr. Conant's advice was listened to very carefully, and it was, as a matter of fact, always followed. The same thing was true with Dr. Bush's advice.

When you have men of that caliber—and that is the type of man I would like to see on such a commission—when they give advice you had better listen to it or be very certain that you are right, and then you have to convince them, or probably you are wrong anyway.

Senator JOHNSON. Were Drs. Conant and Bush consulted in the drafting of the so-called May-Johnson bill?

General GROVES. They were members of that interim committee, sir.

Senator JOHNSON. Then, they approved the nine-man Commission?

General GROVES. Yes, sir; and particularly the part-time features of it.

The CHAIRMAN. How often, General, did this policy committee meet?

General GROVES. That policy committee met—I don't recall exactly—at irregular intervals whenever I felt there was anything I needed their help on, or they felt they should be brought up to date. That was an official meeting. Actually, when he was in Washington,

I should say that I saw Styer at least every week or 10 days; I saw Conant about every week to 2 weeks, depending on how often he came to Washington, and every time he came to Washington I saw him. I saw Bush just a little less frequently, but that was not necessary because I saw him through Conant who took everything that I said back to Bush. I saw Purnell on anything that I felt I needed his particular advice on, or any important matter that came up.

For example, if we got a report that one of these constants was turning the wrong way, and instead of being able to make a bomb with, say, that much material [indicating] we were going to have to use that much [indicating], they were informed immediately, and they were informed just as the board of directors in a company would be informed. When they came to the board of directors meeting, they knew what it was all about. They were not there just to collect a fee, for there were no fees; they were there and knew everything that went on, but didn't know about the details.

The CHAIRMAN. Admiral Purnell, I believe testified before the committee. It is hard to recollect all the testimony that has been before us, but as I recollect his testimony, my general impression at least was that he had not been in too close contact with the project. Have you read his testimony?

General GROVES. Yes, but also it was quite a while ago.

The CHAIRMAN. Do you agree with my impression?

General GROVES. I would like to say in my opinion that dealt with the one phase of it which was the work done at the Naval Research Laboratory.

The CHAIRMAN. That is where he was consulted?

General GROVES. No, sir; that is the part that he did not know as much as you might have expected him to, but that was because there were many complications concerned with that that dated back long before I came into the project. There were a lot of technical and personal problems there that I would rather not go into in open hearing, but it was a touchy thing to handle, and it was nursed and handled just as carefully as it could be done.

The CHAIRMAN. I gather from your description, General, that you really carried the main burden of the policy making of the Manhattan project.

General GROVES. I would not say that is correct.

Now, for example, take the Hanford works. The decision to build the Hanford works was made with the full approval of the policy committee in advance. Every important decision was taken in advance. We built three piles there, and that decision was approved by the policy committee in advance with a description of just what we thought we would get out of each pile.

The fact that we built two chemical separating plants there was approved by the committee in advance. Then, there was a time when one member suggested that we not complete the third pile. We got some erroneous scientific data, and we thought we could do much better than we could do, and because of that erroneous scientific data one member suggested that we not complete the third pile. That was a subject of considerable discussion in that policy committee and the decision that was reached was, you might say, squarely on all of us.

My general feeling always was this, that while I was responsible for the major decisions, no member of the policy committee would

ever be in a position where he would say that he did not know that these decisions were being taken and that if he had known he wouldn't have approved them, because they knew of the major decisions and they approved of them and approved of them in advance, and quite a number of them that were quite important were really taken on the initiative of one of the members of that committee.

There was one particular thing that I would prefer not to state where I was overruled by the policy committee on a certain matter with respect to organization, and that was all there was to it.

The CHAIRMAN. Do you have a record of how many times this policy committee met with you?

General GROVES. Formally?

The CHAIRMAN. Yes.

General GROVES. Yes, sir.

The CHAIRMAN. Do you know how many it was?

General GROVES. No; but I should say offhand that the formal meetings would run from about a month apart to about two to two and a half months, and it all depended on the situation. If there was nothing to be discussed, they did not meet.

The CHAIRMAN. Would you mind submitting for me the number of formal meetings of this advisory board?

General GROVES. I would be glad to, and also with the understanding that that did not mean they were not in constant touch with the situation. There were certain meetings that were held at longer periods than we would like to otherwise because of the fact that we could not always get these people together. Some of them left the country, as you know, from time to time.

The CHAIRMAN. That is always the difficulty with part-time people who have other interests. They might find it difficult to consult in matters of policy.

General GROVES. That is correct, but we never had any trouble with them when they were in this country. It was when they went abroad, to the Pacific and to Europe, that we had trouble.

If there is no provision adopted which includes men with military experience—and I mean by that long military experience, not just the experience of serving in either this war or the last—I believe that something should be done to correct anything which excludes the armed forces.

We have talked a lot about unification of the armed forces, and yet if this is done we would take the controlling weapon, you might say, certainly the controlling weapon of a surprise attack, and divorce it from the armed services and say that the Chief of Staff and the Chief of Naval Operations will have nothing whatsoever to do with it excepting insofar as this Commission permits them to. I think that means that if any such bill is adopted which does not include men with military background on the Commission, the Commission should be directed by law to submit to the Joint Chiefs of Staff all matters of policy prior to adoption and before publication.

In the event that the Joint Chiefs do not concur in such policies, I think they should be submitted to the President for decision. I think it should also direct continuous consultation and maintenance of liaison with the War and Navy Departments on all matters of security, military research, and military applications of atomic energy and development, manufacture, storage, and use of atomic bombs.

The CHAIRMAN. Do you mean by what you have just said that all releases of information, including basic scientific information, should be submitted to the Joint Chiefs of Staff?

General GROVES. You mean each piece?

The CHAIRMAN. Yes.

General GROVES. No, sir; the policy.

Now, I would like to state, for example, how the Smyth report was drawn up. The Smyth report was drawn up by putting down on paper in about the equivalent of a sheet and a half of double-spaced typewriting the rules under which the report would be drawn. Those rules were drawn up originally by me, I think in consultation with various people—I am sure in consultation with Drs. Tolman, Conant and Bush. They were approved later formally by people above me in the War Department—that is, the Secretary—and I don't recall whether they were shown to the President or not. I cannot say, but those rules set forth the basis on which the Smyth report would be written.

Essentially they were that it could not contain anything that was not already known beforehand, and they gave certain exceptions to that as to what could be told; that is so that men of the stature of Hahn or Eisenberg of Germany could not get the answer once knowing the bomb had gone off, and it permitted certain things that we knew could not be kept secret over 10 minutes after the bomb was let off.

The CHAIRMAN. Do you advocate the release of any further basic scientific information?

General GROVES. I will comment on that. These were rules that every person in this room could understand. There wasn't anything scientific about them. They were the type of rules, written by people who had intimate knowledge of the project and intimate knowledge of science and engineering, which would guide Smyth in preparing his report. The report was read afterward by a group of several scientists, particularly Dr. Tolman, on whom I placed the greatest confidence, with the rules right in front of him.

Smyth and Tolman both said that these rules were carried out in the preparation of this report. I read the report also. There were some things in there that I couldn't have told whether they met the rules or not. Maybe some of the physicists couldn't tell when you got over in to the chemical field, but in each instance the necessary check was made by the man who did know that particular small phase of the problem who said that it was within the rules.

Now, the chiefs of staff would concur in the rules and then it would be up to the other people to enforce the rules.

Now, to return to your question, Senator.

The CHAIRMAN. I asked you if you advocated the release of basic scientific information.

General GROVES. I advocate personally—I am very much interested in it—the release of all scientific and engineering information which will not be adverse to the national defense of the United States. Now, in putting that on a practical standpoint, I believe that it means almost all of the medical data which we have secured. It means a tremendous amount of what is properly termed "basic scientific information," things that we learn which have no effect on national defense.

The CHAIRMAN. Are you in agreement with the report of your committee, the War Department's committee, who sent us a copy of the letter addressed to you advocating certain declassifications.

General GROVES. That is the Tolman committee. Tolman was the chairman of that.

The CHAIRMAN. I believe it was Oppenheimer, Urey and Compton.

General GROVES. Yes, I know that. That report has been studied by me in detail. It has been discussed with a few of the members, all the members that could be gathered together at the particular time. As a result of that decision, they have given me an additional report explaining a few of the things that were not clear as to just how far they intended to go, and my own reaction to the report is that in general I am very much in favor of adopting every single recommendation that they have made. There are a few exceptions that I am still worrying about, but I would say offhand that 90 percent of their recommendations I am in favor of.

In view of the statements that have been made before this committee, and in the press and in the editorials of the press, repeated time after time, I feel that it is hardly proper for me to release that without authority from above, and I am taking the necessary steps and don't mind saying that I believe that almost everything in that can be released, and it is a question of when. If it were within my hands, I think that I could tell you exactly what I would do, and I think you would know.

Senator JOHNSON. Can it be released soon enough to assist this committee in drafting the legislation that we expect to draft during the next 2 weeks?

General GROVES. I don't believe it would be of any value to you in drafting it, but I would be very happy to give you as a secret document for your use in the committee the report of the Tolman committee with its addendum showing the things that will help you understand it. I would be very glad to have an officer who served as the nonvoting secretary appear with the report and explain to you just what that means, but it would have to be done in executive session.

Senator VANDENBERG. May I ask you a question, General?

In dealing with the United Nations on this subject, we have proceeded on the theory that any arrangement made by the United Nations Atomic Energy Commission will require the approval of Congress. In other words, we are proceeding on the theory that there is not only a general policy factor involved in this matter, but there is also \$3,000,000,000 worth of American property involved, and that in the final analysis the American Congress is the only power that can make a conclusive decision.

Now, you cannot transfer that analogy completely to the domestic situation, but I want to ask you whether you conceive that Congress has any continuing responsibility of any nature in connection with this affair, and, if so, how you would implement that responsibility?

General GROVES. I feel that Congress has a very definite responsibility, and certainly those of us who have appeared before congressional committees are fully aware of that, particularly when we come seeking money.

I feel that the best control the Congress has on any executive activity really is the power of the purse strings.

On this problem I feel that there are many things; for example, take this release of information that I am now faced with. It is a very difficult decision to make, not because I feel personally that it will hurt the national defense, for as I say, 90 to 95 percent of the data I feel could be released. But it is a decision that I don't believe, in view of what has occurred in the past with respect to the Smyth report, I am justified as an executive officer in releasing.

Now, if the President of the United States tells me to release it, then I will assume that he will decide whether it should be referred to Congress or not. Now, I don't believe that it is sound administration to have to refer such a matter to Congress. If this committee should tell me that they were opposed to releasing that information, I certainly wouldn't release it of my own free will.

SENATOR VANDENBERG. Let me be specific about this thing. Would you object to the inclusion in this legislation of the creation of a standing joint House and Senate committee for purposes of consultation and advice with absolutely no executive authority but as a permanent liaison with a right of constant knowledge and information with respect to what the Atomic Energy Commission is doing?

General GROVES. I don't know what the views of the War Department are, but I can state what I personally feel about it. I would not mind that in the least, and I think if I were connected with this in the future I would be very happy to have it. I would certainly, on a matter of this importance and with so much security bound into it, prefer to have one committee with which to deal rather than two.

SENATOR VANDENBERG. Thank you.

SENATOR BYRD. General, could I ask you if you are in agreement with the declaration of policy contained in the McMahon bill, page 2, "A program for the free dissemination of basic scientific information and for maximum liberality in dissemination of related technical information"?

General GROVES. I would say "yes," provided that nothing will be disseminated that in any way will injure the national defense.

SENATOR BYRD. You think it ought to be restricted to that?

General GROVES. I think there has to be some restriction as to the national defense attitude. Now, I don't know just when you came in, Senator Byrd, but I expressed the view that until various people that are handling international affairs and other nations really put this world on a peaceful basis and we know there isn't going to be any more war, this is a military weapon of prime importance.

If there is anything that can be done so that it can be inspected internationally, so that this particular weapon cannot be used in time of emergency, then of course that, so far as atomic energy goes, puts the world at peace. I don't know of any way.

As you know, we have got a group of men studying that particular question right now, and I would prefer not to discuss the tentative stories that have come to me from that committee. All I can say is that I think they are finding that it is not entirely an easy task. I didn't say it is impossible; I don't know, and I would prefer not to say until I get the views of the whole committee.

I was very particular in appointing that committee to see to it that it had on its roster—I think there are nine men on it, approximately—a minimum of three and I think nearer five who are very much in favor of international control.

Senator JOHNSON. What is the specific task, please?

General GROVES. The task is to study the practicability and actually to come up with a plan that is scientifically and militarily possible, you might say really scientifically possible, of how atomic energy programs can be inspected throughout the world so that we can be sure that no one can make a bomb without our knowing about it in ample time.

Senator AUSTIN. Mr. Chairman, I would like to ask the general if what he has said is not in accord with the declaration by Great Britain, Canada, and the United States, that not until after effective security against the destructive use of atomic energy has been set up in working order shall the information be reciprocally exchanged and acknowledged with respect to the constructive use of it?

General GROVES. I am fully in agreement with that, and I think everything I have said is in agreement with that.

Senator AUSTIN. I so understood it.

General GROVES. As a matter of fact, in that statement there was only one word that I would have liked to have seen changed in the whole statement, which is pretty good for me.

Senator JOHNSON. What was the word?

General GROVES. I don't mind saying that, but I would like to have it off the record. I will tell you afterward.

Senator MILLIKIN. General, in view of the many variables in the picture, such as the fact we do not yet know what the international arrangement will be on this subject, and the general uncertainty of the whole subject, what would be your reaction to approaching this on a temporary basis of conserving our military security and of letting out as much as can be left for peacetime civilian use, but with the prime approach being that we are cognizant of the fact that there are so many uncertainties that therefore this is not the time to lay out a long-range program, but that it is the time to make an interim measure.

General GROVES. I feel that the Commission would approach it from that standpoint; any commission which is appointed and thought they were sitting down to settle this thing for all time to come would be an improper commission, in my opinion; they would have to approach this on the interim basis.

Right today we haven't got international peace guaranteed for all time to come, and until that comes or when that does come the position would shift.

Senator MILLIKIN. So regardless of the form of the bill, that in act is what we have to do?

General GROVES. I think that is essential. Now, there has been a great deal of discussion about security. I spoke about that in the executive session in response to your request.

The CHAIRMAN. General, before you go into that, that nine-man committee that you say is working in the War Department I presume is the same committee that was appointed at the chairman's suggestion to the Secretary of War?

General GROVES. Yes, sir, at your suggestion.

The CHAIRMAN. We have had no report from the workings of that committee. When do you anticipate that we will receive such a report?

General GROVES. I would like to ask General Nichols,¹ who is in the room, if he can give me that.

General NICHOLS. They are supposed to have the report to us by March 8.

The CHAIRMAN. And that will be made available to this committee?

General GROVES. It will be made available as soon as I have read it. I would like to read it first to see if there is anything that requires further study and so that they can go right to work on that.

Now, we have again an officer acting as their nonvoting secretary so as to push this thing along and get it at the earliest possible date.

The CHAIRMAN. Thank you.

General GROVES. With respect to security, no one is more interested in having freedom of research. That is essential to scientific advancement; I believe in it thoroughly. I believed in it before this project started, and I believe in it more thoroughly now.

All of the scientists that I know are in favor of it, and the ones to whom I have talked—and particularly those men in whom the experience of 3½ years has taught me to have confidence that their opinions are absolutely sound, are all also very strongly in favor of it. I think we all are. It is almost an axiom.

But until other nations are willing to join us in reciprocal arrangements which will effectively control this problem, we have got to continue in accordance with the announcement at the White House by the President and Mr. Attlee and Mr. King. I think as a nation we must do that.

In other words, we cannot afford to give all the information we have, or any essential part of it—and I am referring by the word "essential" to that which will really aid another nation in doing this work—until such time as we are assured that it will not be used against us. That, to me, of course, means a like assurance on our part that we are not going to have to use it and won't use it.

Senator VANDENBERG. In a word, General, you agree that security must precede disclosure at every stage?

General GROVES. Yes, sir.

Now, I think also I would like to emphasize again that the security rules must be made by the Commission sitting as a commission, and I would like to see that emphasized in the bill.

I think it was in the May-Johnson bill that that was something the Commission could not delegate to the administrator. If it wasn't in there, it should have been, because that is a sound way to do it. I don't think one man should be deciding that, and I don't think one man should have too great an influence on it. I also feel there is nothing that will do more to break down the morale of the organization and the influence of the administrator on the whole organization, and the effective cooperation of the people with whom he has to work outside, such as university and industrial laboratories, than placing on his shoulders the responsibility for drawing up regulations that can have criminal effects, or if not criminal, at least a smear on the reputation of the man who is guilty.

Senator HICKENLOOPER. General, may I ask a question, please?

General GROVES. Yes, sir.

¹ Brig. Gen. Kenneth D. Nichols, district engineer, Manhattan district, Oak Ridge, Tenn.

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Senator HICKENLOOPER. Did you express yourself earlier in the meeting as to whether or not the administrator should be appointed by the President or selected by the Commission?

General GROVES. No, sir, I did not. My own feeling is that I don't care personally much. I liked what I saw in the original bill, that he would be appointed by the Commission, because then he looks to the Commission as his master. If he is appointed by the President, from what I have seen in Washington since I have been stationed here, which has been almost continuously with the exception of 3 years since 1931, there is a tendency at times for people who are appointed by the President to fail to recognize the man's authority for whom they are working, and I believe that the administrator must be the creature of the Commission.

I would have no objection that amounts to anything if the bill should say "We want him appointed by the President and confirmed by the Senate," but I think he is a very important man and he must be of the highest quality. Any man that accepts this position must go in there feeling that he has got a position that will last for a number of years, but I hope not too long, because I think it is a position which is too important to have it fall into the hands of one man and let him continue in that position.

Senator AUSTIN. General Groves, I understand you to mean that even though he might be appointed by the President and confirmed by the Senate, still you would want the recommendation of the man to come from the Commission?

General GROVES. I would like him to feel that the Commission employed him and can fire him. I would think it would be terrible to have an administrator there about whom even a minority of the Commission had doubts as to his ability or had quarrels with, or anything else that would cause trouble.

The CHAIRMAN. General, as to these regulations that you would have this Commission empowered to make, is it your opinion that before issuance, inasmuch as they would be in fact the same as criminal acts, that is, the violation of them would constitute criminal acts, that they should have the approval of the President?

General GROVES. I have no real strong views on that. The only reason that I would prefer not to have them approved by the President is that before they are issued I think it would be just a form for him to approve them. Now, if he would really study them, if he could study them himself, that would be a different thing.

The CHAIRMAN. Of course, we hold the President responsible in fixing his approval on bills involving the sum of \$156 appropriated by the Congress. Doesn't it impress you that before any commission is empowered to issue what might be loosely called criminal statutes, they would like to have the same kind of approval?

General GROVES. I have no real views on it except that I think the President is already overburdened, and for him to review a highly technical regulation which this would be would just be adding to that burden.

Now, as I say, as far as the operations of the Commission go, I have no views on it. I would just hate to see anything more thrown on the President than he has to have on him.

The CHAIRMAN. I personally would rather try to remove from him some of the administrative acts on purely civilian matters that don't

affect the life and liberty of our citizens, and call upon him to fix his approval to something that might send a man to jail.

I am sympathetic with the burden, but I still would like to protect as well as I could the liberty of our people.

General GROVES. As far as I am concerned, I think that is a matter that I really have no views on. It is just a preference, and I wouldn't want you to feel that I really had any feelings one way or the other.

Senator MILLIKIN. General, on what theory do you justify turning over the control of military security, so far as this energy is concerned, to a civilian commission?

General GROVES. I would really like to see—even assuming that the May-Johnson bill were adopted in its entirety now, and even to the point where there is an amendment requiring at least two and not more than four officers to serve as members of that Commission—the Commission directed to submit policy matters to the joint chiefs of staff before action was taken.

I think that is in step with what we in the country all believe in in one form or another, which is unified command. We may not express in just the same way where this command starts to split off, but there must be that unified command. I think at the present time certainly the Joint Chiefs of Staff are the top military command in the sense of being in uniform.

Now, you could say that that should go to the Secretary of War and the Secretary of the Navy, but it wouldn't have any effect. There would be no difference except that the joint chiefs with present membership would give that direct representation, you might say, to the air forces as well as to the ground and sea.

Senator MILLIKIN. At the present time we have a civilian as Commander in Chief, and we have civilians as Secretaries of War and Navy. They are a part of the hierarchy of military control and have definite positions of responsibility in that hierarchy.

The thought keeps nagging at me that we are setting up something entirely new in having an independent outside body entirely controlled by civilians determining the military security and secrecy of this country.

General GROVES. Well, that is why I would like to see this reference to the joint chiefs which, in addition to the chiefs, you might say, of ground, sea, and air, includes the Chief of Staff to the President himself, so that you are getting the representation there of the people who are really unifying the military defense.

Senator MILLIKIN. Isn't that another way of saying that as long as the energy as a military weapon continues to be predominant, regardless of the mechanics we adopt in the bill the military must keep its hands on it?

General GROVES. I think it has got to keep its hands on the part that is necessary for national defense, and that they should be overruled on matters of policy only by the man at the top, the President, who is after all the man who is responsible for the defense of the United States.

Senator AUSTIN. That point is very well taken, I think, and probably should be considered if we consider that unification is to be considered in any such legislation.

General GROVES. There is one bit of testimony that I would like to have you look at in drawing up any legislation, and that is the

testimony by Secretary Ickes when he was talking about the difficulties of operating any organization such as this with all of the present restrictive laws.

Senator VANDENBERG. You mean ex-Secretary Ickes?

General GROVES. I stand corrected, Senator.

I would also like to make the point that my study of the four bills indicates to me the great importance, in actually preparing any bill, of checking the provisions of all four of these bills to see that nothing has been overlooked that should be in. There are important factors in each one of these bills that I think should be very carefully considered before that idea passes by the board.

Senator HART. General, if I may pick you up right there, is it your belief that this legislation which we are attempting to draw up should have very much to say about the patent situation, or is that something that is so involved that perhaps it should be contained in other legislation?

General GROVES. I think that the patent situation should be covered rather briefly in the bill. I think that you know from specific testimony that we have pretty good control of the patent situation. In other words, anything that United States money has paid for, in the development in any way, we have a very good control of. There are certain things, of course, that are invented by people who don't work for us that we haven't paid for, and there we have a problem; but I believe that anything that directs the Commission, or whatever body is set up, to insure that the patent position of the United States is protected at all times should be enough. I didn't need any such direction when I took over, because we immediately put into effect the previous policies that came to us from OSRD, that Dr. Bush had drawn up, and I think we probably went just a little further in this case because it was so essential that no one be able to interfere in any way with our use of any process that we needed to make this thing work.

Senator HART. You mean by that, General, that the Manhattan district found that the patent laws as they were, were entirely workable and suitable for its purposes?

General GROVES. I think they were. There are some problems that we are faced with in the handling of secret patents, and I am not as familiar with patent law as I am with some other things, but in general it revolves around the secret patents. Secret patents were asked for primarily to prevent the possibility of someone later filing a patent on something that we had discovered, and then we would be in the position of having to upset his patent rather than having a definite bar against it.

The possible financial losses to the United States were so great that we felt it was very desirable to protect ourselves patent-wise, and just what the law is on secret patents, how long these patents can be held secret, I am sorry I cannot answer. I think you can get that testimony; certainly Captain Lavender could give it to you.

The CHAIRMAN. We have had him before the committee.

General GROVES. I mean on that particular point. As far as I know, the law is adequate as long as hostilities do not cease. Now, what happens when they cease I cannot tell you.

Senator MILLIKIN. General, do you believe that a civilian commission or a predominantly civilian commission should have the power to tell our military forces how many bombs to make, how many bombs to keep, how to make them, where to keep them, or what to do with them?

General GROVES. No, sir; I think that that would fall into the classification of policy, and would have to receive the approval of the joint chiefs of staff, and certainly if a commission attempted to dictate as to where these would be kept, or anything of that kind, and overrule the wishes of the joint chiefs, I think there would have to be a decision by the President and one that would upset some of the decisions of the Commission.

Senator MILLIKIN. So that legislation on the subject eventually would have to have a view to the military problem of the nature that I have described?

General GROVES. Yes, sir; and I think I read earlier in the hearing my views on how the Joint Chiefs of Staff would come in and would solve that problem satisfactorily. In other words, the joint chiefs would have to have presented to them the policies that affected such matters; in other words, anything affecting the military would have to be approved by the Joint Chiefs of Staff.

It certainly would be something that they would be very vitally interested in if a decision were made to stop producing all active material, for example, because that of itself would definitely limit the number of bombs that might be available.

The CHAIRMAN. General, assuming we had a nine-man commission made up of five civilians and four military men, a part-time commission, would you have the military men vote on questions of peacetime uses and applications of atomic energy?

General GROVES. Oh, by all means. They would be full members of the Commission.

The CHAIRMAN. What special qualifications would you think the military might have to run the civilian end of the matter?

General GROVES. Well, I think I will put it this way: If you try to take the Commission and say an individual member will not vote unless he is a specialist on that problem, you would never be able to get a full vote of the Commission. For example, if a legal matter came up and there happened to be one lawyer on the Commission, he would decide that; and in the same way you might say, "Why should an academic scientist vote when it came to industrial operations?"

It is getting out of his field, but by service on this Commission I feel that all of these men would be broadened tremendously as the years went on, and each year they would have a better viewpoint on the rest of it.

Certainly in the military policy committee, as I said before, when it came to a matter of chemistry, everybody deferred to Conant. If it was a matter of electrical energy, we all deferred to Bush. When it came to something to do with the Navy, we might ask Admiral Purnell some questions as to why that was necessary, but I personally would not dream of telling him how fast a ship could go or how it should go or anything about it. I think that is the general effect of any commission.

Senator JOHNSON. Mr. Chairman, I should like to ask General Groves this question:

I discover an inconsistency in your testimony with respect to the Commission. In the first place, you advocate a part-time Commission; in the second place, you advocate certain members with military experience serving on that Commission; in the third place, you advocate that these military representatives sever all connections with the military.

Now, just how can that be done? If they are part time, they sever all connections with their careers, and then have a part-time occupation; is that consistent?

General GROVES. No; it is not; and I think that the problem is just how that particular thing can be handled if those officers are on the active list. It is very doubtful. I cannot understand quite how an officer who is on the active list, who was made a member, would be able to do the two jobs unless the Secretary of War just said, "Well, when you represent me on this you are not representing me; you are representing the people."

I think the real answer to it is that there will be a tendency to use retired officers on such duty, and officers who have been retired rather earlier than the usual age.

Senator JOHNSON. In that case, of course, they would lose some of their privileges of retirement.

General GROVES. No, sir; not if the bill provided that they could serve in a part-time capacity and still retain their retirement privileges. That was provided for in the May-Johnson bill.

Senator JOHNSON. Yes, but you do not advocate that. You want them to sever all military connections.

General GROVES. If they are retired, of course, they are severed from military connections.

Senator JOHNSON. Obviously, but that wasn't your testimony. You didn't want to restrict it to retired officers. You didn't want to restrict service on this board to retired officers.

What I am trying to get at is that if we are going to use active officers, must we not have a permanent service? You cannot have part-time service and use active military officers and require them to sever their military connections.

General GROVES. I think the primary place where active officers would be more apt to be used would be in the administrative staff and as the administrator or deputy administrator.

When it comes to the Commission, it is very difficult for me to imagine anyone serving as a member of that Commission as an active officer, although I think provision should be there. He might serve for a certain period as an active officer, but I feel personally that the term of office should be long enough so that that officer knows what it is about, for a long enough period so that he will be really useful.

I cannot picture an active officer getting into that position. But I can see certain active officers who could serve on such a commission and represent their own views without any difficulty whatsoever.

I can imagine, for example, if the Surgeon General of the Army should be particularly fitted for such duty, I can imagine his serving a part-time membership on such a commission and not representing the War Department. I think there may be other special cases of that kind.

Senator JOHNSON. What about such a man as Admiral Blandy?

General GROVES. I think that as long as the Navy retains its sea-duty requirements, that would automatically bar a man of that type.

Senator JOHNSON. Would that be advantageous?

General GROVES. Well, I don't know. I think it is advantageous to require them to serve a considerable length of time on such a commission. You could say, of course, "You are only on it 3½ years"; but we grew up with it, and that is entirely different from somebody who comes in now. They won't grow up with it, and they have to start way behind, so that your problem there is whether you can take an officer like Admiral Blandy and say, "You are going to this Commission for 9 years, and that means you cannot have any more sea duty, or you can only have sea duty when you are not serving on this Commission." I don't think the admiral can have a position where he has to leave his command every month or possibly every 2 months, or more, which is not controlled by the best interests of his command.

Senator JOHNSON. Will this Commission have a tremendous amount of work?

General GROVES. I don't know how much they will have. I think they will have a considerable amount initially, because after all they have got to study it. I think any new member will have a considerable amount of work, but I cannot picture their spending full time on it.

Senator JOHNSON. It wouldn't be like the Interstate Commerce Commission, where applications pour in every day in such volume?

General GROVES. No, sir; because I think those applications would be decided on a policy basis. In other words, they would adopt a policy, and then when the application came in on anything that had to be passed on by them it would be a simple matter to say it either falls within our rules, or doesn't. There is nothing such as the Interstate Commerce Commission has, for example.

Senator JOHNSON. Nor the Federal Power Commission?

General GROVES. Nor the Power Commission, with its multitudinous number of applications.

Senator JOHNSON. Or the Federal Trade?

General GROVES. No, sir.

Senator JOHNSON. The decisions would be few and at greater intervals after the initial work?

General GROVES. After the initial work. I think that if any one moved into this who had not already been in it, I would advise him to spend at least 3 months just finding out what he could; that would mean three solid months of very strenuous effort. Then I think, depending on his background, he would move in and then spend much less time.

I think if you should have somebody on it like Dr. Bush, for example, he would not have to do anything of that kind. He could start right in on a part-time basis except for the drafting of the initial regulations on security, which I picture would take quite a time.

Senator HICKENLOOPER. I assume that what you mean by the fact that it would not take too much time for the Commission, or that it would take full time, means that the Commission would write policies and the administrator and his staff would then carry out the details of the administrative activities and the issuance of licenses, the checking, and all that?

General GROVES. As I see it, the administrator would take care of the administrative details. Now, we contemplate that his administrative duties will divide really into two classes: those of operating the existing organization as it may be reduced, and those of handling the outside contacts. For example if a university wishes to go into research work and wants to get a certain amount of enriched material, which of course has a high value, he would in that department of his activities make the necessary investigation to get all the papers together, and then he would present to the Commission the story of that university: "They can meet our policy requirements on security; they meet our policy requirements on really putting some effort into this thing; they are not just getting it so they can stay in the swim and say, 'Oh, yes; we have a department in nuclear physics.'"

In other words, he would present to them the story either with the statement that it meets all of their policy requirements or meets all the policy requirements with a few exceptions, and these exceptions are such and such, and I think they can be handled in such a way.

Then the Commission would have to decide it. They would also, perhaps, have to actually have appear before them the representatives of any such institution if they were going to decline.

Senator HICKENLOOPER. Would that view be compatible with freedom of scientific research? In other words, is it your view that the Commission should screen applicants, let us say, colleges or universities rather carefully, and have some rather rigid standards before they would be permitted to go into this field by the Commission?

General GROVES. Before the Commission gives them Government material, I think they should meet requirements that will insure the best interests of the United States.

Senator HICKENLOOPER. In your view, should those requirements go beyond just a rough outline of a reliable institution, that is, from the standpoint of reputation and history, a reasonable showing that they seriously want to investigate this field, and a reasonable assurance or reliance that they would maintain adequate security and not use it for subversive or destructive purposes?

General GROVES. That would be my idea.

Senator HICKENLOOPER. And then give them more or less free leeway where if they want to go into the field of atomic research as an original study, or if they want to enlarge or want to experiment in that field, they may do so.

General GROVES. You see, the only problem that comes up that is going to be very difficult—and I am sorry for the administrator if he has to decide it—is what to do with the enriched material that the Commission may decide—as a certain percentage—may be loaned to educational institutions for research work. There won't be enough to go around, and somebody has got to decide which institution gets how much. It isn't enough to say, "We will divide it," because they have to have a certain amount.

Senator HICKENLOOPER. Well, to illustrate a little bit more clearly, perhaps, my thought in this matter, I have in mind a very small college that has not been very well financed. It has been struggling for a number of years, and yet in that situation one man in that college some years ago went into a highly specialized field and today this little poverty-stricken college probably has the most extensive department of that particular kind, small as it may be, in the United

States. It is an extremely valuable department—and of course this department does not compare with nuclear energy, or anything of that sort, but it is an outstanding department.

If regulations were somewhat restrictive, it would be very easy for me to envision some commission saying to this college, "Oh, you are a little one-horse college; you have no finances; your equipment isn't very good; we will deny you the right to go into this field."

Now, it is entirely possible that many small institutions perfectly reliable in their history and their intentions might under too restrictive a policy be barred from investigating this field and thereby impinge upon the freedom of academic research.

General GROVES. I don't think there should be any restriction on any academic research unless such restriction is essential to the national defense or unless such research demands or requires Government support.

If it requires Government support, I think it is the duty of the Commission to decide that the Government is getting the best return on its money. If it is a case of something impinging on national defense, I think that would come about by a sudden discovery and nobody can tell what that might be; for example, what we all feared in the early days, that Germany might have a "bathtub" method of separating U-235. The more we studied it, the more we learned about it, the more we felt that the bathtub would get pretty complicated; and we now believe, I think most people, since we have investigated a great many of those "bathtub" methods and they are always disappointing, they are fine in theory but when you start to work them you do all the separation and when you get through you cannot tell that you have separated anything. We haven't been able to find a method yet, but that is a thing that might happen.

For example, if someone should achieve the thing that people have dreamed of since this started, of getting atomic energy out of a common element, I think if that came up and it was discovered in a small college or in any college, the Commission should immediately be able to control that situation until somebody else moved in and could control it.

In other words, I don't believe that if we make some startling discovery in a college laboratory that that should necessarily be published if it is going to upset our national defense as completely as any such discovery as I have described will do. I don't think they will discover that in my lifetime, and I am not worried about it; but at the same time, it is perfectly possible. After all, lots of things have been discovered in our lifetime that we did not know about when we first started to walk on the ground.

Senator HICKENLOOPER. I think it is perfectly logical to say that the Commission should keep very close supervisory knowledge and control over the results of research to see that those results of research are not used to the point of endangering our national safety.

I think that could be done without destroying the freedom of basic research.

General GROVES. I think it can be done that way.

Now, for example, you are familiar with our laboratory at the Argonne. You have been told about it, and there we are now trying, and have actually drawn up, proposed regulations and a system of establishment which will put that laboratory on a basis where it will practically have free and open research. The only requirement that

we hope to have in there is that if at any time we decide that certain work going on there should be secret, we have the right then to ask the man to continue on a secret basis or to abandon the work and turn it over to us. That probably will be the only limitation on the use of that Argonne laboratory by the colleges and universities not only of the Middle West, but for the time being of the entire United States.

Senator HICKENLOOPER. In other words, the restrictions would apply to the application of the results of research rather than restrictions on basic research itself?

General GROVES. Yes; and that is not hard to do if you have cooperation and general good feeling among all concerned, and we have had that with the laboratories, despite what you read in the papers, right straight through this project.

We don't know all of the people that work for us. After all, our direct pay roll ran to a total of 539,000 people, and obviously I didn't know them all. But the leaders were known, and the relationships, at least as far as I was concerned, were entirely satisfactory and quite happy.

The CHAIRMAN. Wasn't that your indirect pay roll, General? Wasn't your direct pay roll around 200,000?

General GROVES. That was the pay roll of people who worked directly for us, either on our own pay roll or on fixed-fee contracts. It did not include such things as manufacturers who made parts for us on a unit-price basis.

Senator MILLIKIN. General, if this were an energy that were a purely military energy we would have no problem here at all, would we?

General GROVES. No, sir.

Senator MILLIKIN. So we have two things that we have to watch in this bill: One is to encourage science as far as consistent with military security—abstract science and applied science; and the other is to encourage so far as we can, consistent with military security, the commercial and peacetime uses of this energy. Both of those things are subordinated at this present state of affairs to our military security. Is that not correct?

General GROVES. That is correct.

Senator MILLIKIN. And any bill which correctly protects and properly proportions its emphasis according to those things would, generally speaking, be a satisfactory bill, would it not?

General GROVES. Entirely. I would like to add there that I personally believe that we are going to get some peacetime benefits from atomic energy. How much, I don't know, and no one else knows. We are certain that there are going to be many benefits in the medical field, particularly in diagnosis; and as to the benefits from a power standpoint, we really don't know, and no one else knows. We can draw up theories; we can prove it on paper, and you can get any answer you want to. But the problems involved are tremendous and it is going to be, unless a tremendous amount of money is poured into it, a long time before that development reaches anything that becomes commercial.

Senator MILLIKIN. But we should put out as much scientific information as is possible, consistent with military security. We should do everything that we can to encourage these peacetime uses of the energy, consistent with military security. The overriding pre-

dominant thing at the present stage of the business is our military security.

General GROVES. Yes, sir.

Now, another point is: Why has the Manhattan project done certain work on what you might say are peacetime applications? We have done that for two reasons: First, because in doing it we felt that we would be increasing our knowledge which would enable us to do a better job on the military end of it. That was the real justification. We have also had the secondary consideration that we felt that we were carrying on what would eventually have to be done, and it might turn into something of value for peacetime uses; but certainly with the appropriations as they were made for military purposes, the only justification we would have in the past in our appropriations was to carry it on for the military advantages.

The work that has been done in peacetime applications has all been done with the idea that that increase in knowledge would enable us to do the military job better.

Senator HICKENLOOPER. On that point, as I see it now, General, is there any possible reason why basic research in the atomic energy field should demand that it be given strictly military secrets of the making of the bomb in order to aid that research?

General GROVES. No; and I think that except in one way the more that a scientist knows in his own field and related fields, the better job he can do. But I think in this case the military security overrides that, so that we are in effect decreasing, perhaps, in some instances, his ability to do his best work in his scientific research, because there are certain things he doesn't know that if he did know he would be able to do better. It is just as if suddenly the things that we did might be of value—I am not saying they are—for example to the steel manufacturers; but if they are vital to our military security, the manufacturers have to get along without them or have to find it some other way.

The CHAIRMAN. General, one of the greatest achievements for military security would be the devising of an invention of defense for the atomic bomb.

Now, you have just stated in effect that the compartmentalization of it, due to the necessity for military security, would decrease scientific achievement and advancement. I rather take it that any such proposal would commensurately and proportionately decrease the chances of devising a defense to the atomic bomb.

General GROVES. I don't think so, except very indirectly. It is hard to speak of how to devise something that nobody has yet figured out even the slightest indication of how to do, but the only thing that appeals to anyone is to shoot this thing down in the air, and that means stopping anything that comes through the air. That really does not depend on what is in it or anything about it.

The CHAIRMAN. Yes; but logically, General, it strikes me that you cannot escape the conclusion that since unfortunate restrictions that might have to be placed on this thing for military security might obviate any chance of getting the greatest security of all, which would be a defense for it. You say to me that none has been thought of and none has been suggested. I grant you that is true, and up until 1939 nobody thought this thing could be done.

I cannot see how you can escape the conclusion that the restrictiveness applied under what you term the necessities of military security

would very much prejudice our chances, small though they might be, for getting a defense.

General GROVES. I couldn't agree to very much prejudice. I would say they might possibly prejudice, but not very much.

The CHAIRMAN. It is a very important consideration.

General GROVES. Now, I think that really when it comes to military security and the relative advantages of giving out information and not giving it out, what we are interested in from the military standpoint is the relative movement, you might say, of ourselves and other nations. It isn't so much how fast we progress; it is the relative motion of the two.

The CHAIRMAN. General, I have just two questions more, if there are no further questions. I don't want to interrupt.

The first question is this, General: Would you tell us what year you graduated from West Point?

General GROVES. 1918, November.

The CHAIRMAN. And you were commissioned a second lieutenant.

General GROVES. That is correct.

The CHAIRMAN. When were you commissioned a first lieutenant?

General GROVES. May 1, I think, 1919.

The CHAIRMAN. And then a captain?

General GROVES. October 1, 1934.

The CHAIRMAN. And then a major?

General GROVES. I think in July of 1940.

The CHAIRMAN. And then a lieutenant colonel?

General GROVES. I was commissioned a temporary colonel on November 12, I think, of 1940.

The CHAIRMAN. And then your next promotion?

General GROVES. Then I was made a brigadier in September of 1942, and sometime after that I was made a permanent lieutenant colonel.

The CHAIRMAN. And that is your rank now?

General GROVES. Permanent rank. Then I was made a temporary major general in 1944, I think.

The CHAIRMAN. Now, General, between 1919 and 1934, just selecting at random when you were a first lieutenant, what was your principal work?

General GROVES. My principal work from then, besides going to school—I have been going to school since I entered college for 10 years. I have one degree. I don't have any of these doctor's degrees, but I have had 10 years of collegiate and above. During that time I was either a student or a company commander, with the exception of 2 years when I was assistant to the district engineer at Galveston primarily on construction work and general management, and 2 years in Nicaragua.

The CHAIRMAN. Your first experience translating engineering into science has been in connection with this project, has it not?

General GROVES. No; I had 4 years in the Office of Chief of Engineers, a little less than 4 years, from 1931 to 1935.

The CHAIRMAN. What was your rank then?

General GROVES. I was a first lieutenant and a captain. Of course; you know the reasons for rank.

The CHAIRMAN. I don't quarrel with it, General.

General GROVES. I did, a great deal.

The CHAIRMAN. I think it is important that it be in the record.

Now, just one final question.

Senator MILLIKIN. The chairman has demonstrated how fast you learn, General.

General GROVES. I didn't answer your question completely. From 1931 to 1935 I was in the Chief of Engineers Office in charge first of procurement and development of new equipment, and in the last year in charge of the supply division, which included this subbranch of development of equipment.

Senator JOHNSON. I think it should be said, Mr. Chairman, in connection with the promotions that in the first years of the general's service we did not have the automatic-promotion formula that we now have, and that officers had to wait for a vacancy in the next grade, and that there were bottlenecks. They had what the Army calls a "hump," and so the promotions were very far and few between in those earlier years.

The CHAIRMAN. General, you are familiar with the letter addressed to me by the President of the United States on February 1, 1946, in relation to the atomic energy legislation?

General GROVES. I have read it. I don't recall the exact details of it.

The CHAIRMAN. The President stated:

The Commission established by the Congress for the control of atomic energy should be composed exclusively of civilians.

You find yourself in disagreement with that.

It is essential that the members of the Commission be full-time Government employees.

You find yourself in disagreement with that.

In the President's message of October 3, which he quotes, he said:

Our science and industry owe their extent to the spirit of free inquiry and the spirit of free enterprise that characterizes our country. This is our best guaranty of maintaining preeminence in science and industry upon which our national well-being depends.

Legislation in this field must assure genuine freedom to conduct independent research and must guarantee that controls over the dissemination of information will not stifle scientific progress.

I take it you are in agreement with that statement?

General GROVES. Yes, sir.

The CHAIRMAN. Thank you very much.

Senator HICKENLOOPER. General, I just want to make clear my understanding that you did not volunteer or urge this appearance on your part today, did you?

General GROVES. No, sir.

Senator HICKENLOOPER. You came at the specific invitation of the committee to express your personal views and at the urging of the committee, did you not?

General GROVES. Not only at the invitation of the committee, but at the order of the committee.

The CHAIRMAN. I think that should be in the record, Senator Hickenlooper, for the General's protection.

Senator HICKENLOOPER. I thought it was going to be in the other day, but it apparently isn't.

The CHAIRMAN. Thank you.

(Thereupon, at 12:10 p. m. the committee recessed.)

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ATOMIC ENERGY ACT OF 1946

HEARINGS

BEFORE THE

SPECIAL COMMITTEE ON ATOMIC ENERGY

UNITED STATES SENATE

SEVENTY-NINTH CONGRESS

SECOND SESSION

ON

S. 1717

**A BILL FOR THE DEVELOPMENT AND CONTROL
OF ATOMIC ENERGY**

PART 5

APRIL 4 AND 8, 1946

Printed for the use of the Special Committee on Atomic Energy



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III

ATOMIC ENERGY ACT OF 1946

THURSDAY, APRIL 4, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to call, at 10:30 a. m., in room 104-B, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Byrd, Austin, Millikin, Hickenlooper, and Hart.

Also present: Dr. Edward U. Condon, scientific adviser to the special committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. The hearing will come to order.

Mr. Warren, there are certain proposed provisions of S. 1717 for the operation of this Commission which bear upon the Office of the Comptroller General and your duties. Most of them might be termed of a relieving nature, as I don't doubt that you have noticed.

The committee would be glad to hear such comments as you wish to make on the provisions that pertain to your jurisdiction.

STATEMENT OF LINDSAY C. WARREN, COMPTROLLER GENERAL OF THE UNITED STATES, ACCOMPANIED BY FRANK L. YATES, ASSISTANT COMPTROLLER GENERAL OF THE UNITED STATES, AND EDWIN L. FISHER, ACTING GENERAL COUNSEL, GENERAL ACCOUNTING OFFICE

Mr. WARREN. I appreciate the invitation to appear here this morning.

Senator BYRD. Mr. Chairman, may I interrupt to suggest that I think Mr. Warren ought to discuss, too, the provisions on page 8 with respect to—

The Commission may make such arrangements without regard to the provisions of law relating to the making, performance, amendment, or modification of contracts—

et cetera; also pages 10, 14, and 16 in relation to each other, and then discuss page 39.

The CHAIRMAN. You may proceed, Mr. Warren.

Mr. WARREN. Gentlemen, until yesterday I personally had never seen or heard of the provisions on page 8 or on page 39 of this bill.

It is not necessary for me to remind you that the General Accounting Office as well as the Comptroller General is an agent of the Congress. We are entirely disassociated from the executive branch of the Government, and that view was reaffirmed by the Congress with

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the passage of the recent reorganization bill which provided that the Comptroller General of the United States and the General Accounting Office are a part of the legislative branch of the Government. Therefore, except for the friendly interest of Members of Congress who believe in responsible fiscal accountability, naturally we would have no way in the General Accounting Office to know of provisions such as this. The General Accounting Office in my opinion is the last great bulwark in this Nation for the protection of the taxpayers against unbridled and illegal expenditures of appropriated funds, and it is therefore peculiarly the office of the Congress.

I am unalterably opposed to the provisions carried in subsection 10 on page 39. An analysis of it will show you and will convince you that it is a mockery and a fraud, and if it should become a law in this form—and I have been called upon many times in the past to express myself on it—in all candor I would have to use these same expressions. It is utterly meaningless and would constitute an unwarranted waste of appropriated money.

The CHAIRMAN. Which section are you talking about?

Mr. WARREN. I am talking about subsection 10 on page 39.

The CHAIRMAN. You mean the whole section?

I understood you to say the latter part of it.

Mr. WARREN. Well, you would have to consider the section as a whole.

In the first place, it says that this Commission may—

(10) determine its own system of administrative accounts and the forms and contents of its contracts and other business documents.

Senator BYRD. Mr. Warren, could I ask you a question there?

It was stated to the committee yesterday by one of the associates of the committee that these provisions have been agreed to by the assistant general counsel of the Comptroller General's Office. Is that correct?

Mr. WARREN. Senator, that is absolutely incorrect. He is here today. Mr. Fisher is acting general counsel. Mr. Ellis is one of my administrative assistants. They are two of the ablest men that we have in the General Accounting Office. They have my full confidence, and they tell me that never, directly or indirectly, did they agree to any such provision as this, which is contrary to the entire policy of our Office.

One of the primary purposes of the General Accounting Office is to establish the accounts and forms. We do that for every agency of this Government, and this question is therefore pertinent: Why should it not be done in this case? What is there in this that would call for this Commission to set up its own accounting system and its own forms?

It says here:

The Comptroller General shall audit the transactions of the Commission and within 6 months after receipt of each voucher shall file a report with the Commission with respect to each accountable officer showing each action to which exception is taken pending further information and each action which after full examination would have been disallowed except for the provisions of this paragraph.

If that were required, it could be done without this language if we had anything to do with the audit of it.

The expenses of such audit shall be paid from appropriations for the General Accounting Office and in conducting such audit, the Comptroller General may use personnel of his own selection and shall have free and open access to all papers, books, records, files, accounts, plants, warehouses, offices, and all other things, property, and places belonging to or under the control of or used or employed by the Commission * * *

We have all that authority anyway. That doesn't mean a thing, unless you want to restrict certain information from us by excepting access to the information restricted.

The CHAIRMAN. That is the purport of the language, isn't it, Mr. Warren?

Mr. WARREN. Well, I don't so construe it there, unless that is the sole reason for it. But I will get to the restriction in just a minute. [Reading:]

and shall be afforded full facilities for counting all cash and verifying transactions with and balances in depositaries * * *

We would have that right under existing law.

Senator MILLIKIN. You missed some significant words there:

except where access to information restricted under section 10 would be involved * * *

Mr. WARREN. I mentioned that. [Continuing to read:]

but, notwithstanding the provisions of any law governing the expenditure of public funds, the General Accounting Office in the settlement of the accounts of the Commission or any accountable officer or employee of the Commission, shall not disallow credit for, or withhold funds because of, any expenditure which the Commission shall determine and certify to have been necessary to carry out the provisions of this act.

Of course, gentlemen, that is the joker. They could do anything on the face of the earth, practically, and the Commission would then decide it was all right. You provide for an audit all the way down, and at the very end you say that regardless of what you found in the audit, the Commission can upset everything that you have done.

The CHAIRMAN. Mr. Warren, may I ask you a question?

Mr. WARREN. Certainly, Senator.

The CHAIRMAN. You quote this clause in line 10:

or withhold funds because of, any expenditure which the Commission shall determine and certify to have been necessary to carry out the provisions of this act.

Now, as I understand it, under the law, after you disallow the accounts of any disbursing officer, you can file a notice with the Treasury of the United States to cut off further payment of funds to that department.

Mr. WARREN. We could do that; yes.

The CHAIRMAN. That is within your power.

Mr. WARREN. Yes.

The CHAIRMAN. Now, I presume that you are aware of the facts—or I should say I presume you may be, for maybe you haven't been informed—that from a scientific and engineering standpoint it is absolutely necessary that some of the operations of this Commission be not interrupted for 1 second.

Mr. WARREN. Correct.

The CHAIRMAN. The managers of the projects have told us that time and time again, and Senator Hickenlooper, who made a special trip to Hanford at my request, when he was on the west coast, came

back and emphasized that more than any one thing it had to be a continuous operation.

So it would be rather unfortunate if there was in the hands of any office outside of the Commission the power to withhold funds and thereby close off operations.

Mr. WARREN. I may surprise the committee when I tell you that we were in on the atomic secret from the very beginning. There were confidential conferences between the Under Secretary of War, at that time Judge Patterson, and General Groves, the Assistant Comptroller General, and myself. We have audited or are auditing every single penny expended on this project, and that was in wartime. We had our men passed on by the FBI within the enclosures and compounds of these two projects. We audited on the spot and kept it current, and I might say it has been a remarkably clean expenditure.

I have had no conversation with General Groves in several months. I will say, however, that he has personally thanked me and other officials of the General Accounting Office several times for our fine cooperation, and I understand that in a public speech here in Washington, before a group of scientists, he expressed high commendation of the work of the General Accounting Office.

We gave one quick favorable decision on a matter that was presented on this project, but the very fact, gentlemen, that our men were there where the agents of the Government could consult with them time after time assured, in my opinion, a proper accountability.

I would suggest if you have any doubt as to this cooperation that you might ask General Groves, because I will say this for him: From the very beginning he has insisted upon a full audit and a full accountability to the General Accounting Office.

Now, if that went on in war, if we passed upon \$2,000,000,000 of these expenditures in war, I cannot see the argument as to why they should not be audited in peace.

Senator MILLIKIN. Mr. Chairman, I must say that that comes to me as an astonishing piece of good news.

I have often wondered what would turn up when we did get into that 2½ billion-dollar expenditure. By that remark, I do not mean to disparage anyone connected with the operation, but I often wondered how, without the kind of control that you give, they could go through with an operation of that magnitude without making some very bad blunders.

Mr. WARREN. Senator, as far as the General Accounting Office is concerned, we carefully picked our men. We sent the very best we had there, and I invited the inspection of those men by the FBI. They were ever present on the job.

Up to the present time, we have audited 100,265 vouchers on that project.

Senator MILLIKIN. How many?

Mr. WARREN. 100,265 vouchers on that project, totaling \$1,778,000,000. They have been given a most thorough examination to determine whether the expenditures have been properly accounted for, pursuant to applicable laws, Executive orders and regulations.

There only remains to be audited on both projects \$48,000,000, and that is all under way now.

Senator MILLIKIN. May I ask how many men were actually in on that audit?

Mr. WARREN. Twenty-three.

Senator MILLIKIN. They were all examined by the FBI?

Mr. WARREN. Absolutely.

Senator MILLIKIN. At your request?

Mr. WARREN. At my request, and it would be my purpose, if we have anything to do with this, to keep this audit current, just as we did in wartime, and have our men of the same high type and right on the project.

Senator MILLIKIN. By keeping it current, you mean there would not be any backlog of unresolved questions, and by that method there would not be the delays and the possible discontinuity of some operation that would have to be continuous through its very nature?

Mr. WARREN. When you say "current" in the Government, you mean anything from 60 or 90 to 120 days.

I can say with great positiveness to this committee that we will do this in 30 days from the receipt of the vouchers, if we have our own men right on the project, as we would do.

Senator MILLIKIN. Do you ever have in your operations what might be called an interlocutory opinion? Suppose that Senator Byrd were the head of some Government agency and he had to do something under the nature of his job and yet was in some doubt as to whether what he had to do would be approved. Under the circumstances, he could not wait to have it approved. Do you ever give a sort of preliminary, informal interlocutory opinion on that?

Mr. WARREN. I wouldn't say that it is so much informal, but that is a part of our duties under the Budget Accounting Act, and we strive to give these opinions to department heads and agency heads within 10 days; sometimes we do it within a day.

Senator MILLIKIN. That is independent of whatever delay there may be in routine matters that come into your office?

Mr. WARREN. Absolutely; that has precedence.

Senator MILLIKIN. That is what I mean.

The CHAIRMAN. Now, getting back to the question I asked you, Mr. Warren, do you think it would be wise to have in the hands of anybody, in view of the situation I have described to you, the power to withhold funds that would shut down the operation of the manufacturing plants which, if shut down, might cause the Government untold damage?

I am quite sure that if you were there—or any of your associates—it would be treated reasonably, but, of course, you know we do not legislate on that basis.

Mr. WARREN. Well, if you will let me say this: I think that is a very far-fetched question, because, of course, we have never closed down anyone. We have never, so far as I can find out, and certainly not in the 5½ years that I have been Comptroller General, hindered the operation of anything.

If an expenditure was absolutely illegal, then I would be utterly failing in my duty to the Congress if I did not challenge it.

Senator BYRD. On what ground would you challenge an expenditure?

Mr. WARREN. Well, if it was absolutely illegal.

Senator BYRD. On any other ground?

Mr. WARREN. No; I cannot challenge waste or extravagance; that is entirely beyond my scope. I cannot do that; I am not permitted to do that. It is only an illegal expenditure.

Senator BYRD. In other words, it is your duty as the representative of Congress to see that the expenditures are in accordance with the terms of appropriation bills?

Mr. WARREN. And the contracts.

Senator HICKENLOOPER. In other words, you are not to question administrative discretion provided the money is being used for the purposes provided in the statute?

Mr. WARREN. Absolutely. We have no more to do with the administrative end of it than the man in the moon, and we would not have anything to do with it.

Senator HICKENLOOPER. Well, I presume you test the administrative end to see whether it is being administered in the field set out by the statute, but you do not have any jurisdiction over administrative discretion within the field outlined by the statute for the expenditure of those moneys?

Mr. WARREN. None whatever; nor would I permit such a thing if it were attempted.

Mr. YATES. As to the two phrases "shall not disallow credit for" and "withhold funds because of," I think it might be well, Mr. Chairman, to explain a little more in detail what those two things mean in our operations in the General Accounting Office.

The CHAIRMAN. Before you do that, I would like to make this comment, Mr. Yates. I have never talked with the War Department or any representative of it as to their relationship with your office during the period of the operation.

The same provisions that are in here appear, I believe—it is a long time since I have checked it—in the May-Johnson bill which was born in the War Department.

I don't make that as an assertion of fact, because I have not checked it in a long while, but that is my impression, and I just wondered if, in view of your experience, you could tell us why they do it that way?

Mr. WARREN. May I answer that?

The CHAIRMAN. Yes; I would like some information on it.

Mr. WARREN. You are correct, as I now recall, that similar language was in the original bill. Two members of the majority, including the chairman of the House committee, and two members of the minority called me about that provision. They said that they were absolutely opposed to it, and we told them the same thing, although their prohibition was contained in about six lines rather than a page, as here.

The CHAIRMAN. This is just as effective, I take it?

Mr. WARREN. I would think so, without looking it over here now. They asked me if I would propose some other language, and I proposed the following:

Notwithstanding the provisions of any other law governing the expenditure of public funds, the General Accounting Office in the settlement of the accounts pertaining to the operations of the Commission may allow credit for any expenditure shown to have been necessary to carry out the provisions of this Act.

Now, that leaves the law just as it is, but puts the discretion in the Comptroller General rather than in the Commission, because then Congress has a target to shoot at if there is anything wrong. You would never find anything, you would never hear anything, about the

Commission handling these. But if I should do anything wrong, then I am subject to removal or impeachment, and you have got it centered in one person—not that I want that authority. Instead of leaving that discretion in the Commission, under this language you could leave it in me.

I understand that the House committee tentatively adopted this. Now, I was further informed—subject, of course, to being corrected—upon high authority in the House committee that the War Department itself suggested that all reference to the General Accounting Office be completely eliminated from the bill, and that is the way it stands now over there, which, of course, leaves us to audit just as we did during the war.

The CHAIRMAN. Well, that certainly is an interesting situation. I was informed that the committee that drew the original May-Johnson bill gave great consideration to that. In fact, that is what first started me thinking about this, because when the bill was originally introduced we did not have a section pertaining to the General Accounting Office, and on a comparison with the May-Johnson bill I saw that that was there and did a little investigating. It seems to be a very strong point with those who drew the May-Johnson bill that they wanted this language in there.

Now, of course, you have tentatively offered this suggestion to put the discretion in the Comptroller General instead of in the Commission. That is an interesting suggestion, Mr. Warren, but I frankly cannot see how the Government's interests would be better protected by having the discretion in the reviewing officers rather than in the people that must actually do the day-to-day operation, because they are removable by impeachment, too, for malfeasance in office.

We have, I might say further, a joint congressional committee provided for in this bill which, under the terms of the act, is to keep in very close touch with the Commission, and I imagine that committee will be doing a little reviewing on its own account.

Senator BYRD. They wouldn't do any auditing, would they?

The CHAIRMAN. As far as the Commission is concerned, Senator.

Mr. WARREN. I didn't want that myself. That was drawn at the suggestion of some members of the House committee. I think that is all right, but personally I do not want it.

The distinction is this, Senator: The difference lies between an examination by those who spend the money and one by an independent agency looking over it which is not responsible under the executive branch of the Government but is responsible to the Congress itself.

Now, there is a school of thought in the Government that is violently opposed to any audit, that is violently opposed to any fiscal accountability to anyone but themselves. That is true. And no one knows that any better than the Senator from Virginia, and the great fight in Congress here within a year, in the passage of the Byrd-Butler-Whittington bill, which in my opinion was the most forward step in fiscal accountability the Congress has taken in the last 25 years.

But resistance from certain forces, as Senator Byrd knows, was ever present in every possible way.

Senator BYRD. It took us 5 years to get it through.

Mr. WARREN. Now, I am not using extreme language, and I merely ask you to believe me when I say this from experience. The language in subsection 10 is an absolute fraud and a joke and means nothing whatever.

The CHAIRMAN. The only correction that I would make of you, Mr. Warren—and I did not write that subsection—when you denominate it as a fraud is that that has the connotation of intent to deceive. Now, I think you would agree with me that it would be a bold spirit indeed that would write language that is so obviously fraudulent as you denominate this to be, with the hope that it might get through 535 Members of Congress.

Mr. WARREN. Senator, I have seen language like this submitted.

The CHAIRMAN. You take out the intent to deceive?

Mr. WARREN. Well, you know what I am talking about, but I have seen language like this proposed time after time, and it is proposed deliberately. I don't know of any other way except to say that it is proposed to deceive. I don't know of any other way to express it. It is to break down these controls.

Now, the whole position of the Congress in the last year has been to draw back and to vote back controls where they have been let down to see that they are now safeguarded in accounting. That was done in the Butler-Byrd bill.

The CHAIRMAN. Mr. Warren, there is a provision in the bill or in this suggestion for a complete audit by your Office?

Mr. WARREN. Yes; but what does that mean, Senator? It means that we would spend thousands, maybe over a hundred thousand dollars. Say that we do audit. Then, whatever we find, the Commission will say, "Oh, well, we are paying for that."

The CHAIRMAN. If you find any crooked business going on, I presume you would report it to the Congress, would you not?

Mr. WARREN. Well, this doesn't even provide for a report to Congress. I won't quibble on that.

The CHAIRMAN. I would assume you would.

Mr. WARREN. I have a right to do it, anyway.

The CHAIRMAN. That is right.

Mr. WARREN. Now, you want me to be frank, I know.

The CHAIRMAN. I am working for information.

Mr. WARREN. With all due respect, because I have the greatest respect for the Congress, since I was a Member of it for 16 years, we are very discouraged about the reports that we send to Congress. That is part of my duties, to report to Congress, and no matter how flagrant some of the things are we do not find that we ever get any results.

I think one of the reasons for that is that there is no special committee that these reports go to. Right now, the House is showing a little interest in holding some hearings on some reports, but I have been sending reports to Congress for 5½ years, and I do not get any encouragement.

The CHAIRMAN. Do you hand them to the press, too?

Mr. WARREN. No, sir; but they are published. They are printed up here.

The CHAIRMAN. You mean they are available to the press?

Mr. WARREN. Yes, whenever you have them printed.

I might say that last year I sent to Congress 14 reports required by law. There were 148 reports sent up that I prepared that were requested, and I also sent up 32 recommendations.

I sent to the Congress or to committees of Congress approximately 300 to 400 reports on extravagance, and that was the end of it. Of course, I cannot stop extravagance, but I am talking about the reception you meet in Congress.

Therefore, when you say that we come in and just report to Congress when you are going to audit \$2,000,000,000, of course it is meaningless.

Our position is that if you gentlemen in your wisdom and discretion think that we should have nothing to do with this, I very strongly urge you and recommend that it be specifically stated in here.

If you want us to have anything to do with it, then section 10 should be eliminated entirely. If we have anything to do with it, we will go along just as we have during the war, in auditing these accounts. But please do not let any such language as subsection 10 stay in the bill, gentlemen, because it means absolutely nothing.

Senator BYRD. Mr. Comptroller, you have full power to audit every department now?

Mr. WARREN. That is correct.

Senator BYRD. Including the corporations, including the TVA?

Mr. WARREN. That is correct.

Senator BYRD. That is the complete power that was covered by the Byrd-Butler-Whittington bill, so this would be the first department of all the agencies of the Government, as the laws now exist, that would not be subject to the kind of audit you think it is necessary to make?

Mr. WARREN. That is correct.

Senator BYRD. Now, you have the same power to withhold an appropriation from the War Department?

Mr. WARREN. That is correct.

Senator BYRD. You have it from the Navy; you have it from every branch of the Government, and I am unable to see why any injury to the service of the Government would occur by extending the power to this operation.

Mr. WARREN. Senator, that is a specious argument advanced by those who are opposed to any audit. It is nothing new with us. We hear the same argument. We heard it on the corporations, as you well know.

The CHAIRMAN. Mr. Warren, I do not want you to misunderstand your appearance here this morning. We are frankly looking for information.

The basis of it is in the War Department prepared bill, the so-called May-Johnson bill. I cannot emphasize that too much, because it came out of the Department which you state—and I don't doubt your statement—had such happy relationships with the Accounting Office in the operation of this project.

I turn to the subject "Audits" under section 15 of the May-Johnson bill, and it contains exactly the same provision—and that is where we got it—that we wrote into this bill, which is:

Notwithstanding the provisions of any other law governing the expenditure of public funds, the General Accounting Office in the settlement of the accounts of the Administrator or other accountable officer or employee of the Commission,

the Administrator, or their agents, shall not disallow credit for, nor withhold funds because of any expenditure which the Commission shall determine and certify to have been necessary to carry out the provisions of this act.¹

If it is fraudulent, I just want to denominate the source of the fraud.

Mr. WARREN. I say it means nothing so far as an audit is concerned, and there may be people in the War Department—I know there are people in the War Department—who are opposed to General Accounting audits.

I have just quoted what General Groves has told us personally, and what he is alleged to have said at a banquet here.

Senator BYRD. It would seem to me that the committee in the House could have obtained the same impression that this committee obtained yesterday, when we were told by one of the employees of this committee that this provision had been agreed to by the assistant general counsel of the Comptroller's Office.

The CHAIRMAN. Senator, I think that can be explained.

Senator BYRD. I know, but I am speaking of how these things occurred.

The committee was considering this yesterday and was going over it and was told then it had the full approval of the Comptroller General's Office.

I was the member that questioned that and called Mr. Warren on the phone, and he said it was totally and absolutely untrue.

Senator MILLIKIN. Mr. Warren would be abrogating his office.

Senator BYRD. The committee was informed of that, and maybe the House committee was likewise so informed.

The CHAIRMAN. I have inquired into that series of circumstances, and I would be willing to go into it now, but I think it can be explained to your entire satisfaction.

Senator BYRD. I will say that that information came very near to having this bill passed out by this committee with a unanimous report on that particular provision under a misunderstanding of what actually occurred. I think that that is quite a serious matter.

The CHAIRMAN. Let me ask Mr. Warren whether this language was submitted by him to the chairman of the Military Affairs Committee of the House.

Mr. WARREN. Senator, I have never appeared on this measure before the House Committee on Military Affairs. It was all over the phone. Four members of that committee, four very prominent members—two Democrats and two Republicans—called me on the phone. They were in the same room, and they said that they were unalterably opposed to section 15 of the House bill and were going to seek to strike it out. They then asked us to submit something along the lines of which I have just read here, as a substitute, as a proposal that they were going to make rather than us. Later on I was told that this had been tentatively approved. Still later on I was notified by the chairman of the committee that the War Department itself had agreed that the entire section should be stricken.

Senator HICKENLOOPER. As I understand it, Mr. Warren, this language that you have just referred to that they asked you to suggest

¹ See H. R. 4280, 79th Cong., 1st sess., introduced in the House of Representatives by Mr. May on October 3, 1945, and referred to the Committee on Military Affairs; see also S. 1463, 79th Cong., 1st sess., introduced in the Senate by Mr. Johnson of Colorado on October 3 (legislative day, October 2) 1945, and subsequently referred to the Special Committee on Atomic Energy.

as a substitute is not language that you were affirmatively urging in the bill, but you were merely complying with their request to suggest something, if a substitute were necessary for the language to which they objected in the bill?

Mr. WARREN. Senator, that expresses it absolutely.

Senator HICKENLOOPER. I want to get your attitude straight on this thing.

Mr. WARREN. You have expressed it correctly. I have no objection to this, but I am not seeking this. I don't want any more power.

Senator HICKENLOOPER. Do I understand that the gist of your statement here is that you think the reference to the General Accounting Office or the Comptroller should be eliminated from the bill, leaving you in the same position with respect to auditing this activity as other governmental activities?

Mr. WARREN. That is absolutely my position, but if the committee wishes any substitute, I have no objection to this, although I am not advocating this.

Senator MILLIKIN. I don't want you to have the power to waive it any more than I would the Commission.

The CHAIRMAN. Let me ask you this, Mr. Warren: You would like all references to the Comptroller General stricken out. Would you advocate the rules on competitive bidding on the awards to scientific institutions for research?

Mr. WARREN. May we turn to page 8. I think that is where you have it.

Senator MILLIKIN. Mr. Chairman, before we get into that, I would like to ask Mr. Warren categorically whether anyone in the House ever submitted him section 10 for his approval or comment.

Mr. WARREN. Never.

Referring to (2) on page 8, I certainly think that you should give them authority to make partial and advance payments. I think that is all right. I think that you should give them the right to waive advertisement. I think that may be essential and necessary.

The CHAIRMAN. Where is that, you say?

Mr. YATES. On pages 8, 11, 14, and 16.

Mr. WARREN. Now, here is something that I might call your attention to:

Such arrangements shall contain such provisions to protect health, to minimize danger from explosion and other hazards, and to require the reporting and to permit the inspection of work performed thereunder, as the Commission may determine * * *.

That would give them the right, gentlemen, in that broad language—which is probably necessary and proper, assuming that these projects would be in isolated places—to set up health facilities and all of those things right here in the District of Columbia. If we had to construe that, we would so hold.

I don't know whether that is your idea, to let them set up all those facilities here or on the project; but it is so wide that they could set it up anywhere, including the District of Columbia if they wanted to.

The CHAIRMAN. Now, where do you read that?

That provides the arrangements for health and minimizing danger from explosion.

Mr. WARREN. Also on page 38, section 12(a) (5), the committee is authorized to—

construct, acquire, provide, or arrange for such facilities and services for the housing, health, safety, welfare, and recreation of personnel employed by the Commission as it may deem necessary * * *

Now, we are not questioning that, except the broad provisions of it. We would at once construe that all of that could be provided in the District of Columbia if the Commission saw fit to. I just merely call the committee's attention to that.

The CHAIRMAN. Of course, you realize that Oak Ridge and Hanford are two towns by themselves.

Mr. WARREN. Yes.

The CHAIRMAN. You have got to keep personnel there, and it would be impossible to do it without some recreational facilities.

Mr. WARREN. I am in full accord, Senator, with that, but I was wondering if you wanted to give the Commission the right to put it here in the District of Columbia. I can see where it should be on the projects, and I am wondering whether you want to restrict that somewhat.

The CHAIRMAN. I don't think there is any intention to give the Commission the right to erect any dance halls in the District of Columbia.

Mr. WARREN. They could do it under this provision; we have studied it very carefully.

The CHAIRMAN. What language do you suggest to modify?

Mr. YATES. If they restrict it to isolated places, it would take care of it, the isolated project areas.

Senator BYRD. Projects?

Mr. YATES. Projects; yes.

The CHAIRMAN. Would that be sufficient?

Mr. YATES. I would think so; yes.

Senator BYRD. I wish you would continue on this page 8 and give your comments as to any changes you would suggest there.

The Commission may make such arrangements without regard to the provisions of law relating to the making, performance, amendment, or modification of contracts * * *

Do you object to that?

Mr. WARREN. Well, we might not object to it in regard to contracts. We say a greater authority is not needed here than was essential to the prosecution of the war.

Senator BYRD. This applies to contracts, agreements, grants-in-aid, and loans, at the top of page 8, and permits them to make arrangements without regard to the provisions of law for those four categories.

Senator MILLIKIN. I would like to ask, first, what are the provisions of law which this language is intended to circumvent? What is the thing that is feared here?

Mr. FISHER. Section 3709, I think is the statute that they are generally after here, on the competitive bidding. They don't want to have to advertise and get bids and take the lowest bidder for research and development.

Senator MILLIKIN. The language is broad enough, though, to include the whole field of law.

Mr. FISHER. They have authority to amend contracts and modify contracts by virtue of their authority to make contracts. This has

been construed under the War Powers Act, which is similar language, as authorizing an amendment or modification without consideration.

If you have got a contract for doing a job for \$100,000, you can amend it just to get in \$300,000 if you want to.

Senator MILLIKIN. I should like to invite your attention to the first sentence, commencing on line 1, page 8:

To this end the Commission is authorized and directed to make arrangements, including contracts, agreements, grants-in-aid, and loans—

Now, has there been any interpretation of language of that kind, so far as contracts and agreements are concerned? What is the scope of that? Is there any limit?

Mr. FISHER. Just except to the extent of this research assistance; that is all.

Senator MILLIKIN. To the extent of those specified things?

Mr. FISHER. That is right.

Senator MILLIKIN. They could make any kind of contract or any kind of agreement, in addition to grants-in-aid and loans, as to these specified things?

Mr. FISHER. That is right. Their loans and grants-in-aid would be in the nature of a contract.

Senator MILLIKIN. Now, coming down again to the language on line 18, if the purpose is to suspend competitive bidding, would it not be better to say so rather than to have language there which is broad enough to cover anything that might touch the subject matter in the law?

Mr. FISHER. I think it should be confined to that.

The CHAIRMAN. Let me ask you this, just looking for information.

Senator, it would be rather a bad thing if the Commission was required at any time to conform with anything that grew out of the competitive bidding section. Let us assume that the Commission was going to put out \$200,000 on research over a period of 4 years on "plutonium-590." You wouldn't want anybody to know that we were even thinking that research would produce 590; we wouldn't want to notify the world. We will agree that that shouldn't be done.

Senator MILLIKIN. Let us assume that to start with.

The CHAIRMAN. Now, let us assume there is some trouble in the contract, and due to the amount of work that is necessary, they have got to revise that contract. Would we have the right to revise it without any trouble at all?

Mr. FISHER. For a consideration.

The CHAIRMAN. What do you mean?

Mr. YATES. If there is a consideration moving to the Government, not necessarily financial.

Mr. FISHER. They want to change the scope of their research, enlarge or decrease it.

The CHAIRMAN. You people have the right to reject their modification of the contract?

Let us assume that the contract is for \$200,000. You get into a year's work of research, and it turns out to be a much vaster project than they anticipated. Instead of \$200,000 they up the ante to a million dollars, to the University of Florida.

Mr. YATES. But they are going to get additional work.

The CHAIRMAN. Well, they are going to get additional work in the way of getting three additional appliances to do some additional experimentation.

Now, do you pass on the value of the consideration that is moving for the revision of that contract?

Mr. YATES. Yes, Senator, in determining whether payments under the contract are proper and legal payments.

The CHAIRMAN. Now, that is the point I want to arrive at. If you remove the competitive bidding restrictions, you would have nothing to say about the original contract. That is, they can work without bids.

Mr. YATES. That is right.

The CHAIRMAN. But they could not change that contract and up the ante without your passing on whether the consideration that was moving to the Government was sufficient to justify the increased cost?

Mr. YATES. That is correct, Senator, and I think that is as it should be. Of course, we would never raise a question there unless obviously the consideration fails.

The CHAIRMAN. Wait a minute—unless the consideration fails. What do you mean by that? I assume there would be no guaranty, Mr. Yates, that research was going to result in a finished product.

Mr. YATES. I don't mean that, Senator. I mean unless the consideration fails to appear in any sufficient degree so that any reasonable man would regard it as consideration.

For instance, if the Government is going to amend the contract, increase the price, but is going to get some additional work, we don't question the value of that additional work. We question whether there was additional work; we question whether it required additional cost. We raise no questions other than what a court would raise in a similar case.

The CHAIRMAN. In other words, you say it is all right in the first instance not to have competitive bidding because of the necessity for nondisclosure of what you are doing. You recognize that, I take it?

Mr. YATES. Not in all their contracts, but we think they will need freedom from that section in a great many of them.

The CHAIRMAN. You recognize it as a predicate of operation under many of their contracts. Now, if those same contracts, however, should have to be revised due to the developments arising under the contract, you feel that at that point you should have the right of veto in the revision of that contract?

Mr. YATES. If they alter the payments under the contract, yes.

Mr. FISHER. If they have a provision in the original contract to increase and add to it, there is no question raised. We would question it—to take a ridiculous situation—if you had a million-dollar contract and you asked the contractor later on to furnish one crate of oranges and upped the contract price another million dollars. Obviously, we would question that.

If you agree to buy an automobile, without advertising, for \$1,000, and then the contractor has a strike and runs into trouble, and when he gets through he thinks he will lose money unless he gets \$2,000, we would question an amendment to that to pay him another thousand.

The CHAIRMAN. You have given an absurd example, in the crate of oranges. Let me give you one as absurd and find out what your answer would be.

Let us assume that the Commission, in going along under this \$200,000 contract looking for "plutonium-590," suddenly hears about a scientist over in Czechoslovakia who has the answer, so everybody says, locked up in his head, and he wants \$250,000 as the price to come over here and produce "plutonium-590."

Now, the Commission in judging the situation and the necessity for that grade of plutonium makes a contract with the University of Florida to get that man and adds \$250,000 to the contract.

Now, the Comptroller General could look at it and say, "That is a lot of money for one fellow; we won't allow that."

Mr. YATES. We would not question that, but would probably report it to Congress as being a most ridiculous thing which Congress ought to look into.

The CHAIRMAN. It might be ridiculous in your eyes, but that might be the difference between his giving that to an enemy nation and blowing us off the face of the earth or our having it right in this country—and that is what the five Commissioners might know and you would not know.

Mr. WARREN. As I said, Senator, we would not question that, but we might report it. I take it that we can report anything in the world that comes under our notice.

The CHAIRMAN. Of course, that was what I was rather relying on, Mr. Warren—your power of publication and report—to see that the public funds are not wasted, in the same way that Price, Waterhouse would audit Jones & Laughlin Steel Co. in its operations and report to its stockholders that they had gone through the books and found that they were in balance.

I reiterate that I have no terribly fixed conviction on this. I am examining the works of the Commission. I want the Commission to be a success, as we all do, and I think we have to realize that this Commission is going to be engaged in a very unusual activity, a very unusual governmental activity. It is not going to be the Post Office Department. It is not going to be the Department of Justice. It is going to break in new and untried ground.

Now, have you given any thought to that aspect of it, the necessity for quick and unusual decisions that this Commission is going to have to make?

Mr. WARREN. Absolutely, and the best evidence that there would be no strait-jacket attempts on the part of the General Accounting Office is the fact that we have passed upon \$2,000,000,000 of their expenditures with a war on.

The CHAIRMAN. Of course, a war creates certain pressures on all of us, you know. I don't think any Comptroller General should cut off funds with an atomic bomb in the making.

Mr. WARREN. Senator, I think we have an appreciation of the magnitude of this thing so as to have the same view.

Senator BYRD. Of course, this is one of the secret things the Government is doing. There are a lot of others. You have the same power as to all of the other contracts of the Army and Navy.

Mr. WARREN. Every contract entered into by the Government is filed with the General Accounting Office. We have seen them all.

Senator BYRD. And have you had any difficulty at any time where you have been compelled to refuse approval?

Mr. WARREN. None at all. We have questioned some transactions under the First War Powers Act and have collected back some money where it was abused.

The CHAIRMAN. Of course, I realize you have the same power with regard to jet planes and the rest of it, but each time there has been urged in the committee, Senator Byrd, for a basis of comparison on security restrictions, we have been immediately reminded that this was sui generis, and this was the weapon of saturation, the weapon that required more of security and secrecy regulations than anything else, than the jet plane or naval guns, or anything of that nature.

I am just wondering—and I am asking the question, trying to test it out—whether the nature of the Commission's work is not such as to demand something of the same approach in the way of its fiscal operations as we approached it with security regulations. In other words, we are acknowledging on the one hand that it is a very unusual situation in trying to legislate for it, and we are—if we adopt the Comptroller General's viewpoint, and it may be entirely consistent—nevertheless sitting within the framework of existing ideas.

Mr. WARREN. Now, Senator, let me supplement what I have said by telling you this, too.

(Discussion off the record.)

Senator HICKENLOOPER. May I ask this to clarify?

Let us assume—we are assuming some perhaps ridiculous cases or far-fetched cases—that a scientific and technically or theoretically sound technical process has been projected but hasn't been built yet, for the production of some desirable material for use in some field in this thing, but it is all on paper. It looks good and it ought to work. A contract is let for the production of that particular thing as specified. Then, the contracting people get about two-thirds with that and something is discovered, so that they say they need material. They say: "We can go ahead and build this thing as you prescribe just exactly according to the contract. We can build it as you prescribe, but we now discover that we can make a workable thing out of this thing or we can make something else out of this thing by the use of some more expensive materials and some much more expensive activities, and we ask you to modify this contract and increase it by a half a billion dollars, or something like that."

Would that be such a modification of the contract that you would consider that a consideration was moving toward the Government?

Mr. Warren. I would certainly think there was a very strong consideration moving to the Government on the statement of facts.

Mr. YATES. It is a good illustration.

Senator HICKENLOOPER. I should have said that the Government did not prescribe to the contractor that we wanted to produce a result. The Government prescribed the manufacture of certain things, prescribed a detailed machine, detailed specifications. If you met those specifications, whether it works or not would be immaterial. That is what they contracted for, but in the process the Government became convinced they didn't either have the proper information when they laid down their contract or they would like to accomplish a different result at greater expense. That would be a consideration moving toward the Government?

Mr. WARREN. I don't think there is any question about that.

Mr. FISHER. We have those every day, and there is no question about it.

Mr. YATES. Those are called "change orders."

Mr. WARREN. We have the appreciation that this is an untried field. We realize that we must be reasonable.

Senator HICKENLOOPER. One other illustration. The contractor makes an agreement with the Government to produce a certain specified and detailed job. He goes through that job and meticulously produces according to the blueprints and the plans and the formula, whatever it may be. He gets down about two-thirds of the way through that thing and says: "Well, I just bit off more than I can chew. I haven't got the money to finish it." There is no question of the alteration of the plans. He just hasn't got the money to finish it. We have got it in process up to this point, and the contractor says: "Now, I have either got to have some more money or I stop right here on this thing, because I cannot go any further; I cannot get any loans; I cannot get any money; I cannot pay my workmen; I cannot get materials."

The Government says: "Well, you probably did bite off more than you can chew. We will agree that maybe now it seems the price was too low which you charged us for that. We will go on and put in a hundred million dollars more on this thing so that this can be completed."

Now, where does that fall?

Mr. FISHER. We would question that if the contract was established originally at a fixed price.

Senator HICKENLOOPER. All right. Then let us assume a situation where that particular contractor was peculiarly adapted to make that thing and that the Government considered that it would cost the Government more to have someone else start in on this process under peculiar circumstances than it would to throw in another hundred million to let that fellow finish it. Would that be a consideration in that case moving toward the Government?

Mr. FISHER. We could not recognize that as legal consideration, but what you could do in those cases is to authorize those particular parts of contracts to be made on the cost-plus basis.

Senator HICKENLOOPER. I am not assuming on a cost-plus basis. I am assuming a rigid contract.

Mr. FISHER. We would question it. To get around that particular thing, you could authorize them to make it on a cost-plus basis.

Senator HICKENLOOPER. I presume the Government would always have an out if the contractor came to the end of the rope. The Government could make a new contract with somebody else to step in and finish it.

Mr. YATES. And hold the original contractor for the difference in cost.

Senator HICKENLOOPER. If he is broke, it would not do much good.

Mr. YATES. That would be the Government's remedy.

Senator MILLIKIN. Mr. Chairman, I have been very much disturbed by much of the language in section 3 (a), and I am back on page 8 again.

It seems to me that this language is so broad, so limitless, that the Commission could go before an appropriations committee, and while,

of course, it could not control the action of the Appropriations Committee, it could make a claim that it was the intent of Congress to put no limit on their judgment, and therefore their Appropriations Committee should accept their judgment.

I do not assume for one moment that an appropriations committee would accept that argument in full but it might be greatly influenced by it. I am wondering what the usual technique would be to put some sort of a limit on these grants-in-aid, and loans, and these contracts and agreements. Is there any way to get some sort of an advance consent of Congress, which is to say in the whole process of the Appropriations Committee. I am not asking for advance consent of the appropriation, but of the Congress.

Of course, I assume that we could put a money limit on all or any part of these specified expenditures. Are there any other techniques that could be used to put some sort of a ceiling on this thing?

The CHAIRMAN. Five hundred and thirty-five Members of Congress.

Senator MILLIKIN. I mean it is customary when we give an authorization to put a dollar sign after it.

Mr. FISHER. That is about the only way you can limit it. You couldn't very well do that here unless you made the limit extremely high.

Senator MILLIKIN. You could on a number of the items. When you get into the strictly military field, you would have a tough problem, but no tougher than when the Appropriations Committee considers naval appropriations or any of the usual military provisions.

Is it your judgment, then, that if a ceiling is to be put on that it be put on terms of authorizations limited by dollars?

Mr. FISHER. That is about the only way I know that you could do it:

The CHAIRMAN. Mr. Warren I would like to ask you a couple of questions. You denominated this language as, if at least not intended to be fraudulent, fraudulent on its face. Let me ask you this.

Mr. WARREN. Perhaps I should say, Senator, that it creates the impression that it is effective, and it is deceptive because it is not effective.

The CHAIRMAN. Well, let us find out the limit of its effectiveness. It is effective in permitting you to go with your auditors and accountants to examine every single account and every single transaction that this Commission makes.

It is effective in the sense that it permits you to report on what you find to the Congress.

Mr. WARREN. Well, it doesn't even say that. I would hold, however, I could report.

The CHAIRMAN. You said you had a right to do that?

Mr. WARREN. Yes.

The CHAIRMAN. Now, it is effective then in those two respects. Where it is not effective, in your opinion, is that it does not permit you to (a) disallow certain expenditures as having been made not in accordance with the law, and (b) to withhold funds pending the restoration of the disallowance by the disbursing agent to the Treasury of the United States. Those are the two ineffectives.

Mr. WARREN. Well, the last thing that you mentioned is one of the last resorts of the Comptroller General and in fact is his real power.

Of course, the withholding power primarily is intended for cases of failure to account, not for mere disallowances. There has been

no occasion to ever exercise that since I have been Comptroller General.

The CHAIRMAN. I just wanted to get the problem set out in the four corners of it, in view of the strong language that you did use, that those are the two things which you think are essential; namely, (a) the power to disallow and call upon the disbursing clerk, call him what you will, of the organization to restore some money to the Treasury and (b) to withhold funds. Those are the two powers; am I right?

Mr. YATES. Yes, Senator. But there is a third that is not so tangible.

The CHAIRMAN. What is it?

Mr. YATES. It is the effective result of the audit by the General Accounting Office which flows from the knowledge on the part of the spending officers that the General Accounting Office can disallow credit or withhold funds.

Now, if you will write in the law that the very spending agency, the Commission itself, can by a stroke of the pen remove any disallowance of credit or withholding of funds, then all responsible officers for funds know that the Commission under which they are operating can save their own skins, and your effective deterrent is gone.

The CHAIRMAN. I am very glad to have those three things set out.

Senator BYRD. Isn't there another one, Mr. Chairman, that under this provision the Commission determines its own system of administrative accounts; it fixes its own forms, which must be audited?

The CHAIRMAN. Until I am informed differently, I assume that that isn't too important.

Senator BYRD. I am just discussing the provision as it stands now.

Mr. YATES. It is important, for this reason: The Commission conceivably—I do not charge that any Commission would—could establish forms that would give so little or no information that an audit would be fruitless.

The CHAIRMAN. Of course it might, but this thought occurs to me, Mr. Yates: If you were on the Commission and had an understanding of the desperate necessity for secrecy in regard to a certain proposition, you would not want a detailed form of any kind.

Mr. YATES. No; we don't want that, and that isn't necessary, but we want enough on the voucher and the contract to establish that there is an obligation. They could establish forms that would even preclude that.

Senator BYRD. There couldn't be any more desperate need for secrecy than on the Manhattan project, and every detail of that was audited in time of war.

Mr. YATES. May I make one explanation of those words "disallow credit" and "withhold funds"?

The CHAIRMAN. Yes.

Mr. YATES. I am afraid they might not be understood.

The words "disallow credit" pertain to the action in the audit of a disbursing officer. When credit is disallowed, it is in the accounts of a disbursing officer, and he must explain or furnish additional facts to justify the change of that action and the subsequent allowance of credit. Sometimes credit cannot be allowed. It is obviously and outrightly illegal.

"Withhold funds" pertains to action within the control functions of the General Accounting Office and goes to the issuance of warrants and authorizations of requisitions for funds. Now, funds would never be withheld. That is, the Comptroller General would never decline to approve a Treasury warrant for funds, nor would a requisition be disapproved except in two general situations:

One is that the disbursing officer seeking the funds on a requisition has failed to account faithfully for his uses of Federal funds. He has failed to render his accounts completely or as required by law.

The other general situation would be where there is asked on a warrant money in excess of that appropriated by Congress or from an appropriation which Congress has not made for that purpose. It has made the appropriation for some entirely different purpose.

I have the very definite impression that those who are seeking this freedom from the disallowance of credit and from the withholding of funds are attaching to it too much importance and if there is anything in the importance they do attach to it, it would reach a result that the Congress of the United States would not want them to reach anyway.

You would not want the General Accounting Office to approve a warrant setting up funds on the books of the Treasury from an appropriation that you made for an entirely different purpose, or perhaps to an entirely different office. You would not want, even in this project, the General Accounting Office to approve a warrant for more money than the Congress has yet appropriated.

You would not want, I take it, that we should approve a requisition for funds to a disbursing officer who has failed and perhaps consistently refused to send in an accounting for his stewardship of the Government's funds.

Now, those, in a general way, are the only circumstances involved there, Mr. Chairman.

The CHAIRMAN. Let me ask this question, and I ask it in all earnestness, trying to find out what is the best thing to do. This, of course, is a huge manufacturing enterprise. It is not a usual thing in which the Government is engaged. That is true; is it not? I suppose it is comparable to operating the United States Steel Corp.

Mr. YATES. It is scientific, manufacturing, experimental.

The CHAIRMAN. It is equivalent to operating the United States Steel Corp. or General Motors.

Senator MILLIKIN. Du Pont would probably be more applicable.

Mr. YATES. I will accept that, Mr. Chairman.

The CHAIRMAN. They, of course, have their board of directors, and they go ahead and try to do the best job they can for the stockholders.

Now, if you were running du Pont, or in the operation of du Pont, I assume, we might say, they would have Price, Waterhouse, or Ernst & Ernst. They come in and make an accounting and report to the stockholders. That is the beginning and the end of their responsibility; is it not?

Mr. YATES. Of the firm of accountants, as I understand commercial accounting; yes.

The CHAIRMAN. How would you think it would affect the operations of the business if Price, Waterhouse or Ernst & Ernst had a right to enter into the policy making of du Pont Co.? Would you approve of that as a stockholder of the du Pont Co.?

Mr. YATES. Mr. Chairman, that brings up a question that has so many angles we could discuss it for the next 5 hours.

The thing you are really bringing into question is the relationship, if any, between a so-called commercial type of audit and the system of accountability of Government fiscal officers which the Congress years ago established.

There really, in my opinion, is little relationship between the circumstances and the results. The Congress has enacted a law based on the theory that when money is handed out to a fiscal officer he must come in and account for his uses of that money.

The CHAIRMAN. Doesn't it run into conflict, though? That law was enacted to establish governmental operations, such as the Post Office Department. Does it apply when the Government enters into a strictly manufacturing enterprise? Do the same principles apply?

In other words, we are after the most efficient operation that we can get here of a manufacturing enterprise of vast dimensions. Now, you operate that in accordance with the traditional method that you advocate for efficiency, or you operate it in the way that a huge manufacturing organization is operated.

Senator BYRD. May I inject there, Mr. Chairman, that the Government has been for years and years conducting vast business enterprises. They conduct all the navy yards all over the country. They conduct arsenals and conduct many other things in time of peace—and in time of war they conducted many plants that were audited by the General Accounting Office without any difficulty whatever.

The CHAIRMAN. You know a great deal more about this, Senator; this is new to me.

Senator BYRD. They have run the navy yards for years. They run the navy yard in Norfolk which employs 40,000 people, the largest operation in Virginia, and that has been running without trouble.

Let me say about the policy that I do not believe Mr. Yates intends to leave the committee under the impression that the Comptroller General attempts to define policy. All he does is see that these expenditures are made in accordance with the law. Congress defines the policy, not the Comptroller General.

The CHAIRMAN. Of course, Senator, I was just thinking out loud. I think, of course, as a statement of principles, that is true, but in the day-to-day operation of a business enterprise of this magnitude, quick decisions have to be made.

For instance, let us take an example: Let us assume that in a far-away place we have a project. We have 3,000 workers there, and we set up recreation facilities. We also set up a cafeteria, and there we furnish a meal for 25 cents that costs the Government 40 cents. That might amount to very little in the sum total of maintaining the morale of those 3,000 workers.

Senator BYRD. But it first ought to be authorized by Congress, shouldn't it, and that is all that the Comptroller General determines?

Mr. FISHER. The bill authorizes recreational facilities. We would not question a case like that, Mr. Chairman. That would be nothing we could question.

The CHAIRMAN. Even though there was a loss?

Mr. FISHER. We might report that to Congress as bad administration, but there would be nothing we would disallow in the accounts.

The CHAIRMAN. You might recognize that to be good administration.

Senator MILLIKIN. Mr. Chairman, as I see this thing, I think your analogy of an auditor passing on the policy of the company would be better if you considered an outside legal review.

A lawyer looking at the business of the company says to himself, "Is this piece of business in accordance with our charter, in accordance with our bylaws; is it in accordance with the authority given by the minutes of the board of directors?"

Now, the Commission will have its inside legal staff to determine those things. This method, by preserving alive the powers of the Comptroller, gives you an additional legal review. The lawyer in the company doesn't stick his nose into the detail of how the minutes are carried out or how the bylaws are carried out unless he is asked to. His business is to advise the directors, "Is this thing that we propose to do within our charter, within our limits, within our bylaws?" That is the end of his immediate concern. Now, he may have other duties.

As I understand it, you gentlemen look to see first that you have a voucher before you. You look to see whether that comes within the terms of the law. Isn't that your job?

Mr. WARREN. Yes, sir.

Senator MILLIKIN. So what we are doing is enclosing another legal review on the Commission's own lawyers.

Now, that brings me to this question: I am very much interested in the security features of this bill. You preserve the security through the knowledge of your own employees, and you say that you had them all cleared by the FBI. That is what you did on your own initiative. The law didn't tell you to do that. If we allowed the Comptroller to have his normal powers here, and struck out subsection 10, would it be advisable to incorporate some definite mandate that you do follow a security routine? You might not always be there. Some careless fellow might be in there.

Mr. WARREN. Of course, if there was any phase of it which Congress thinks should be secure from us, I have no objection to that phase at all. In fact, when we were let in on the secret, we asked no questions whatever, Senator.

Senator BYRD. You must make a brief statement, Mr. Warren. Senator Austin wasn't here when you discussed that part of it.

Mr. WARREN. We were in on this secret from the very beginning, Senator. A memorandum which other people may not have understood because it was couched that way on account of its secretiveness was filed in the safe in my own office at the time. We audited every dollar of the Manhattan project and the one out on the west coast. We have been publicly commended by General Groves for our fine cooperation, and have been thanked by him.

The audit was kept current, and if we are given that same authority we will keep it, and will have our men on the very project as we did have before.

There hasn't been, as I told Senator Millikin, any difficulty. This expenditure has been remarkably clean. I do think, however, that the fact that we were there, like the policemen on his beat, had a very salutary effect. Our auditors were the greatest help and assistance to those who were spending money on the project. Time and time again they would consult us, and that was very salutary.

I have yet to receive a single solitary complaint about either the conduct of our men or lack of efficiency or thoroughness on their part. Senator MILLIKIN. Mr. Warren stated that in order to preserve the security of the thing as far as his department was concerned, he had the men who worked on this cleared by the FBI.

Senator AUSTIN. Yes; I understood that.

Senator MILLIKIN. That gave me a lot of comfort insofar as the tax is concerned. Now, I am wondering whether something of that kind should be required by law.

I would like to ask one more question categorically: Did any assistant counsel of your department advise or consult with anybody on section 10?

Mr. WARREN. The acting general counsel is Mr. E. L. Fisher.

Mr. FISHER. I consulted with Mr. Miller, who came down from the Office of the Legislative Counsel. We had a copy of the old S. 1717, which he informed me was being rewritten. In fact, he was going to try to get it printed up that night. He had a big mimeographed copy of how they were going to change it, so we had nothing. The original S. 1717 had no provisions at all in it, and we just discussed it generally.

Senator AUSTIN. You mean provisions relating to audit?

Mr. FISHER. That is right. We discussed generally the operations of the General Accounting Office. The gentleman wasn't informed on the audit procedure and how we operate, and he discussed, of course, the feeling, I presume, of the committee or the people back of him that they wanted to restrict our audit to some extent, no part of which, of course, I agreed with.

He left me with the impression that they either would cut the General Accounting Office clear out of the picture, or probably put in some such provision as this.

Senator MILLIKIN. Was that provision before you?

Mr. FISHER. No; we had no language whatever.

Senator AUSTIN. Did you assent to that final proposition?

Mr. FISHER. I told him either way we would object to it.

The CHAIRMAN. I am trying to reconstruct what happened. I called attention to the fact that that provision appeared in the May-Johnson bill. Then there was representation made to me that this was not in very good form, and I suggested—I think this is the way the misunderstanding arose—to counsel that they go over to the General Accounting Office and find out what language would do better than what is written in the May-Johnson bill.

So it wasn't with the idea of going over to get your assent, as I understand it.

Mr. FISHER. I didn't understand it as that.

Senator BYRD. The committee was told that the General Accounting Office did consent to it. We were told that yesterday.

Mr. FISHER. There was no consent whatever.

The CHAIRMAN. You saw this language which appears here?

Mr. FISHER. No; we didn't see that. You see, I had a copy of the original S. 1717 which had nothing in it.

The CHAIRMAN. Is this the language that comes out of TVA Act?

Mr. FISHER. That follows it to a certain extent.

The CHAIRMAN. Now, just for my information, for I am not familiar with this, how do they operate differently than the set-up under section 10?

Mr. FISHER. They operate substantially on that basis, except that the TVA law specifically requires us to report to Congress anything that we think is illegal or wrong, and also to make an annual audit and report back to the TVA, get their comments and criticisms and send our reports with their comments to the Congress.

In addition to that, they will get the regular commercial corporation audits. You see we get two audits working in there—an audit which this would propose, and the regular commercial audit.

The CHAIRMAN. For my information, have you reported anything to the Congress that is wrong with the TVA operations?

Mr. FISHER. I cannot answer that. We probably have in the past. We had some trouble with the TVA years ago.

Mr. WARREN. May I inject there, the reason that provision is in the TVA Act is this: Shortly after I became Comptroller General, the TVA got an opinion from the Attorney General saying that they were not under the Budget and Accounting Act. There was no way we could contest that, because the Attorney General would have been our attorney, and I am quite sure he would have gone in and confessed judgment, having delivered the opinion.

The matter was placed before Congress, and more or less as a compromise—because they were then clearly out of it, and they claimed they were going to be bound by the Attorney General's opinion and therefore were not under us at all—those provisions were more or less agreed upon. But never since then have I ever taken the position that that was a pattern for anything else. We would have vigorously opposed that as a pattern, and we are just waiting a fair test before making any report to Congress on it.

The CHAIRMAN. That interests me. I have never gone into the controversy, but I knew there was a controversy.

Mr. WARREN. It was a controversy that I inherited when I came in there, Senator, and I had been in just a few months when the Attorney General issued a very sweeping opinion that they were not even under the General Accounting Office. I didn't want the Attorney General at that time to be my attorney in testing it.

The CHAIRMAN. Is there anything, since you have been Comptroller General, that stands out in your mind as subject to criticism?

Mr. WARREN. Well, we have challenged some things to the board of directors. You see, under the provisions of this thing this Commission could be the most capricious set in the world if they saw fit.

The CHAIRMAN. You could be capricious, too, in disallowing, Mr. Warren, if you wanted to.

Mr. WARREN. Yes; if I wanted to, but there is an entirely different slant on that. I have no ax whatever to grind. I am wholly independent and accountable and answerable only to the Congress itself. I am your agent; I am acting for you.

They are in the executive branch of the Government, and I am not. They are the ones that make the expenditures, and if they were so minded—understand this is no inference—if they wanted to, they would have the power to cover up.

Senator HICKENLOOPER. They would have power by merely making the assertion that they considered that to be essential?

Mr. WARREN. Absolutely, and that would end it, and it would be the conclusion.

We have no prejudices. We have no friends to reward in the Government and no enemies to punish. I think, if I can say it modestly, that my policy has been to call them as I see them.

Senator HICKENLOOPER. As I recall, the Comptroller may have pride of ancestry but no hope of prosperity.

Mr. FISHER. I would like to explain the disallowance a little, too.

As a normal thing, when we make a disallowance it does not handicap their operations at all. We make it a month or two after it has been done. They go right ahead, but we have put the disbursing officer on notice that when we settle his accounts at the end of a 3-month period, or so, he is going to owe us that much money.

Then, we take that and report it to the Department of Justice to have the Attorney General sue the disbursing officer and his surety to recover that money.

The CHAIRMAN. How many suits have you got pending?

Mr. YATES. Meanwhile the officers can come to Congress and get relief, so there is no suit in that event.

Mr. FISHER. I do not know how many suits we have, but I can find out the number for you.

Senator BYRD. Before we leave the TVA, my understanding is this: The TVA collects a large sum of money each year, and the question in controversy was whether or not that fund should go back into the Treasury to be reappropriated by Congress, or whether the TVA would have the right to use it for the expansion of their business. That was the issue before Congress as I remember.

Mr. YATES. That was the appropriations issue which Senator McKellar has always been interested in.

Senator BYRD. It was a question of yearly income of the TVA, as to what disposition they should make of that or whether it should be going into the Treasury.

Mr. YATES. And their collections are large.

Senator BYRD. Very large.

That presented an entirely different question.

Mr. YATES. It was a different situation all the way through, Senator.

The CHAIRMAN. You agree, as I get it, that competitive bidding should not be required.

Mr. WARREN. Yes; I agree with you on that.

The CHAIRMAN. That is required under the law, and if that were not in the bill you would have to require competitive bidding for the disbursement of funds.

Mr. WARREN. That is right.

Mr. FISHER. Not in all cases.

Senator HICKENLOOPER. I thought the competitive bidding discussion was limited.

The CHAIRMAN. Don't you think it would be highly unfortunate if competitive bidding restrictions were put on the building of a pile?

Senator HICKENLOOPER. Not necessarily. It involves an awfully lot of money and could involve a lot of favoritism.

The CHAIRMAN. I realize that, but also if competitive bidding were to be followed, you might have some very questionable people with the low bid designedly.

I can remember when the Germans bid much lower for the Moscow subways—it seems to me now I remember this anecdote—they bid

much lower on the Moscow subways than an English firm did. They wanted to put it much nearer the top of the ground, which would have been just as expensive. They awarded it to the English for putting it deeper down. It might have been highly inconvenient for the Russians if it had been built by the Germans. Now, I am just wondering, assuming competitive bidding had existed, whether they wouldn't have had to give it to them.

Senator BYRD. Would you object to a provision that where the Commission thought competitive bidding should not be carried out—would you object to not having competitive bidding?

Mr. WARREN. No; because I visualize so many things where you should not have competitive bidding. Of course, on some things I think you should have.

The CHAIRMAN. Wouldn't you leave that in the power of the Commission?

Mr. WARREN. I have no objection in the world to that.

Mr. YATES. Would it be helpful, Mr. Chairman, to modify the wording so as to place upon the Commission the responsibility of concluding that it would not be in the interest of security to ask for competitive bidding?

Senator BYRD. And make a report to that effect?

Senator MILLIKIN. And conform the language so we will know what we are talking about.

Mr. YATES. Not to remove competition in cases where it could safely be had.

Senator BYRD. Make a report to the Comptroller General that they thought it advisable.

The CHAIRMAN. You wouldn't have that within the determination of the Comptroller General?

Senator BYRD. No; but have them make a report.

The CHAIRMAN. A certification by the Commission that in the interest of public defense and security they were not putting this item out for bid.

Now, what else do you think would be harmful if you were to exercise your jurisdiction? How about this changing of contracts on the example I gave about paying the Czechoslovakian \$250,000, where Mr. Yates said he thought that ought to be reported to Congress.

Mr. YATES. Just because of the amount.

The CHAIRMAN. I would make it \$2,500,000.

Mr. WARREN. Reports to Congress are, of course, entirely within my discretion or Mr. Yates'. It is hard to say what we would report or what we would not report.

The CHAIRMAN. But you would not restrict the Commission in its right to change its contract?

Mr. WARREN. None whatever.

The CHAIRMAN. So that is all right in the bill.

Mr. YATES. The authority to contract carries with it the discretion to determine the contract price.

The CHAIRMAN. What you really are driving at, as I see it here, is the right to disallow and the right to cut off; is that right?

Mr. YATES. The right to make the audit effective so it is worth its cost.

The CHAIRMAN. That may be translated into this language, but what the power is is the right to cut off and the right to disallow.

Mr. WARREN. Just as we do other agencies of the Government.

Senator BYRD. Let us get that clear. If you exercise that power, you then file a statement showing there is an illegal expenditure?

Mr. WARREN. That is right, and they then answer that.

Senator BYRD. That is made a matter of record. In other words, he cannot just arbitrarily say, "I disallow this," and go on record. You have got to give your reason as to why it is not in accordance with the appropriation legislation of Congress.

Mr. YATES. And a statement embodying those reasons goes to the responsible administrative officials.

The CHAIRMAN. Now, as quickly as possible, gentlemen, I would like our lawyers here to get together with your lawyer for the purpose of drawing up language because it ought to be put to the vote of the committee, and I want to hear one other witness or possibly two on this subject, because I think it is tremendously important.

Senator BYRD. I would suggest, Mr. Chairman, if you have any doubt about the War Department, to summon either the Secretary of War or General Groves. Did General Groves have something to do with writing this bill?

The CHAIRMAN. I think Royall did. My limited research, Senator, indicates that Under Secretary Royall was responsible for this elimination of the Comptroller General's, which participation provision we adopted.

I am sorry, Mr. Warren, that you didn't denominate it as fraudulent then rather than now, because it is simply an adoption here without any intent to deceive.

Mr. WARREN. I didn't intend any offense on that, Senator, you know.

The CHAIRMAN. I am sorry, but I wish you hadn't used that phrase. I might as well be frank with you.

Senator BYRD. I would like to ask, if you have Mr. Royall that you also have General Groves because he has dealt with the General Accounting Office on the Manhattan project.

Before you adjourn, may I ask the Comptroller here with respect to line 14 on page 40, whether he has any comment?

Mr. WARREN. I would like to read a paragraph about that.

Section 12 (b) on page 40 of the bill provides:

The President may exempt any action of the Commission from the provisions of any law relating to contracts, purchases, sales, audits, reports, and similar matters whenever he determines that such action is essential in the interest of the national security.

While it may be that in isolated cases the authority which the bill would confer on the President might be necessary to the national security, the language of the bill at present is such as to authorize a disregard of all laws relating to contracts, purchases, sale, audits, reports, and so forth, on a broad and general basis; and conceivably the authority could be exercised in such a way as to eliminate the Comptroller General from the picture entirely irrespective of other provisions of the bill.

To this extent the provision is much broader than title II of the First War Powers Act of 1941, which relates only to contracts, whereas the provision in this bill relates to any action and extends to all audits, reports, and so forth.

Senator BYRD. Of all other departments?

Mr. WARREN. Yes. If some such authority is deemed necessary, it should require exemption by the President in advance, and only with respect to specific individual actions.

Senator BYRD. Would you construe that that applies to all audits of every department by the use of any law?

Mr. FISHER. No.

Mr. WARREN. I think he is referring only to action by the Commission.

Senator BYRD. It says "provisions of any law relating to contracts."

Mr. FISHER. That exempts the action of the Commission.

The CHAIRMAN. In other words, you would strike out "purchases, sales, audits, reports, and similar matters." Is that the purport of what you have just said, Mr. Warren?

Mr. WARREN. Well, I would certainly strike out "audits."

Senator MILLIKIN. Would you substitute anything for it?

Mr. FISHER. The purport is so broad that it would presumably let him do it after the fact instead of in advance, and I assume they would know in advance when the situation arose.

The CHAIRMAN. I don't see why knowing in advance is important—for security, that is the only reason I can see, so long as it is going to be audited.

Mr. FISHER. Rather than come out broadly and say, "Any action of the Commission relating to contracts is exempt," I think it should be confined to specific instances.

The CHAIRMAN. Will you also suggest a wording of that. As I say, I would like you gentlemen to get together on this as quickly as possible so that we could have a concrete proposal to which I would like to direct the attention of a couple of other witnesses.

Mr. YATES. A proposal for an amendment to the bill as it is now worded?

The CHAIRMAN. Keeping in mind the necessity for the competitive bidding elimination, and changes in the contract under the contracts as made.

Mr. FISHER. You still want that provision in the bill to let them make changes and amendments?

The CHAIRMAN. Are you against that? I thought you finally were in favor of that.

Mr. FISHER. No; I do not think we would be in favor of it without limitation, as it is now. They could amend a contract anytime for consideration. It is these gratuities that they try to get by amending contracts. Under the War Powers Act, for instance, the War Department could come along after the contract had been completed and amend the contract then to pay back the liquidated damages that had already been withheld, a simple gratuity.

The CHAIRMAN. They had that power?

Mr. FISHER. We objected to those things, but that is what they tried to do.

Mr. YATES. We objected on the ground that it couldn't further the prosecution of the war after the contract was completed and ended.

The CHAIRMAN. I can see where another argument can be made on that. It kept the contractor in business to go ahead and take another contract.

Mr. YATES. Where that argument was made, of course we considered it fully.

The CHAIRMAN. We are going to have a couple more witnesses.

(Whereupon, at 12:20 p. m., the committee recessed until 10:30 a. m., Monday, April 8, 1946.)

ATOMIC ENERGY ACT OF 1946

MONDAY, APRIL 8, 1946

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to notice, at 10:30 a. m., in room 104-B, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Connally, Byrd, Vandenberg, Austin, Millikin, Hickenlooper, Hart.

Also present: Lindsay C. Warren, Comptroller General of the United States, accompanied by Frank L. Yates, Assistant Comptroller General of the United States, and Edwin L. Fisher, assistant general counsel, General Accounting Office; Dr. Edward U. Condon, scientific adviser to the special committee; James R. Newman, special counsel; and Christopher T. Boland, staff director.

The CHAIRMAN. General Groves, we have heard testimony from the Comptroller General relative to what provisions he thought should and should not be in an act governing the Atomic Energy Commission.

We heard this testimony on Thursday. The committee decided to ask you to come over this morning for a few minutes to give any ideas that you might have as to the necessity for any exemptions from the general statutes governing the Comptroller General, if you thought there should be any exemptions, and what their nature should be.

Now, we have, as you know, the power in the Comptroller General to audit and disallow. I believe it is fair to say, Mr. Warren, that you are in agreement that there should not be competitive bidding.

Mr. WARREN. I assume you got the proposed amendments you asked us to provide.

Senator AUSTIN. Mr. Chairman, my recollection is that on that point we had a specific idea under consideration, and that was placing in the Commission the duty of certifying that competitive bidding would not be in the interest of security, in order to waive competitive bidding.

Wasn't that what was under consideration?

Mr. WARREN. That is my understanding, and we have incorporated that view in the proposed amendment.

(The amendments offered by the Comptroller General are as follows:)

S. 1717—A BILL FOR THE DEVELOPMENT AND CONTROL OF ATOMIC ENERGY
AMENDMENTS SUGGESTED BY THE GENERAL ACCOUNTING OFFICE

Amend the sentence beginning at line 17, on page 8, so that it will read as follows:
"The Commission may make such arrangements without regard to the provisions of section 3709, Revised Statutes, upon certification by the Commission

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that such action is necessary in the interest of common defense and security, or upon a showing that advertising is not reasonably practicable, and may make partial and advance payments under such arrangements, and may make available for use in connection therewith such of its equipment and facilities as it may deem desirable."

Amend section 4 (c) (2), line 16, page 10, by striking out the words "with or without modification."

Amend section 4 (c) (2), so that the sentence beginning on line 10, page 11, will read as follows:

"Any contract made under the provisions of this paragraph may be made without regard to the provisions of section 3709, Revised Statutes, upon certification by the Commission that such action is necessary in the interest of common defense and security, or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made under such contracts."

Amend section 5 (a) (5) so that the sentence beginning on line 14, page 14, will read as follows:

"The Commission is authorized to purchase or otherwise acquire any fissionable material or any interest therein outside the United States, or any interest in facilities for the production of fissionable material, or in real property on which such facilities are located, without regard to the provisions of section 3709, Revised Statutes, upon certification by the Commission that such action is necessary in the interest of common defense and security, or upon a showing that advertising is not reasonably practicable."

Amend section 5 (b) (5) so that the sentence beginning on line 13, page 16, will read as follows:

"Any purchase made under this paragraph may be made without regard to the provisions of section 3709, Revised Statutes, upon certification by the Commission that such action is necessary in the interest of common defense and security, or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made thereunder."

Amend section 12 (a) (5), which begins at line 6, page 38, so that it will read as follows:

"(5) acquire such materials, property, equipment, and facilities, establish or construct such buildings and facilities, and modify such buildings and facilities from time to time as it may deem necessary; and construct, acquire, provide, or arrange for such facilities and services at project sites for the housing, health, safety, welfare, and recreation of personnel employed by the Commission as it may deem necessary;"

Amend the bill so as to omit entirely section 12 (a) (10), on pages 39 and 40.

Amend section 12 (b), which begins at line 14, page 40, so that it will read as follows:

"SECURITY.—The President may, in advance, exempt any specific action of the Commission in a particular matter from the provisions of law relating to contracts whenever he determines that such action is essential in the interest of the national security."

The CHAIRMAN. We are agreed, General, on the noncompetitive bidding upon certification. Taking it from that point, and particularly with regard to the security aspects of it, what do you see that is necessary to protect security, as far as the Comptroller General's Office is concerned?

STATEMENT OF MAJ. GEN. LESLIE R. GROVES

General GROVES. I would say that, if the Comptroller General's Office functioned in the future as it did in the past with me, there is nothing needed, because everything was done, as far as I could tell, to protect security. The personnel that audited the accounts, the protection of papers—everything was entirely satisfactory from start to finish without any argument, without the slightest question at all. There was just complete agreement as to that.

I feel very strongly that the audit of accounts should be in the hands of the Comptroller General. Those of us who have been in the Government service for a number of years have had lots of difficulties

with the Comptroller General's Office, particularly under the previous administration.

Senator VANDENBERG. You mean the previous administration of the Comptroller's office?

General GROVES. That is correct, sir, and even with those difficulties, I always had the very strong personal feeling that it was a very desirable thing, because it gives the United States the protection it needs and it also removes, from the officer who is responsible, a tremendous responsibility. It would be a very bad thing, in my opinion, to remove these accounts from the control of the Comptroller General. I think it would also be bad to remove them from him in the sense that the Commission could say, "Well, we are not interested in that; we will just say that that is O. K."

Now, I think, in the appropriations, there should be some provision for certain expenditures, such as now exists, I believe, with respect to the FBI. I am not familiar with the FBI appropriations; whether they can certify, but I think there may be, depending on the bill, which I have not seen in its present form, the necessity for some such appropriations in a limited sum, but I cannot see anything that should remove from the Comptroller General the power of audit.

I think it would be a mistake to do it.

The CHAIRMAN. Now, do you know what the genesis of this provision was in the May-Johnson bill?

General GROVES. No, I don't. I know that the Interim Committee apparently felt that was a desirable thing, but, when it was acted on in the House, I believe that as the bill was reported out by the May committee that particular section was struck out.

The CHAIRMAN. Is that right, Mr. Warren?

Mr. WARREN. Mr. May informed me late Thursday afternoon that it was stricken out after the Department had seen the attitude of the committee—it was stricken out on the suggestion of General Royall.

General GROVES. In other words, it was with the full assent and even the recommendation of the War Department.

The CHAIRMAN. You don't know how it got in there in the first place?

General GROVES. No; I do not.

The CHAIRMAN. But the Interim Committee put it in?

General GROVES. Yes; because it was the Interim Committee's bill.

The CHAIRMAN. I would like to ask Mr. Warren what the provision is that General Groves is talking about in the FBI.

Mr. FISHER. They have a right to make a certification without disclosing what the money is spent for.

Mr. YATES. That only goes to a limited part of the appropriation. It is something like the fund which the Congress has provided in the appropriation for the War Department. A certain limited amount of money may be expended for unforeseen emergencies upon certification.

The CHAIRMAN. How much is that in the case of the War Department?

Mr. YATES. I cannot tell you that exactly, Mr. Chairman, but it is a very small amount compared to the total appropriation.

The CHAIRMAN. There is no provision for that, of course, in here?

Mr. FISHER. No.

The CHAIRMAN. Now, should there be anything in here to carry out General Groves' idea on that?

Mr. YATES. It wouldn't be necessary, Mr. Chairman, because it could be done, as General Groves is suggesting, and has been done in like situations before, by the Appropriations Committee.

The general bill that you have here authorizes the necessary appropriations. Now, if the Appropriations Committees wish to provide that a certain part of that appropriation which they may make pursuant to the authorization may be expended upon certification for emergency purposes, that in the past has been regarded as within the province of the Appropriations Committees.

The CHAIRMAN. That could not be raised as a question of legislation in the appropriations bill?

Mr. YATES. I would not think so.

The CHAIRMAN. Now, General, there has been some discussion about the right of the Comptroller General to audit the vouchers.

You give a contract, we will say, for half a million dollars for research in Chicago. You might not even want to put on the voucher what the research was for. You can conceive of that situation, can't you?

General GROVES. Yes; that is a possibility, but I don't think that would hurt. Maybe the Comptroller General might say, "We want to have a certification that this is for the purposes of the Atomic Energy Commission," but then he audits the accounts just the same.

The CHAIRMAN. But under the Comptroller's language as submitted—if I am mistaken, I wish you would correct me—in that particular situation it might be highly necessary that it not be divulged on a voucher what the research contract was about.

Would you insist on having that detailed for you?

Mr. FISHER. I don't think so.

Mr. YATES. The contract, Mr. Chairman, would be required by general law, to be filed in the General Accounting Office, anyway. There is nothing in the pending bill to the contrary.

The CHAIRMAN. That is a public record?

Mr. YATES. Well, it is a public record subject to the control of the General Accounting Office, as to where it is exhibited.

The CHAIRMAN. Let me understand that. I, as a citizen—could I not go down and ask for that to be produced?

Mr. YATES. You could ask for it, Mr. Chairman, and if you could show that you had a public purpose or an important purpose to be served, and if there were no other objections, we would exhibit them. But if they were of a class of confidential contracts, such as we have had during the war period, we would hold it confidential, and decline to exhibit to you.

The CHAIRMAN. Well, my point is, let us assume there is a contract for "uranium-635½" to Chicago to a million dollars.

Now, it might be that we wouldn't want to disclose that we were even trying to find "uranium-635½." I admit that I am at a loss. How would you conceal that?

General GROVES. The way that would be done, in my opinion is this: We would prepare a contract, and this contract would have attached to it a secret letter, and the contract would have a code which would make the contract something that could be used to a much larger extent in the Comptroller's office, just as in our office. But this secret letter would be available to the Comptroller General. If he wanted to file it down in his office, in his private safe, there

could be no objection on the part of the Atomic Energy Commission, and that is exactly the way we handled things in this affair.

Mr. WARREN. May I interpose there, Mr. Chairman?

I think General Groves will agree that, although we were taken in on this secret at practically the very start, we have religiously refrained from asking even any question about it in any way, shape, or form. I think that is correct, isn't it?

General GROVES. That is correct.

Mr. WARREN. We wanted to know nothing about it other than the general audit provision.

General GROVES. There were complicated financial arrangements in these contracts, unheard of before, and such a particular arrangement was discussed and received the approval of the Comptroller General in advance, that we were proceeding in a legal manner, and he agreed with us that it was the best way to handle it.

The CHAIRMAN. General, on your ultra-secret material heretofore in the operation of the project, was that all filed with the Comptroller General?

General GROVES. Such part of it as we wished to have filed. In other words, so that he could make an intelligent audit, and carry out his responsibility to the Congress, we assumed that anything that he felt was necessary was all right for him to have, and he felt that he didn't want to have anything more than he had to have. If you have two people operating in that way, there is never any friction, and that is exactly the way this worked out.

Now, in the bill that you have here, I notice that you say the Comptroller General may use personnel of his own selection. Well, that is the way it was operated here. He used personnel of his own selection, but he told us who they were in advance, and he was satisfied that we felt that personnel was responsible from a security standpoint.

If he hadn't been willing to do that, I don't know what we would have done. But as long as it is operated as this was, we won't have friction.

The CHAIRMAN. General, did you give any testimony before the committee that drew up the May-Johnson bill or consult with them?

General GROVES. You mean the Interim Committee? I talked with them at considerable length.

The CHAIRMAN. Did you talk about the Comptroller General's provision?

General GROVES. I don't recall.

Senator MILLIKIN. Mr. Chairman, what is that Interim Committee?

The CHAIRMAN. They drew up the May-Johnson bill, Senator. It was a committee appointed by the Secretary of War with the consent of the President. I think there were eight members on it.

Senator MILLIKIN. Not a congressional committee?

The CHAIRMAN. No.

General GROVES. All civilian members. There were no men in uniform on it.

Senator HART. It was Dr. Vannevar Bush and Dr. James B. Conant.

General GROVES. Karl Compton, of MIT.

Senator HART. Henry L. Stimson, Secretary of War, and the Under Secretary of the Navy, Ralph A. Bard.

General GROVES. William L. Clayton, Assistant Secretary of State; James F. Byrnes, representing the President; and George L. Harrison, special consultant to the Secretary of War.

Senator HART. I think Mr. Wallace was on that.

General GROVES. He wasn't on that, but Mr. Byrnes was. It was at the time that Mr. Byrnes was a private citizen; and later, when he became Secretary, he continued with it.

Senator BYRD. General, do you think the auditing of the Manhattan project in any way endangered any of the secrets?

General GROVES. No, sir.

Senator BYRD. And you think the audit in the future can be handled in the same way, namely, that there would be an audit made by the General Accounting Office?

General GROVES. I see no reason why it cannot be handled that way and I am sure it will be, as long as the present administration of the Comptroller General's office is as it is today and as long as the Atomic Energy Commission does its part in the getting along, too.

Senator BYRD. Have the suggested amendments been shown to you?

General GROVES. I have just seen them this morning. I did not know what some of these revised statutes were, unfortunately; but, as I understood them, they essentially said that you could enter into contracts without advertising and without competitive bidding.

Now, that is very essential, because it is the same thing as if you were trying to get competitive bidding when you want to get a doctor to perform an operation on you. That is the kind of affair that you have here, and I don't see how you could have competitive bidding from the standpoint of security; but let alone security, just from the standpoint of getting the best possible job that has to be gotten.

The CHAIRMAN. Mr. Warren, how about the State Department? Do they have any procedure whereby they spend money on a blanket authorization?

Mr. FISHER. Yes.

The CHAIRMAN. That is the same nature as the FBI?

Mr. FISHER. Generally, the same purpose, just not to disclose the purpose for which the money was spent, and make certification that it was spent for confidential purposes, which it is not in the public interest to disclose.

The CHAIRMAN. Now, that has no legislative authorization? It is simply before the Appropriations Committee?

Mr. FISHER. It is in the statutes of the State Department.

The CHAIRMAN. Would there be any objection, from the Comptroller General's standpoint, to putting it in here? Do you think we will need it?

Mr. YATES. I don't think you do, Mr. Chairman.

Mr. WARREN. I don't think you need it, although we are not opposing that.

The CHAIRMAN. Why, if they need it, would this Commission not need it, or do they need it themselves?

Mr. WARREN. Well, they probably do, dealing with world affairs as they do and highly confidential matters between nations. Probably they do need it.

The CHAIRMAN. Of course, there would be some highly confidential operations in this Commission, I presume.

Mr. YATES. I thought your question was whether the authorization is needed or not.

The CHAIRMAN. Well, since it is written into the Revised Statutes applying to the State Department, I questioned whether, unless we wrote it into this bill, the Appropriations Committee could make that kind of appropriation. Frankly, I don't know. The very fact that it appears in the Revised Statutes of the State Department, which apparently thought it was necessary, leads me to believe that maybe it should be in here.

Mr. WARREN. You have reference to a point of order?

The CHAIRMAN. Yes.

Mr. WARREN. I don't think it is subject to a point of order.

Senator VANDENBERG. I see no objection to putting it in the statute, do you, Mr. Warren?

Mr. WARREN. No; I do not, Senator.

Senator VANDENBERG. Well, let's put it in.

The CHAIRMAN. Are there any other questions, gentlemen?

Senator AUSTIN. I would like to ask General Groves to read that first amendment and see if he has any suggestion regarding it.

I will read it, if you wish to have me:

The Commission may make such arrangements without regard to the provisions of section 3709, Revised Statutes, upon certification by the Commission that such action is necessary in the interest of common defense and security, or upon a showing that advertising is not reasonably practicable, and may make partial and advance payments under such arrangements, and may make available for use in connection therewith such of its equipment and facilities as it may deem desirable.

Senator MILLIKIN. I don't understand that "equipment and facilities" reference. What is that?

The CHAIRMAN. Well, Senator, the Commission might have some technical equipment; but it might want to ship that out to the University of Iowa to assist them in connection with the performance of their contract, without any compensation, of course.

General GROVES. Of course, without that language being in there, that last clause, I wouldn't hesitate to make the equipment and facilities available in the performance of the contract. I have done it in the past, long before this ever came up.

For example, it was quite customary, if we wanted a design problem solved on antiaircraft searchlights, to say, "Here is the searchlight; now you work out your design on this particular light which belongs to the United States," and it was perfectly legal. At least, it was never questioned by anyone.

Mr. FISHER. I think they could do it without the language. I don't see that the language hurts it any. It is a right they would have under their contract anyway.

The CHAIRMAN. Would there be some thought that they would have to pay some rental for it, or anything like that?

Mr. FISHER. Not necessarily. If you provide it in the contract they take care of it that way, you see.

Senator BYRD. What is the language "upon a showing that advertising is not reasonably practicable"? Does that mean it is subject to the approval of the General Accounting Office?

Mr. FISHER. A recitation of the facts which would make advertising impracticable.

Senator BYRD. A certification which is final, or is it subject to review by the General Accounting Office?

Mr. FISHER. That particular feature there, the "reasonably practicable," isn't a certification; it would be a recitation of the facts, stating why it is not practicable. It is too easy to say it is just impracticable, without saying why.

The CHAIRMAN. That would put the final decision in the Comptroller General, wouldn't it?

Mr. YATES. It would require, Mr. Chairman, a showing. If a question is raised in the General Accounting Office, it would require a showing of the reasons to the General Accounting Office.

The CHAIRMAN. If you didn't agree with those reasons you could disallow, couldn't you?

Mr. YATES. Certainly.

General GROVES. Not with this language. It says "upon certification by the Commission," or "upon a showing."

The CHAIRMAN. We are talking about the alternative. In other words, let us assume the Commission could not honestly make a certification that it was in the interest of common defense and security, although I cannot imagine any contract that they would have that they couldn't certify under that provision.

Senator VANDENBERG. Why not take out the three words "upon a showing" so that it reads:

upon certification by the Commission that such action is necessary in the interest of common defense and security, or that advertising is not reasonably practicable.

Senator BYRD. I think they ought to give their reasons, though.

Senator VANDENBERG. That would be a certification. A certification is stronger than just a showing.

Senator BYRD. Does a certification show the reasons why the action is necessary?

Mr. YATES. In a doubtful case, a showing might be more effective than a certification, Senator Vandenberg. It is one thing to certify to something and another thing to state your reasons in the record for reaching that conclusion.

Senator VANDENBERG. I retire in complete humiliation.

General GROVES. From an operating standpoint, who is going to make the decision then? That wouldn't mean that the Comptroller General would pass on that showing, would it?

Mr. YATES. Yes; it would, General Groves. Of course, the certification would be accepted, except in a very unusual case which was highly doubtful, and therein would come the effectiveness of the showing.

Senator BYRD. In other words, they can make a certification for all action in the interest of common defense and security; and upon other things that they cannot make such a certification, they have to make a showing.

Senator VANDENBERG. And a showing, you say, is more useful than a certification?

The CHAIRMAN. To the Comptroller General.

Mr. YATES. I think it is more effective in a doubtful case, Senator.

Senator VANDENBERG. Maybe we ought to have a showing in both cases, then.

Mr. FISHER. They practically would have to disclose to us what the point in issue was in national security, otherwise.

Senator BYRD. That covers the national security end of it entirely.

General GROVES. That is all right as far as I can see, because if it isn't covered by the common defense and security, if we think back of what has been covered on the defense and think of the court decisions of various kinds, I think almost everything is covered by that, really.

Senator BYRD. That would probably cover 95 percent, anyway, wouldn't it?

General GROVES. That is correct.

The CHAIRMAN. There isn't anything you cannot bring in under common defense and security. Don't you agree?

General GROVES. That is correct; and the courts have held that repeatedly.

Senator BYRD. I would like General Groves to express his judgment on these other suggested amendments. The next one is to amend section 4 (c) (2), line 6, page 10, by striking out the words "with or without modification."

General GROVES. It doesn't make any difference to me. I don't understand why they want to strike it out, but I don't see any objection to it.

Mr. FISHER. That is unnecessary language, if you are going to make what would be termed a "legal modification." If you are just going to increase the contract price and pay the man a lot more money for doing the same thing, that would be what we would call a contract without consideration, and we are not recommending that you permit it in the other sections and see no point in having it here. They can amend any contract that they have if they get presumptive value out of it without being permitted in the bill.

General GROVES. This would permit them to modify it and give a man \$2 for what he contracted to do for \$1?

Mr. FISHER. That is right.

The CHAIRMAN. Now, have you used that provision, General, in the operation of the project? Have you found it necessary to amend your contracts sometimes?

General GROVES. Oh, yes; we have amended a lot of contracts, but I cannot recall any contract that was amended to give a man \$2 for something he had agreed to do for \$1.

The CHAIRMAN. How about \$2 for something he agreed to do for \$1.80?

General GROVES. Well, the same thing. In other words, any increase in price would have to be justified in some way or other.

Now, when you are dealing with anything like this, you always have those very difficult problems that in civilian life you would meet by just saying, "Well, we put this man into an impossible hole, and we have got to take him out."

We cannot do that in the Government service, and that is all there is to it. It is one of the unfortunate things, to do business that way, but we haven't the right to give away the Government's money, and for that reason I see no reason why this isn't all right.

The CHAIRMAN. Under the War Department appropriation bill as it has been carried on, they made considerable use of that, I understand, increasing the model contract.

General GROVES. I am not familiar with that.

Mr. FISHER. They did quite a lot under the First War Powers Act, probably 95 percent of which they don't have to rely on the First War Powers Act for, or maybe 99 percent.

Mr. WARREN. After all, equitable jurisdiction remains where it ought to remain, in the Congress, does it not?

General GROVES. That is correct, and it has got to remain there.

We had very unfortunate cases, things where if we were in a civilian organization we would just go out and pay the money; but you cannot pay it. You have that when you have a personal injury suit, where a man is crippled for life, and there is nothing you can do about it. It is a very unfortunate thing, because if you were in private business you would say, "We will pay this man; we will make him a gift." But as Government officers, we cannot make him that gift, much as we feel it is the thing to do, which should be done. I am perfectly anxious to have it introduced in Congress as a bill for relief, but I think that would apply.

The CHAIRMAN. Are there any further questions?

Senator BYRD. The amendment in line 10, page 11, I suppose, is in line with this other amendment on page 8.

General GROVES. As I understand it, it is the same as the one on page 8. It does the same thing.

Mr. FISHER. That is right.

Senator BYRD. What change does the amendment on line 14, page 14, effect?

The CHAIRMAN. To certify that it is necessary in the interest of national defense.

Mr. FISHER. In the bill they have it that they can make purchases without regard to the provisions of law relating to the making, performance, amendment, or modification of contracts.

That is the same provision that is in these other paragraphs that we are suggesting be amended all to read the same way.

General GROVES. You refer to it so much. Have you got section 3709 of the Revised Statutes?

Mr. FISHER. That is the statute that requires advertising for competitive bids.

General GROVES. Then what is the difference?

Mr. FISHER. You just don't have to get competitive bids. You can make any contract. But "without regard to the provisions of law relating to the making, performance, amendment, or modification of contracts," would come back to the same authority of giving the man \$2 instead of \$1 after you have made a contract.

Senator BYRD. Your suggested amendment there provides mainly that it has to be certified that it is in the interest of common defense and security?

Mr. FISHER. That is right, just like the one on page 8 for the showing that they couldn't advertise for competitive bids.

Senator BYRD. The next is along the same lines, page 16, line 13?

Mr. FISHER. That is the same situation.

Senator BYRD. And the next one on line 6, page 38?

Mr. FISHER. The purpose of that amendment is merely to restrict the housing, health, safety, welfare, and recreation of personnel to the project sites.

The CHAIRMAN. You couldn't build any places in Washington here for this personnel?

Mr. FISHER. That is right.

The CHAIRMAN. That is sensible.

General GROVES. That is the only thing? You have made that apply at the project site?

Mr. FISHER. That is right.

General GROVES. Now, what is your definition of a "project site"?

Mr. FISHER. These isolated places.

General GROVES. Let us just assume that we had work carried on, say, at Columbia University. How would that affect us? Would that be a project site?

Mr. FISHER. I don't think it would.

Senator BYRD. I think it ought to be a project site in terms of this amendment. They certainly shouldn't put up recreation facilities at Columbia, because they have a contract to do this work. That shouldn't open the door to have a lot of recreation facilities.

Mr. FISHER. I didn't write the law, but I imagine it was to construct these facilities at out-of-the-way places.

Senator BYRD. This money is going to be distributed all over the United States. I think there ought to be some limitation as to what they can do for recreation purposes. I certainly, for one, don't think it ought to apply to any university that has a grant. That grant should be used for research and not for recreation purposes.

Senator HICKENLOOPER. Should the limitation, Mr. Chairman, be put in there to the effect that these facilities for health, housing, welfare, and recreation, should be limited to project sites where such facilities are not generally available for use or something of that kind?

The CHAIRMAN. It is just the recreation of personnel that you would want to restrict. The housing, health, safety, and welfare might be as necessary there as at Oak Ridge.

Senator Byrd's point is that they have a movie house at One Hundred and Sixteenth Street, and you wouldn't have to build one at Columbia University; so the limitation, I take it, would come only on the recreation of personnel. Isn't that right, General Groves?

General GROVES. That is what I assumed. I just asked the question as to what the project site was.

Mr. FISHER. You wouldn't want to build houses for employees here in Washington and give them to them either, or on the university campus. I don't think you would want to build houses for employees.

General GROVES. It doesn't make any difference where your employee is. If you have this question of safety come in, you have got to provide the safety.

The CHAIRMAN. Take the Argonne Laboratories in Chicago. They are near civilization, aren't they?

General GROVES. About 20 miles out, but there, for example, we have to provide housing because you have a man who has to be available all the time.

Suppose we were running a continuous experiment of some kind where we wanted the man to be present. Then you have to provide the housing. Now, our housing provided at the Argonne was a bunkroom with a lot of bunks in it, but it was still properly considered as housing.

The CHAIRMAN. Do you have any recreation there?

General GROVES. I don't think we did. Nothing in the sense that you would think of it.

The CHAIRMAN. Cafeteria?

General GROVES. We had a lunchroom that was far from anything that would be put up here, but you have to spend some money for it. However economically you do it, you are still spending money.

The CHAIRMAN. We are not talking about the economy of it, but the necessity for it. I think you are right that if you are going to have a place like that, you have to have the power to do those things. That is the difficulty, Senator; take it only 20 miles out of Chicago, and all those things might be necessary.

General GROVES. I would hate to see that limit you.

The CHAIRMAN. I don't think, General, the Commission would be likely to be setting up any moving-picture theaters in Washington. Do you, Senator Vandenberg?

Senator VANDENBERG. I don't.

General GROVES. I think it would be perfectly safe, Senator Byrd, to have that "project sites" either removed, or have it understood that it meant anywhere where there was work going on, and then it wouldn't make any difference.

The CHAIRMAN. Have you a suggestion, Senator Byrd, for amending it?

Senator BYRD. No, I haven't. I don't exactly understand what the project sites means.

Senator VANDENBERG. Everything.

Senator BYRD. It wouldn't mean offices here in Washington. It would mean any place where any work was going on.

General GROVES. That is what it would mean to me.

Mr. FISHER. My thought was like the project at Oak Ridge.

Senator BYRD. You mean isolated places, and all that. It wouldn't mean that necessarily; it would mean any place where work was going on. It might be in the middle of New York City, mightn't it?

Mr. FISHER. If it were interpreted that way.

Senator BYRD. Why wouldn't it? The project site is where you are working on a project.

General GROVES. That is my understanding of it.

Senator BYRD. I don't think that language is good language. Have you any further suggestions?

Mr. FISHER. No, sir.

Senator CONNALLY. That is a pretty broad authorization.

Senator BYRD. You say there "where the recreation is not available." You have housing, safety, health, welfare—I don't know what "welfare" means—most anything—and recreation of personnel at the project site, which may be any place. You might have one here in Washington, might you not?

General GROVES. Yes, sir. We have work going on at various places in Washington, and you can call those project sites perfectly properly. That is why the word bothered me.

Senator BYRD. I am not objecting to having the proper recreation and welfare, but one single agency should not be permitted to have its own operation unless they are out in Oak Ridge, where they are separated from everything else.

If you build a new town as you did at Oak Ridge, where you have no facilities at all, then you have to furnish those facilities. If we let every individual agency of the Government have it separately, it is going to be a pretty far-reaching thing.

I would like to ask General Accounting Office to reconsider that and see if they cannot get some better language. I believe there should be some limitation with regard to it.

Senator AUSTIN. Why not put a qualification on it—"project sites at which such facilities are not available"?

Mr. WARREN. The committee's report could well cover that. We always look at committee reports in construing legislative language.

Senator CONNALLY. But it is better to have it in the law, rather than go back.

Mr. WARREN. I agree with you, Senator.

Senator BYRD. What do you think of the language suggested by Senator Austin?

Mr. YATES. I think it would be helpful.

The CHAIRMAN. Where would you put it?

Senator AUSTIN. Right after "sites," modifying "sites," "where such facilities are not available."

Senator VANDENBERG. "Where such facilities or services are not available."

Senator AUSTIN. Are there services in there?

General GROVES. "Welfare."

Senator AUSTIN. I think this was limited to buildings. Let's read it.

(5) acquire such materials, property, equipment, and facilities, establish or construct such buildings and facilities, and modify such buildings and facilities from time to time as it may deem necessary; and construct, acquire, provide, or arrange for such facilities and services at project sites where such facilities and services are not available * * *

Senator HART. Senator, do we need those words "and services"?

General GROVES. If you have an office that has as many as 100 female employees, you normally have to have a welfare worker among those employees. I think that is the standard in Washington.

Senator BYRD. Doesn't the general law cover that?

General GROVES. I should think so.

Senator BYRD. The point I am making is that this is a particular law applying to a certain agency of the Government. Doesn't the general law provide for welfare workers?

Mr. FISHER. I don't know that they call it welfare workers as such.

Senator BYRD. I mean a welfare officer, or whatever you call it.

Mr. YATES. I don't know of any specific provision for it, Senator Byrd, in any general law.

Senator BYRD. They have nurses.

The CHAIRMAN. Does that satisfy you, Senator Byrd, with that addition?

Senator BYRD. I believe so.

The CHAIRMAN. Are there any further questions?

Senator CONNALLY. That is separated by a semicolon. Are you sure that goes back to the acquisition of facilities and things in the first part of that paragraph? I am not sure that that is true.

Senator AUSTIN. Well, the verb "acquire"—

Senator CONNALLY. You put in the words "are not available." Will that be translated back up into the first three lines of that paragraph? It is set off by a semicolon.

Senator AUSTIN. But it goes back to the word "such"—"construct such buildings, acquire, provide, or arrange for such facilities and services."

Senator CONNALLY. That doesn't necessarily mean the "such" in the first three lines but means "such as are not available."

Senator AUSTIN. "Such facilities" refers there to the ones mentioned in the phrase set off by the semicolon. There isn't any other place to go with that "such."

Senator CONNALLY. Why a semicolon, then?

Mr. YATES. I suggest, Senator Austin, we cut out the semicolon, and then there will be no question.

Senator CONNALLY. Well, I won my point.

We had a supreme court in our State that got to be called the "semicolon court," because it decided some fool case as to where the semicolon was.

Senator VANDENBERG. I don't see any analogy.

Senator CONNALLY. Well, we decided this paragraph on a semicolon.

The CHAIRMAN. Now, you have taken out 12 (a) (10) on pages 39 and 40. That is the language which the Comptroller objected to.

Have you any further questions, Senator Byrd?

Senator AUSTIN. There is quite a change in the next paragraph, (b), security.

The CHAIRMAN. You mean the President may exempt?

Senator AUSTIN. Yes.

The CHAIRMAN. May in advance exempt.

Senator AUSTIN. That really changes the meaning of the paragraph. I have no objection to it myself, but it is quite a change.

The CHAIRMAN. In other words, they have to go to him now and show why they need an exemption before they may make the expenditure.

Senator AUSTIN. Yes; and there must be specific matter submitted and it is narrowed again by the words "in a particular matter," so that each one of those efforts has to be taken up in advance.

The CHAIRMAN. That is right.

Senator AUSTIN. Separately and individually?

Senator VANDENBERG. Don't you want consistent language—"in the interest of common defense and security?"

Senator AUSTIN. I always want that.

Senator VANDENBERG. "Common defense and security" should be in there, and strike out "national."

The CHAIRMAN. Are there any further questions of the Comptroller General or General Groves?

General GROVES. I would like to ask a question. If you eliminate 12 (a) (10), does anything take its place at all?

Senator AUSTIN. Yes. The first paragraph in the suggested amendment really takes its place.

Senator BYRD. You mean the amendment to the security clause?

Senator AUSTIN. The first paragraph:

The Commission may make such arrangements without regard to the provisions of section 3709 * * *.

No; that doesn't substitute.

Senator BYRD. That simply goes back to the general law.

Mr. FISHER. That is right.

Senator HART. May I ask the Comptroller General why his amendment omits these words after "contracts." The original language includes "purchases, sales, audits, reports, and similar matters."

The CHAIRMAN. Where are you reading from, Senator Hart?

Senator HART. Line 17, page 40.

Mr. WARREN. That came as a suggestion from several members of the committee, as I understood it. That should be reformed so that the President should act in advance. In the original draft of it, we objected to the word "audits."

Mr. FISHER. Then you have "contracts, purchases, and sales" there. Purchases and sales are contracts anyway; that is a sort of repetition there.

Senator CONNALLY. You mean you objected to exempting it from an audit; is that what you mean?

Mr. WARREN. Yes, and members of the committee—that is, Senator Hickenlooper and Senator Byrd, as I recall—suggested that that whole section there be re-formed so that the President should act in advance in a given case.

Senator BYRD. Then it specifies the particular case. Your suggestion would require the President to deal with a specific case rather than in generalities.

The CHAIRMAN. And also takes away from him the power to exempt the Commission from standard audit and reporting. Purchases and sales are certainly included within contracts. Do you want to make any comment on that, Senator?

Senator HART. No; I wasn't here when it was discussed.

The CHAIRMAN. Are there any further questions?

Senator BYRD. I would like to ask General Groves if he doesn't approve the deletion here of subsection 10.

General GROVES. I have just asked one question here on the side, and I see no reason why it shouldn't be deleted. I would like to state that I haven't seen this committee print before, so I assume that these things don't tie in in any way that is strange to me. I have only testified on what has been shown me this morning.

The CHAIRMAN. All right, gentlemen. I think we are through with this.

Senator HICKENLOOPER. I would like the committee to know Dr. F. H. Spedding, of Iowa State College. He did a tremendously vital part of this whole project. He happened to be in Washington, and I asked him to come down and see the committee work. He isn't here to testify; he says he has nothing to add to what the committee has done so far. The whole story of his activities is quite interesting.

The CHAIRMAN. The committee will now go into executive session. (Whereupon, at 11:25 a. m., the committee retired into executive session.)

x

ATOMIC ENERGY

HEARINGS

BEFORE THE

COMMITTEE ON MILITARY AFFAIRS

HOUSE OF REPRESENTATIVES

SEVENTY-NINTH CONGRESS

SECOND SESSION

ON

S. 1717

AN ACT FOR THE DEVELOPMENT AND CONTROL
OF ATOMIC ENERGY

JUNE 11, 12, AND 26, 1946.

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SEVENTY-NINTH CONGRESS

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JULIA WATTERSON, *Clerk*

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ATOMIC ENERGY

TUESDAY, JUNE 11, 1946

HOUSE OF REPRESENTATIVES,
COMMITTEE ON MILITARY AFFAIRS,
Washington, D. C.

The committee met at 10 a. m., Hon. Andrew J. May (chairman) presiding.

The CHAIRMAN. The committee will please be in order. The committee has met for the purpose of getting some advice from Secretary Patterson, as well as recommendations, on the question involved in S. 1717, commonly known as the atomic energy bill, it being an act for the development and control of atomic energy.

For the purpose of the record we will insert S. 1717 at this point. (S. 1717 is as follows:)

[S. 1717, 79th Cong., 2d sess.]

AN ACT For the development and control of atomic energy

Be it enacted by the Senate and House of Representatives of the United State of America in Congress assembled,

DECLARATION OF POLICY

SECTION 1. (a) FINDINGS AND DECLARATION.—Research and experimentation in the field of nuclear chain reaction have attained the stage at which the release of atomic energy on a large scale is practical. The significance of the atomic bomb for military purposes is evident. The effect of the use of atomic energy for civilian purposes upon the social, economic, and political structures of today cannot now be determined. It is a field in which unknown factors are involved. Therefore, any legislation will necessarily be subject to revision from time to time. It is reasonable to anticipate, however, that tapping this new source of energy will cause profound changes in our present way of life. Accordingly, it is hereby declared to be the policy of the people of the United States that, subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace.

(b) PURPOSE OF ACT.—It is the purpose of this Act to effectuate the policies set out in section 1 (a) by providing, among others, for the following major programs relating to atomic energy:

- (1) A program of assisting and fostering private research and development to encourage maximum scientific progress;
- (2) A program for the control of scientific and technical information which will permit the dissemination of such information to encourage scientific progress, and for the sharing on a reciprocal basis of information concerning the practical industrial application of atomic energy as soon as effective and enforceable safeguards against its use for destructive purposes can be devised;
- (3) A program of federally conducted research and development to assure the Government of adequate scientific and technical accomplishment;
- (4) A program for Government control of the production, ownership, and use of fissionable material to assure the common defense and security and to insure the broadest possible exploitation of the field; and

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(5) A program of administration which will be consistent with the foregoing policies and with international arrangements made by the United States, and which will enable the Congress to be currently informed so as to take further legislative action as may hereafter be appropriate.

ORGANIZATION

SEC. 2. (a) ATOMIC ENERGY COMMISSION.—

(1) There is hereby established an Atomic Energy Commission (herein called the Commission), which shall be composed of five members. Three members shall constitute a quorum of the Commission. The President shall designate one member as Chairman of the Commission.

(2) Members of the Commission shall be appointed by the President, by and with the advice and consent of the Senate. In submitting any nomination to the Senate, the President shall set for the experience and the qualifications of the nominee. The term of office of each member of the Commission taking office prior to the expiration of two years after the date of enactment of this Act shall expire upon the expiration of such two years. The term of office of each member of the Commission taking office after the expiration of two years from the date of enactment of this Act shall be five years, except that (A) the terms of office of the members first taking office after the expiration of two years from the date of enactment of this Act shall expire, as designated by the President at the time of appointment, one at the end of three years, one at the end of four years, one at the end of five years, one at the end of six years, and one at the end of seven years, after the date of enactment of this Act; and (B) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed, shall be appointed for the remainder of such term. Any member of the Commission may be removed by the President for inefficiency, neglect of duty, or malfeasance in office. Each member, except the Chairman, shall receive compensation at the rate of \$15,000 per annum; and the Chairman shall receive compensation at the rate of \$17,500 per annum. No member of the Commission shall engage in any other business, vocation, or employment than that of serving as a member of the Commission.

(3) The principal office of the Commission shall be in the District of Columbia, but the Commission or any duly authorized representative may exercise any or all of its powers in any place. The Commission shall hold such meetings, conduct such hearings, and receive such reports, as may be necessary to enable it to carry out the provisions of this Act.

(4) There are hereby established within the Commission—

(A) a General Manager, who shall discharge such of the administrative and executive functions of the Commission as the Commission may direct. The General Manager shall be appointed by the President by and with the advice and consent of the Senate, and shall receive compensation at the rate of \$15,000 per annum. The Commission may make recommendations to the President with respect to the appointment or removal of the General Manager.

(B) a Division of Research, a Division of Production, a Division of Engineering, and a Division of Military Application. Each division shall be under the direction of a Director who shall be appointed by the Commission, and shall receive compensation at the rate of \$14,000 per annum. The Commission shall require each such division to exercise such of the Commission's powers under this Act as the Commission may determine, except that the authority granted under section 3 (a) of this Act shall not be exercised by the Division of Research.

(b) GENERAL ADVISORY COMMITTEE.—There shall be a General Advisory Committee to advise the Commission on scientific and technical matters relating to materials, production, and research and development, to be composed of nine members, who shall be appointed from civilian life by the President. Each member shall hold office for a term of six years, except that (1) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed, shall be appointed for the remainder of such term; and (2) the terms of office of the members first taking office after the date of the enactment of this Act shall expire, as designated by the President at the time of appointment, three at the end of two years, three at the end of four years, and three at the end of six years, after the date of the enactment of this Act. The Committee shall designate one of its own members as Chairman. The Commit-

tee shall meet at least four times in every calendar year. The members of the Committee shall receive a per diem compensation of \$50 for each day spent in meetings or conferences, and all members shall receive their necessary traveling or other expenses while engaged in the work of the Committee.

(c) **MILITARY LIAISON COMMITTEE.**—There shall be a Military Liaison Committee consisting of representatives of the Departments of War and Navy, detailed or assigned thereto, without additional compensation, by the Secretaries of War and Navy in such number as they may determine. The Commission shall advise and consult with the Committee on all atomic energy matters which the Committee deems to relate to military applications, including the development, manufacture, use, and storage of bombs, the allocation of fissionable material for military research, and the control of information relating to the manufacture or utilization of atomic weapons. The Commission shall keep the Committee fully informed of all such matters before it and the Committee shall keep the Commission fully informed of all atomic energy activities of the War and Navy Departments. The Committee shall have authority to make written recommendations to the Commission on matters relating to military applications from time to time as it may deem appropriate. If the Committee at any time concludes that any action, proposed action, or failure to act of the Commission on such matters is adverse to the responsibilities of the Departments of War or Navy, derived from the Constitution, laws, and treaties, the Committee may refer such action, proposed action, or failure to act to the Secretaries of War and Navy.

If either Secretary concurs, he may refer the matter to the President, whose decision shall be final.

RESEARCH

SEC. 3. (a) RESEARCH ASSISTANCE.—The Commission is directed to exercise its powers in such manner as to insure the continued conduct of research and development activities in the fields specified below by private or public institutions or persons and to assist in the acquisition of an ever-expanding fund of theoretical and practical knowledge in such fields. To this end the Commission is authorized and directed to make arrangements (including contracts, agreements, grants-in-aid, and loans) for the conduct of research and development activities relating to—

- (1) nuclear processes;
- (2) the theory and production of atomic energy, including processes, materials, and devices related to such production;
- (3) utilization of fissionable and radioactive materials for medical, biological, health, or military purposes;
- (4) utilization of fissionable and radioactive materials and processes entailed in the production of such materials for all other purposes, including industrial uses; and
- (5) the protection of health during research and production activities.

The Commission may make such arrangements without regard to the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is not reasonably practicable, and may make partial and advance payments under such arrangements, and may make available for use in connection therewith such of its equipment and facilities as it may deem desirable. Such arrangements shall contain such provisions to protect health, to minimize danger from explosion and other hazards to life or property, and to require the reporting and to permit the inspection of work performed thereunder, as the Commission may determine; but shall not contain any provisions or conditions which prevent the dissemination of scientific or technical information, except to the extent such dissemination is prohibited by law.

(b) **RESEARCH BY THE COMMISSION.**—The Commission is authorized and directed to conduct, through its own facilities, activities and studies of the types specified in subsection (a) above.

PRODUCTION OF FISSIONABLE MATERIAL

SEC. 4. (a) DEFINITION.—As used in this Act, the term "produce", when used in relation to fissionable material, means to manufacture, produce, or refine fissionable material, as distinguished from source materials as defined in section 5 (b) (1), or to separate fissionable material from other substances in which such material may be contained or to produce new fissionable material.

(b) **PROHIBITION.**—It shall be unlawful for any person to own any facilities for the production of fissionable material or for any person to produce fissionable material, except to the extent authorized by subsection (c).

(c) **OWNERSHIP AND OPERATION OF PRODUCTION FACILITIES.**—

(1) **OWNERSHIP OF PRODUCTION FACILITIES.**—The Commission shall be the exclusive owner of all facilities for the production of fissionable material other than facilities which (A) are useful in the conduct of research and development activities in the fields specified in section 3, and (B) do not, in the opinion of the Commission, have a potential production rate adequate to enable the operator of such facilities to produce within a reasonable period of time a sufficient quantity of fissionable material to produce an atomic bomb or any other atomic weapon.

(2) **OPERATION OF THE COMMISSION'S PRODUCTION FACILITIES.**—The Commission is authorized and directed to produce or to provide for the production of fissionable material in its own facilities. To the extent deemed necessary, the Commission is authorized to make, or to continue in effect, contracts with persons obligating them to produce fissionable material in facilities owned by the Commission. The Commission is also authorized to enter into research and development contracts authorizing the contractor to produce fissionable material in facilities owned by the Commission to the extent that the production of such fissionable material may be incident to the conduct of research and development activities under such contracts. Any contract entered into under this section shall contain provisions (A) prohibiting the contractor with the Commission from subcontracting any part of the work he is obligated to perform under the contract, and (B) obligating the contractor to make such reports to the Commission as it may deem appropriate with respect to his activities under the contract, to submit to frequent inspection by employees of the Commission of all such activities, and to comply with all safety and security regulations which may be prescribed by the Commission. Any contract made under the provisions of this paragraph may be made without regard to the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made under such contracts. The President shall determine at least once each year the quantities of fissionable material to be produced under this paragraph.

(3) **OPERATION OF OTHER PRODUCTION FACILITIES.**—Fissionable material may be produced in the conduct of research and development activities in facilities which, under paragraph (1) above, are not required to be owned by the Commission.

(d) **IRRADIATION OF MATERIALS.**—For the purpose of increasing the supply of radioactive materials, the Commission is authorized to expose materials of any kind to the radiation incident to the processes of producing or utilizing fissionable material.

(e) **MANUFACTURE OF PRODUCTION FACILITIES.**—Unless authorized by a license issued by the Commission, no person may manufacture, produce, transfer, or acquire any facilities for the production of fissionable material. Licenses shall be issued in accordance with such procedures as the Commission may by regulation establish and shall be issued in accordance with such standards and upon such conditions as will restrict the production and distribution of such facilities to effectuate the policies and purposes of this Act. Nothing in this section shall be deemed to require a license for such manufacture, production, transfer, or acquisition incident to or for the conduct of research or development activities in the United States of the types specified in section 3, or to prohibit the Commission from manufacturing or producing such facilities for its own use.

CONTROL OF MATERIALS

SEC. 5. (a) FISSIONABLE MATERIALS.—

(1) **DEFINITION.**—As used in this Act, the term "fissionable material" means plutonium, uranium enriched in the isotope 235, any other material which the Commission determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, or any material, artificially enriched by any of the foregoing; but does not include source materials, as defined in section 5 (b) (1).

(2) **GOVERNMENT OWNERSHIP OF ALL FISSIONABLE MATERIALS.**—All right, title, and interest within or under the jurisdiction of the United States, in or to any fissionable material, now or hereafter produced, shall be the property of the Commission, and shall be deemed to be vested in the Commission by virtue of this Act. Any person owning any interest in any fissionable material at the time of the enactment of this Act, or owning any interest in any material at the time when such material is hereafter determined to be fissionable material, or who lawfully produces any fissionable material incident to privately financed research or development activities, shall be paid just compensation therefor. The Commission may, by action consistent with the provisions of paragraph (4) below, authorize any such person to retain possession of such fissionable material, but no person shall have any title in or to any fissionable material.

(3) **PROHIBITION.**—It shall be unlawful for any person, after sixty days from the effective date of this Act to (A) possess or transfer any fissionable material, except as authorized by the Commission, or (B) export from or import into the United States any fissionable material, or (C) directly or indirectly engage in the production of any fissionable material outside of the United States.

(4) **DISTRIBUTION OF FISSIONABLE MATERIAL.**—Without prejudice to its continued ownership thereof, the Commission is authorized to distribute fissionable material, with or without charge, to applicants requesting such material (A) for the conduct of research or development activities either independently or under contract or other arrangement with the Commission, (B) for use in medical therapy, or (C) for use pursuant to a license issued under the authority of section 7. Such material shall be distributed in such quantities and on such terms that no applicant will be enabled to obtain an amount sufficient to construct a bomb or other military weapon. The Commission is directed to distribute sufficient fissionable material to permit the conduct of widespread independent research and development activity, to the maximum extent practicable. In determining the quantities of fissionable material to be distributed, the Commission shall make such provisions for its own needs and for the conservation of fissionable material as it may determine to be necessary in the national interest for the future development of atomic energy. The Commission shall not distribute any material to any applicant, and shall recall any distributed material from any applicant, who is not equipped to observe or who fails to observe such safety standards to protect health and to minimize danger from explosion or other hazard to life or property as may be established by the Commission, or who uses such material in violation of law or regulation of the Commission or in a manner other than as disclosed in the application therefor.

(5) The Commission is authorized to purchase or otherwise acquire any fissionable material or any interest therein outside the United States, or any interest in facilities for the production of fissionable material, or in real property on which such facilities are located, without regard to the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made under contracts for such purposes. The Commission is further authorized to take, requisition, or condemn, or otherwise acquire any interest in such facilities or real property, and just compensation shall be made therefor.

(b) **SOURCE MATERIALS.**—

(1) **DEFINITION.**—As used in this Act, the term "source material" means uranium, thorium, or any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable materials; but includes ores only if they contain one or more of the foregoing materials in such concentration as the Commission may by regulation determine from time to time.

(2) **LICENSE FOR TRANSFERS REQUIRED.**—Unless authorized by a license issued by the Commission, no person may transfer or deliver and no person may receive possession of or title to any source material after removal from its place of deposit in nature, except that licenses shall not be required for quantities of source materials which, in the opinion of the Commission, are unimportant.

(3) **ISSUANCE OF LICENSES.**—The Commission shall establish such standards for the issuance, refusal, or revocation of licenses as it may deem necessary to assure adequate source materials for production, research, or development activities pursuant to this Act or to prevent the use of such materials in a manner incon-

sistent with the national welfare. Licenses shall be issued in accordance with such procedures as the Commission may by regulation establish.

(4) REPORTING.—The Commission is authorized to issue such regulations or orders requiring reports of ownership, possession, extraction, refining, shipment, or other handling of source materials as it may deem necessary, except that such reports shall not be required with respect to (A) any source material prior to removal from its place of deposit in nature, or (B) quantities of source materials which in the opinion of the Commission are unimportant or the reporting of which will discourage independent prospecting for new deposits.

(5) ACQUISITION.—The Commission is authorized and directed to purchase, take, requisition, condemn, or otherwise acquire, supplies of source materials or any interest in real property containing deposits of source materials to the extent it deems necessary to effectuate the provisions of this Act. Any purchase made under this paragraph may be made without regard to the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made thereunder. The Commission may establish guaranteed prices for all source materials delivered to it within a specified time. Just compensation shall be made for any property taken, requisitioned, or condemned under this paragraph.

(6) EXPLORATION.—The Commission is authorized to conduct and enter into contracts for the conduct of exploratory operations, investigations, and inspections to determine the location, extent, mode of occurrence, use, or conditions of deposits or supplies of source materials, making just compensation for any damage or injury occasioned thereby. Such exploratory operations may be conducted only with the consent of the owner, but such investigations and inspections may be conducted with or without such consent.

(7) PUBLIC LANDS.—All uranium, thorium, and all other materials determined pursuant to paragraph (1) of this subsection to be peculiarly essential to the production of fissionable material, contained, in whatever concentration, in deposits in the public lands are hereby reserved for the use of the United States; except that with respect to any location, entry, or settlement made prior to the date of enactment of this Act no reservation shall be deemed to have been made, if such reservation would deprive any person of any existing or inchoate rights or privileges to which he would otherwise be entitled or would otherwise enjoy: *Provided, however,* That no person, corporation, partnership, or association, which had any part, directly or indirectly, in the development of the atomic bomb project, may benefit by any location, entry, or settlement upon the public domain made after such person, corporation, partnership, or association took part in such project. The Secretary of the Interior shall cause to be inserted in every patent, conveyance, lease, permit, or other authorization hereafter granted to use the public lands or their mineral resources, under any of which there might result the extraction of any materials so reserved, a reservation to the United States of all such materials, whether or not of commercial value, together with the right of the United States through its authorized agents or representatives at any time to enter upon the land and prospect for, mine, and remove the same, making just compensation for any damage or injury occasioned thereby. Any lands so patented, conveyed, leased, or otherwise disposed of may be used, and any rights under any such permit or authorization may be exercised, as if no reservation of such materials had been made under this subsection; except that, when such use results in the extraction of any such material from the land in quantities which may not be transferred or delivered without a license under this subsection, such material shall be the property of the Commission and the Commission may require delivery of such material to it by any possessor thereof after such material has been separated as such from the ores in which it was contained. If the Commission requires the delivery of such material to it, it shall pay to the person mining or extracting the same, or to such other person as the Commission determines to be entitled thereto, such sums, including profits, as the Commission deems fair and reasonable for the discovery, mining, development, production, extraction, and other services performed with respect to such material prior to such delivery, but such payment shall not include any amount on account of the value of such material before removal from its place of deposit in nature. If the Commission does not require delivery of such material to it, the reservation made pursuant to this paragraph shall be of no further force or effect.

(c) BYPRODUCT MATERIALS.—

(1) **DEFINITION.**—As used in this Act, the term "byproduct material" means any radioactive material (except fissionable material) yielded in or made radioactive by exposure to the radiation incident to the processes of producing or utilizing fissionable material.

(2) **DISTRIBUTION.**—The Commission is authorized to distribute, with or without charge, byproduct materials to applicants seeking such materials for research or development activity, medical therapy, industrial uses, or such other useful applications as may be developed. In distributing such materials, the Commission shall give preference to applicants proposing to use such materials in the conduct of research and development activity or medical therapy. The Commission shall not distribute any byproduct materials to any applicant, and shall recall any distributed materials from any applicant, who is not equipped to observe or who fails to observe such safety standards to protect health as may be established by the Commission or who uses such materials in violation of law or regulation of the Commission or in a manner other than as disclosed in the application therefor. **(d) GENERAL PROVISIONS.—**

(1) The Commission shall not distribute any fissionable or source material to any person for a use which is not under or within the jurisdiction of the United States or to any foreign government.

(2) The Commission shall establish by regulation a procedure by which any person who is dissatisfied with the distribution or refusal to distribute to him, or the recall from him, of any fissionable or byproduct materials or with the issuance, refusal, or revocation of a license to him for the transfer or receipt of source materials may obtain a review of such determination by a board of appeal consisting of three members appointed by the Commission. The Commission may in its discretion review and revise any decision of such board of appeal.

MILITARY APPLICATIONS OF ATOMIC ENERGY

SEC. 6. (a) AUTHORITY.—The Commission is authorized to—

(1) conduct experiments and do research and development work in the military application of atomic energy; and

(2) engage in the production of atomic bombs, atomic bomb parts, or other military weapons utilizing fissionable materials; except that such activities shall be carried on only to the extent that the express consent and direction of the President of the United States has been obtained, which consent and direction shall be obtained at least once each year.

The President from time to time may direct the Commission to deliver such quantities of weapons to the armed forces for such use as he deems necessary in the interest of national defense.

(b) **PROHIBITION.**—It shall be unlawful for any person to manufacture, produce, transfer, or acquire any equipment or device utilizing fissionable material or atomic energy as a military weapon, except as may be authorized by the Commission. Nothing in this subsection shall be deemed to modify the provisions of section 4 of this Act, or to prohibit research activities in respect of military weapons, or to permit the export of any such equipment or device.

UTILIZATION OF ATOMIC ENERGY

SEC. 7. (a) LICENSE REQUIRED.—It shall be unlawful, except as provided in sections 5 (a) (4) (A) or (B) or 6 (a), for any person to manufacture, produce, or export any equipment or device utilizing fissionable material or atomic energy or to utilize fissionable material or atomic energy with or without such equipment or device, except under and in accordance with a license issued by the Commission authorizing such manufacture, production, export, or utilization. No license may permit any such activity if fissionable material is produced incident to such activity, except as provided in sections 3 and 4. Nothing in this section shall be deemed to require a license for the conduct of research or development activities relating to the manufacture of such equipment or devices or the utilization of fissionable material or atomic energy, or for the manufacture or use of equipment or devices for medical therapy.

(b) **REPORT TO CONGRESS.**—Whenever in its opinion any industrial, commercial, or other nonmilitary use of fissionable material or atomic energy has been sufficiently developed to be of practical value, the Commission shall prepare a report to the President stating all the facts with respect to such use, the Commission's estimate of the social, political, economic, and international effects of

such use and the Commission's recommendations for necessary or desirable supplemental legislation. The President shall then transmit this report to the Congress together with his recommendations. No license for any manufacture, production, export, or use shall be issued by the Commission under this section until after (1) a report with respect to such manufacture, production, export, or use has been filed with the Congress; and (2) a period of ninety days in which the Congress was in session has elapsed after the report has been so filed. In computing such period of ninety days, there shall be excluded the days on which either House is not in session because of an adjournment of more than three days.

(c) **ISSUANCE OF LICENSES.**—After such ninety-day period, unless hereafter prohibited by law, the Commission may license such manufacture, production, export, or use in accordance with such procedures and subject to such conditions as it may by regulation establish to effectuate the provisions of this Act. The Commission is authorized and directed to issue licenses on a nonexclusive basis and to supply to the extent available appropriate quantities of fissionable material to licensees (1) whose proposed activities will serve some useful purpose proportionate to the quantities of fissionable material to be consumed; (2) who are equipped to observe such safety standards to protect health and to minimize danger from explosion or other hazard to life or property as the Commission may establish; and (3) who agree to make available to the Commission such technical information and data concerning their activities pursuant to such licenses as the Commission may determine necessary to encourage similar activities by as many licensees as possible. Each such license shall be issued for a specified period, not to exceed one year, shall be revocable at any time by the Commission in accordance with such procedures as the Commission may establish, and may be renewed upon the expiration of such period. Where activities under any license might serve to maintain or to foster the growth of monopoly, restraint of trade, unlawful competition, or other trade position inimical to the entry of new, freely competitive enterprises in the field, the Commission is authorized and directed to refuse to issue such license or to establish such conditions to prevent these results as the Commission, in consultation with the Attorney General, may determine. The Commission shall report promptly to the Attorney General any information it may have with respect to any utilization of fissionable material or atomic energy which appears to have these results. No license may be given to any person for activities which are not under or within the jurisdiction of the United States or to any foreign government.

(d) **BYPRODUCT POWER.**—If energy which may be utilized is produced in the production of fissionable material, such energy may be used by the Commission, transferred to other Government agencies, or sold to public or private utilities under contracts providing for reasonable resale prices.

INTERNATIONAL ARRANGEMENTS

SEC. 8. (a) DEFINITION.—As used in this Act, the term "international arrangement" shall mean any treaty approved by the Senate or international agreement approved by the Congress, during the time such treaty or agreement is in full force and effect.

(b) **EFFECT OF INTERNATIONAL ARRANGEMENTS.**—Any provision of this Act or any action of the Commission to the extent that it conflicts with the provisions of any international arrangement made after the date of enactment of this Act shall be deemed to be of no further force or effect.

(c) **POLICIES CONTAINED IN INTERNATIONAL ARRANGEMENTS.**—In the performance of its functions under this Act, the Commission shall give maximum effect to the policies contained in any such international arrangement.

PROPERTY OF THE COMMISSION

SEC. 9. (a) The President shall direct the transfer to the Commission of all interests owned by the United States or any Government agency in the following property:

(1) All fissionable material; all atomic weapons and parts thereof; all facilities, equipment, and materials for the processing, production, or utilization of fissionable material or atomic energy; all processes and technical information of any kind, and the source thereof (including data, drawings, specifications, patents, patent applications, and other sources) relating to the processing, production, or utilization of fissionable material or atomic energy; and all contracts, agreements, leases, patents, applications for patents, inventions and

discoveries (whether patented or unpatented), and other rights of any kind concerning any such items;

(2) All facilities, equipment, and materials, devoted primarily to atomic energy research and development; and

(3) Such other property owned by or in the custody or control of the Manhattan Engineer District or other Government agencies as the President may determine.

(b) In order to render financial assistance to those States and localities in which the activities of the Commission are carried on and in which the Commission has acquired property previously subject to State and local taxation, the Commission is authorized to make payments to State and local governments in lieu of property taxes. Such payments may be in the amounts, at the times, and upon the terms the Commission deems appropriate, but the Commission shall be guided by the policy of not making payments in excess of the taxes which would have been payable for such property in the condition in which it was acquired, except in cases where special burdens have been cast upon the State or local government by activities of the Commission, the Manhattan Engineer District or their agents. In any such case, any benefit accruing to the State or local government by reason of such activities shall be considered in determining the amount of the payment. The Commission, and the property, activities, and income of the Commission, are hereby expressly exempted from taxation in any manner or form by any State, county, municipality, or any subdivision thereof.

CONTROL OF INFORMATION

SEC. 10. (a) Policy.—It shall be the policy of the Commission to control the dissemination of restricted data in such a manner as to assure the common defense and security. Consistent with such policy, the Commission shall be guided by the following principles:

(1) That information with respect to the use of atomic energy for industrial purposes should be shared with other nations on a reciprocal basis as soon as the Congress declares by joint resolution that effective and enforceable international safeguards against the use of such energy for destructive purposes have been established; and

(2) That the dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged so as to provide that free interchange of ideas and criticism which is essential to scientific progress.

(b) DISSEMINATION.—The Commission is authorized and directed to establish such information services, publications, libraries, and other registers of available information as it may deem necessary or desirable to provide for the dissemination of information in accordance with subsection (a).

(c) RESTRICTIONS.—

(1) The term "restricted data" as used in this section means all data concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production of power, but shall not include any data which the Commission from time to time determines may be published without adversely affecting the common defense and security.

(2) Whoever, lawfully or unlawfully, having possession of, access to, control over, or being entrusted with, any document, writing, sketch, photograph, plan, model, instrument, appliance, note, or information involving or incorporating restricted data—

(A) communicates, transmits, or discloses the same to any individual or person, or attempts or conspires to do any of the foregoing with intent to injure the United States or with intent to secure an advantage to any foreign nation, upon conviction thereof, shall be punished by a fine of not more than \$20,000 or imprisonment for not more than twenty years, or both;

(B) communicates, transmits, or discloses the same to any individual or person, or attempts or conspires to do any of the foregoing, with reason to believe such data will be utilized to injure the United States or to secure an advantage to any foreign nation, shall, upon conviction, be punished by a fine of not more than \$10,000 or imprisonment for not more than ten years, or both.

(3) Whoever, with intent to injure the United States or with intent to secure an advantage to any foreign nation, acquires or attempts or conspires to acquire any document, writing, sketch, photograph, plan, model, instrument, appliance, note or information involving or incorporating restricted data shall, upon con-

viction thereof, be punished by a fine of not more than \$20,000 or imprisonment for not more than twenty years, or both.

(4) Whoever, with intent to injure the United States or with intent to secure an advantage to any foreign nation, removes, conceals, tampers with, alters, mutilates, or destroys any document, writing, sketch, photograph, plan, model, instrument, appliance, or note involving or incorporating restricted data and used by any individual or person in connection with the production of fissionable material, or research or development relating to atomic energy, conducted by the United States, or financed in whole or in part by Federal funds, or conducted with the aid of fissionable material, shall be punished by a fine of not more than \$20,000 or imprisonment for not more than twenty years or both.

(5) No person shall be prosecuted for any violation under this section unless and until the Attorney General of the United States has advised and consulted with the Commission with respect to such prosecution.

(6) This section shall not exclude the applicable provisions of any other laws, except that no Government agency shall take any action under such other laws inconsistent with the provisions of this section.

(d) INSPECTIONS, RECORDS, AND REPORTS.—The Commission is—

(1) authorized by regulation or order to require such reports and the keeping of such records with respect to, and to provide for such inspections of, activities and studies of types specified in section 3 and of activities under licenses issued pursuant to section 7 as may be necessary to effectuate the purposes of this Act;

(2) authorized and directed by regulation or order to require regular reports and records with respect to, and to provide for frequent inspections of, the production of fissionable material in the conduct of research and development activities.

PATENTS AND INVENTIONS

SEC. 11. (a) PRODUCTION AND MILITARY UTILIZATION.

(1) No patent shall hereafter be granted for any invention or discovery which is useful solely in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon. Any patent granted for any such invention or discovery is hereby revoked, and just compensation shall be made therefor.

(2) No patent hereafter granted shall confer any rights with respect to any invention or discovery to the extent that such invention or discovery is used in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon. Any rights conferred by any patent heretofore granted for any invention or discovery are hereby revoked to the extent that such invention or discovery is so used, and just compensation shall be made therefor.

(3) Any person who has made or hereafter makes any invention or discovery useful in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon shall file with the Commission a report containing a complete description thereof, unless such invention or discovery is described in an application for a patent filed in the Patent Office by such person within the time required for the filing of such report. The report covering any such invention or discovery shall be filed on or before whichever of the following is the latest: (A) The sixtieth day after the date of enactment of this Act; (B) the sixtieth day after the completion of such invention or discovery; or (C) the sixtieth day after such person first discovers or first has reason to believe that such invention or discovery is useful in such production or utilization.

(b) USE OF INVENTIONS FOR RESEARCH.—No patent hereafter granted shall confer any rights with respect to any invention or discovery to the extent that such invention or discovery is used in the conduct of research or development activities in the fields specified in section 3. Any rights conferred by any patent heretofore granted for any invention or discovery are hereby revoked to the extent that such invention or discovery is so used, and just compensation shall be made therefor.

(c) NONMILITARY UTILIZATION.—

(1) It shall be the duty of the Commission to declare any patent to be affected with the public interest if (A) the invention or discovery covered by the patent utilizes or is essential in the utilization of fissionable material or

atomic energy; and (B) the licensing of such invention or discovery under this subsection is necessary to effectuate the policies and purposes of this Act.

(2) Whenever any patent has been declared, pursuant to paragraph (1), to be affected with the public interest—

(A) The Commission is hereby licensed to use the invention or discovery covered by such patent in performing any of its powers under this Act; and

(B) Any person to whom a license has been issued under section 7 is hereby licensed to use the invention or discovery covered by such patent to the extent such invention or discovery is used by him in carrying on the activities authorized by his license under section 7.

The owner of the patent shall be entitled to a reasonable royalty fee for any use of an invention or discovery licensed by this subsection. Such royalty fee may be agreed upon by such owner and the licensee, or in the absence of such agreement shall be determined by the Commission.

(3) No court shall have jurisdiction or power to stay, restrain, or otherwise enjoin the use of any invention or discovery by a licensee, to the extent that such use is licensed by paragraph (2) above, on the ground of infringement of any patent. If any action for infringement against such licensee the court shall determine that the defendant is exercising such license, the measure of damages shall be the royalty fee determined pursuant to this section, together with such costs, interest, and reasonable attorney's fees as may be fixed by the court. If no royalty fee has been determined, the court shall stay the proceeding until the royalty fee is determined pursuant to this section. If any such licensee shall fail to pay such royalty fee, the patentee may bring an action in any court of competent jurisdiction for such royalty fee, together with such costs, interest, and reasonable attorney's fees as may be fixed by the court.

(d) ACQUISITION OF PATENTS.—The Commission is authorized to purchase, or take, requisition, or condemn, and make just compensation for, (1) any invention or discovery which is useful in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon, or which utilizes or is essential in the utilization of fissionable material or atomic energy, or (2) any patent application covering any such invention or discovery. The Commissioner of Patents shall notify the Commission of all applications for patents heretofore or hereafter filed which in his opinion disclose such inventions or discoveries and shall provide the Commission access to all such applications.

(e) COMPENSATION AWARDS, AND ROYALTIES.—

(1) PATENT COMPENSATION BOARD.—The Commission shall designate a Patent Compensation Board, consisting of two or more employees of the Commission, to consider applications under this subsection.

(2) ELIGIBILITY.—

(A) Any owner of a patent licensed under subsection (c) (2) or any licensee thereunder may make application to the Commission for the determination of a reasonable royalty fee in accordance with such procedures as it by regulation may establish.

(B) Any person seeking to obtain the just compensation provided in subsections (a), (b), or (d) shall make application therefor to the Commission in accordance with such procedures as it may by regulation establish.

(C) Any person making any invention or discovery useful in the production of fissionable material or in the utilization of fissionable material or atomic energy, or a military weapon who is not entitled to compensation therefor under subsection (a) and who has complied with subsection (a) (3) above may make application to the Commission for, and the Commission may grant, an award.

(D) Any person making application under this subsection shall have the right to be represented by counsel.

(3) STANDARDS.—

(A) In determining such reasonable royalty fee, the Commission shall take into consideration any defense, general or special, that might be pleaded by a defendant in an action for infringement, the extent to which, if any, such patent was developed through federally financed research, the degree of utility, novelty, and importance of the invention or discovery, and may consider the cost to the owner of the patent of developing such invention or discovery or acquiring such patent.

(B) In determining what constitutes just compensation under subsection (a), (b), or (d) above, the Commission shall take into account the considera-

tions set forth in paragraph (A) above, and the actual use of such invention or discovery, and may determine that such compensation be paid in periodic payments or in a lump sum.

(C) In determining the amount of any award under paragraph (2) (C) of this subsection, the Commission shall take into account the considerations set forth in paragraph (A) above, and the actual use of such invention or discovery. Awards so made may be paid by the Commission in periodic payments or in a lump sum.

(4) JUDICIAL REVIEW.—Any person aggrieved by any determination of the Commission of an award or of a reasonable royalty fee may obtain a review of such determination in the Court of Appeals for the District of Columbia by filing in such court, within thirty days after notice of such determination, a written petition praying that such determination be set aside. A copy of such petition shall be forthwith served upon the Commission and thereupon the Commission shall file with the court a certified transcript of the entire record in the proceeding, including the findings and conclusions upon which the determination was based. Upon the filing of such transcript the court shall have exclusive jurisdiction upon the record certified to it to affirm the determination in its entirety or set it aside and remand it to the Commission for further proceedings. The findings of the Commission as to the facts, if supported by substantial evidence, shall be conclusive. The court's judgment shall be final, subject, however, to review by the Supreme Court of the United States upon writ of certiorari or petition therefor under section 240 of the Judicial Code (U. S. C., title 28, sec. 347), by the Commission or any party to the court proceeding.

GENERAL AUTHORITY

Sec. 12. (a) In the performance of its functions the Commission is authorized to—

(1) establish advisory boards to advise with and make recommendations to the Commission on legislation, policies, administration, research, and other matters;

(2) establish by regulation or order such standards and instructions to govern the possession and use of fissionable and byproduct materials as the Commission may deem necessary or desirable to protect health or to minimize danger from explosions and other hazards to life or property;

(3) make such studies and investigations, obtain such information, and hold such hearings as the Commission may deem necessary or proper to assist it in exercising any authority provided in this Act, or in the administration or enforcement of this Act, or any regulations or orders issued thereunder. For such purposes the Commission is authorized to administer oaths and affirmations, and by subpoena to require any person to appear and testify, or to appear and produce documents, or both, at any designated place. No person shall be excused from complying with any requirements under this paragraph because of his privilege against self incrimination, but the immunity provisions of the Compulsory Testimony Act of February 11, 1893 (U. S. C., title 49, sec. 46), shall apply with respect to any individual who specifically claims such privilege. Witnesses subpoenaed under this subsection shall be paid the same fees and mileage as are paid witnesses in the district courts of the United States;

(4) appoint and fix the compensation of such officers and employees as may be necessary to carry out the functions of the Commission. Such officers and employees shall be appointed in accordance with the civil-service laws and their compensation fixed in accordance with the Classification Act of 1923, as amended, except that to the extent the Commission deems such action necessary to the discharge of its responsibilities, personnel may be employed and their compensation fixed without regard to such laws. Attorneys appointed under this paragraph may appear for and represent the Commission in any case in any court. The Commission shall make adequate provision for administrative review of any determination to dismiss any employee;

(5) acquire such materials, property, equipment, and facilities, establish or construct such buildings and facilities, and modify such buildings and facilities from time to time as it may deem necessary, and construct, acquire, provide, or arrange for such facilities and services (at project sites where such facilities and services are not available) for the housing, health, safety,

welfare, and recreation of personnel employed by the Commission as it may deem necessary;

(6) with the consent of the agency concerned, utilize or employ the services or personnel of any Government agency or any State or local government, or voluntary or uncompensated personnel, to perform such functions on its behalf as may appear desirable;

(7) acquire, purchase, lease, and hold real and personal property as agent of and on behalf of the United States and to sell, lease, grant, and dispose of such real and personal property as provided in this Act;

(8) contract for the expenditure of funds for the purposes specified in section 10 (b) without regard to the provisions of section 87 of the Act of January 12, 1895 (28 Stat. 622), and section 11 of the Act of March 1, 1919 (40 Stat. 1270; U. S. C., title 44, sec. 111); and

(9) without regard to the provisions of the Surplus Property Act of 1944 or any other law, make such disposition as it may deem desirable of (A) radioactive materials, and (B) any other property the special disposition of which is, in the opinion of the Commission, in the interest of the national security.

(b) SECURITY.—The President may, in advance, exempt any specific action of the Commission in a particular matter from the provisions of law relating to contracts whenever he determines that such action is essential in the interest of the common defense and security.

(c) ADVISORY COMMITTEES.—The members of the General Advisory Committee established pursuant to section 2 (b) and the members of advisory boards established pursuant to subsection (a) (1) of this section may serve as such without regard to the provisions of sections 109 and 113 of the Criminal Code (18 U. S. C., secs. 183 and 203) or section 19 (e) of the Contract Settlement Act of 1944, except insofar as such sections may prohibit any such member from receiving compensation in respect of any particular matter which directly involves the Commission or in which the Commission is directly interested.

COMPENSATION FOR PRIVATE PROPERTY ACQUIRED

SEC. 13. (a) The United States shall make just compensation for any property or interests therein taken or requisitioned pursuant to sections 5 and 11. The Commission shall determine such compensation. If the compensation so determined is unsatisfactory to the person entitled thereto, such person shall be paid 50 percent of the amount so determined, and shall be entitled to sue the United States in the Court of Claims or in any district court of the United States in the manner provided by sections 24 (20) and 145 of the Judicial Code to recover such further sum as added to said 50 percent will make up such amount as will be just compensation.

(b) In the exercise of the rights of eminent domain and condemnation, proceedings may be instituted under the Act of August 1, 1888 (U. S. C., title 40, sec. 257), or any other applicable Federal statute. Upon or after the filing of the condemnation petition, immediate possession may be taken and the property may be occupied, used, and improved for the purposes of this act, notwithstanding any other law. Real property acquired by purchase, donation, or other means of transfer may also be occupied, used and improved for the purposes of this act, prior to approval of title by the Attorney General.

JOINT COMMITTEE ON ATOMIC ENERGY

SEC. 14. (a) There is hereby established a Joint Committee on Atomic Energy to be composed of nine Members of the Senate to be appointed by the President of the Senate, and nine Members of the House of Representatives to be appointed by the Speaker of the House of Representatives. In each instance not more than five members shall be members of the same political party.

(b) The joint committee shall make continuing studies of the activities of the Atomic Energy Commission and of problems relating to the development, use, and control of atomic energy. The Commission shall keep the joint committee fully and currently informed with respect to the Commission's activities. All bills, resolutions, and other matters in the Senate or the House of Representatives relating primarily to the Commission or to the development, use, or control of atomic energy shall be referred to the joint committee. The members of the joint committee who are Members of the Senate shall from time to time report to the Senate, and the members of the joint committee who are Members of the

House of Representatives shall from time to time report to the House, by bill or otherwise, their recommendations with respect to matters within the jurisdiction of their respective Houses which are (1) referred to the joint committee or (2) otherwise within the jurisdiction of the joint committee.

(c) Vacancies in the membership of the joint committee shall not affect the power of the remaining members to execute the functions of the joint committee, and shall be filled in the same manner as in the case of the original selection. The joint committee shall select a chairman and a vice chairman from among its members.

(d) The joint committee, or any duly authorized subcommittee thereof, is authorized to hold such hearings, to sit and act at such places and times, to require, by subpoena or otherwise, the attendance of such witnesses and the production of such books, papers, and documents, to administer such oaths, to take such testimony, to procure such printing and binding, and to make such expenditures as it deems advisable. The cost of stenographic services to report such hearings shall not be in excess of 25 cents per hundred words. The provisions of sections 102 to 104, inclusive, of the Revised Statutes shall apply in case of any failure of any witness to comply with a subpoena or to testify when summoned under authority of this section.

(e) The joint committee is empowered to appoint and fix the compensation of such experts, consultants, technicians, and clerical and stenographic assistants as it deems necessary and advisable, but the compensation so fixed shall not exceed the compensation prescribed under the Classification Act of 1923, as amended, for comparable duties. The committee is authorized to utilize the services, information, facilities, and personnel of the departments and establishments of the Government.

ENFORCEMENT

Sec. 15. (a) Whoever willfully violates, attempts to violate, or conspires to violate, any provision of sections 4 (b), 4 (e), 5 (a) (3), or 6 (b) shall, upon conviction thereof, be punished by a fine of not more than \$10,000 or by imprisonment for not more than five years, or both, except that whoever commits such an offense with intent to injure the United States or with intent to secure an advantage to any foreign nation shall, upon conviction thereof, be punished by a fine of not more than \$20,000 or by imprisonment for not more than twenty years, or both.

(b) Whoever willfully violates, attempts to violate, or conspires to violate, any provision of this Act other than those specified in subsection (a) and other than section 10 (c), or of any regulation or order prescribed or issued under sections 5 (b) (4), 10 (d), or 12 (a) (2), shall, upon conviction thereof, be punished by a fine of not more than \$5,000 or by imprisonment for not more than two years, or both, except that whoever commits such an offense with intent to injure the United States or with intent to secure an advantage to any foreign nation shall, upon conviction thereof, be punished by a fine of not more than \$20,000 or by imprisonment for not more than twenty years, or both.

(c) Whenever in the judgment of the Commission any person has engaged or is about to engage in any acts or practices which constitute or will constitute a violation of any provision of this Act, or any regulation or order issued thereunder, it may make application to the appropriate court for an order enjoining such acts or practices, or for an order enforcing compliance with such provision, and upon a showing by the Commission that such person has engaged or is about to engage in any such acts or practices a permanent or temporary injunction, restraining order, or other order shall be granted without bond.

(d) In case of failure or refusal to obey a subpoena served upon any person pursuant to section 12 (a) (3), the district court for any district in which such person is found or resides or transacts business, upon application by the Commission, shall have jurisdiction to issue an order requiring such person to appear and give testimony or to appear and produce documents, or both, in accordance with the subpoena; and any failure to obey such order of the court may be punished by such court as a contempt thereof.

REPORTS

Sec. 16. The Commission shall submit to the Congress, in January and July of each year, a report concerning the activities of the Commission. The Commission shall include in such report, and shall at such other times as it deems de-

sirable submit to the Congress, such recommendations for additional legislation as the Commission deems necessary or desirable.

DEFINITIONS

SEC. 17. As used in this Act—

(a) The term "atomic energy" shall be construed to mean all forms of energy released in the course of or as a result of nuclear fission or nuclear transformation.

(b) The term "Government agency" means any executive department, commission, independent establishment, corporation wholly or partly owned by the United States which is an instrumentality of the United States, board, bureau, division, service, office, officer, authority, administration, or other establishment, in the executive branch of the Government.

(c) The term "person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, the United States or any agency thereof, any government other than the United States, any political subdivision of any such government, and any legal successor, representative, agent, or agency of the foregoing, or other entity, but shall not include the Commission or officers or employees of the Commission in the exercise of duly authorized functions.

(d) The term "United States," when used in a geographical sense, includes all Territories and possessions of the United States.

(e) The term "research and development" means theoretical analysis, exploration, and experimentation, and the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes.

(f) The term "equipment or device utilizing fissionable material or atomic energy" shall be construed to mean any equipment or device capable of making use of fissionable material or peculiarly adapted for making use of atomic energy and any important component part especially designed for such equipment or devices, as determined by the Commission.

(g) The term "facilities for the production of fissionable material" shall be construed to mean any equipment or device capable of such production and any important component part especially designed for such equipment or devices, as determined by the Commission.

APPROPRIATIONS

SEC. 18. (a) There are hereby authorized to be appropriated such sums as may be necessary and appropriate to carry out the provisions and purposes of this Act. The Acts appropriating such sums may appropriate specified portions thereof to be accounted for upon the certification of the Commission only. Funds appropriated to the Commission shall, if obligated by contract during the fiscal year for which appropriated, remain available for expenditure for four years following the expiration of the fiscal year for which appropriated. After such four-year period, the unexpended balances of appropriations shall be carried to the surplus fund and covered into the Treasury.

(b) Such parts as the President may determine of the unexpended balances of appropriations, allocations, or other funds available for expenditure in connection with the Manhattan Engineer District are hereby transferred to the Commission and shall be available for expenditure for the purpose of carrying out the provisions of this Act.

SEPARABILITY OF PROVISIONS

SEC. 19. If any provision of this Act, or the application of such provision to any person or circumstances, is held invalid, the remainder of this Act or the application of such provision to persons or circumstances other than those as to which it is held invalid, shall not be affected thereby.

SHORT TITLE

SEC. 20. This Act may be cited as the "Atomic Energy Act of 1946."

Passed the Senate June 1 (legislative day, March 5), 1946.

Attest:

LESLIE L. BIFFLE, *Secretary.*

STATEMENT OF HON. ROBERT P. PATTERSON, SECRETARY OF WAR

The CHAIRMAN. Secretary Patterson, we are interested in having any statement you care to make to the committee at this time on S. 1717.

Secretary PATTERSON. I have a fairly short prepared statement, Mr. Chairman, which I should be glad to read and then answer questions.

The CHAIRMAN. That will be very agreeable.

Mr. THOMAS. A parliamentary inquiry, Mr. Chairman?

The CHAIRMAN. The gentleman will state it.

Mr. THOMAS. What bill are we considering now?

The CHAIRMAN. S. 1717.

Mr. THOMAS. What happened to the bill that we have already reported?

The CHAIRMAN. It is on the calendar of the House and is before the Rules Committee.

Mr. THOMAS. Why do we not take that up? What is the purpose of taking up the Senate bill?

The CHAIRMAN. We are taking up this bill for the purpose of getting the Secretary's views. We will talk about the other matter when we go into executive session.

You may proceed, Mr. Secretary.

The War Department favors prompt passage of S. 1717, intended to establish national policy in regard to atomic energy.

In the first place, the bill is believed to be along sound and constructive lines.

In the second place, promptness in passage of legislation is of urgent importance. This bill has already passed the Senate, and of the various bills that have been introduced on the subject of atomic energy it has made the greatest amount of progress toward ultimate passage.

The reasons for War Department support of this measure will be made evident, I believe, by a review of our record on atomic energy.

MANHATTAN DISTRICT

President Roosevelt in 1942 gave the War Department the responsibility of developing atomic energy as a weapon of war. The possibilities of an atomic bomb had been brought to his notice as early as 1939, and preliminary work on the matter had been carried forward by the National Defense Research Committee and the Office of Scientific Research and Development.

It was a responsibility of vast proportion and momentous consequences. We organized the Manhattan district to carry the project through to success. General Groves of the Corps of Engineers was placed in command, under direct supervision of the Secretary of War. Mobilization of scientists and of industrial concerns was intensified, and the program was pressed with the utmost vigor. The enormous scale of the enterprise can be gaged from the fact that at the height of activity 130,000 people were directly employed in it and \$2,000,000,000 were expended on it before the first bomb was dropped. Despite this, secrecy was imperative and was, on the whole, well maintained.

From the outset it was a war project, pure and simple. Success was signalized by the bombs dropped on Hiroshima and Nagasaki in August of last year. The Japanese gave their unconditional surrender a week later.

The War Department does not claim any disproportionate credit for what was achieved. Great credit is due to the scientists who developed the basic scientific information; to the men in industry who translated the scientific information into the final product; to the skilled and unskilled workers who labored long and hard; and to the Congress which made available vast sums of money without premature revelation of this great activity.

PLANNING FOR POSTWAR DEVELOPMENT

Secretary Stimson did not wait for the war to come to a close before starting plans for postwar development of atomic energy under civilian direction.

In May 1945, in anticipation of the probable success of the atomic bomb and of the prospect of an early end of the war, the Secretary, with approval of the President, took steps to initiate a long-range policy on atomic energy. He appointed the following special committee to survey the subject and to submit a program: Secretary Stimson, chairman; James F. Byrnes (then a private citizen); Will Clayton, Assistant Secretary of State; Ralph Bard, Under Secretary of Navy; George Harrison, Special Assistant to Secretary of War; Dr. Vannevar Bush, Chairman of the Office of Scientific Research and Development; Dr. Karl Compton, president, Massachusetts Institute of Technology; Dr. James Conant, president, Harvard University.

The special committee was assisted by a scientific panel drawn from the most eminent scientists working on the atomic energy project: Dr. J. R. Oppenheimer, Dr. E. O. Lawrence, Dr. Arthur H. Compton, Dr. Enrico Fermi.

After months of steady work the special committee recommended that legislation be adopted by Congress to direct the postwar development of atomic energy. The main objectives in the suggested legislation were to be as follows:

1. Creation of a civilian agency, a commission appointed by the President to take over the Manhattan project and relieve the War Department of responsibility for development of atomic energy.
2. Research and development to be conducted by the Commission for scientific, industrial, military, and medical purposes, with maximum use made of educational and research institutions and private enterprise; the Commission also to aid, encourage, and not interfere with independent research where the quantities involved should not be of military or industrial value and should not result in undue hazards.
3. The Commission to have the right to acquire all source materials, fissionable materials, patents, processes, and information with power to grant licenses on equal terms to qualified persons with a view to discouraging monopolies.
4. Exclusion of other persons from production, utilization, export and import of appreciable quantities of materials comprising the sources of atomic energy, except under conditions laid down by the Commission.

5. Security regulations to be adopted by Commission as required by considerations of national defense, with penalties for violation of regulations or terms of the act.

6. Activities of the Commission to be consistent with foreign policy and national defense as communicated to the Commission by the President.

The President approved of this general program. On October 3 of last year he sent a message to Congress, urging prompt passage of legislation and outlining the chief points to be covered, substantially as set forth above.

MAY-JOHNSON BILL

At the same time the War Department caused the bill later known as the May-Johnson bill to be introduced. The bill embodied the program formulated by the Stimson committee, as mentioned above, and was drawn up under supervision of the committee. It had already been submitted to and approved by the State Department, Department of Justice, and Department of the Interior.

The House Military Affairs Committee held prompt hearings. This was last October. Some witnesses criticized the bill as not containing sufficient safeguards for independent research. The War Department recalled the scientific panel and requested the members of it to consider these objections. The scientific panel suggested certain clarifying language to reinforce the provisions relative to research. The War Department tendered these provisions as amendments. This committee, after giving effect to these amendments and other amendments, reported the bill favorably last November.

I wish to express appreciation to this committee for the intensive and exacting study given to this problem last October. The bill then reported out marked the first legislative effort to chart a national policy on control of this new force that inevitably will bring about profound changes in the future of all peoples. You realized then that the situation called for prompt attention. There was and still is need for avoiding undue delay. The project was in charge of the War Department as a war measure. The War Department was not charged with responsibility for long-range development of atomic energy for peacetime uses. Continued uncertainties as to future policy were bound to be damaging to current operations of the enterprise. And with international arrangements on atomic energy clearly called for, it was vital that something be done to put our own house in order.

The May-Johnson bill came in later for heavy criticism. It was said that the bill was drafted by the military. This was conclusively disproved by the fact that the bill represented the conclusions of the special committee named by Secretary Stimson, with all members civilians; and a very distinguished and eminent committee it was.

The CHAIRMAN. Mr. Secretary, do you mean to say that every one of the committee was a civilian, there were no members of the armed forces?

Secretary PATTERSON. Every one of them was a civilian; yes, sir.

Mr. JOHNSON. Are the names of those men in the record?

Secretary PATTERSON. I named them a moment ago. It was also said that the bill was to perpetuate military control of atomic energy. A reading of the bill rebutted that charge, since complete control was to pass to the proposed civilian agency. No vestige of authority was left in the War Department. But the critics would not read the bill. Then the charge was made that at any rate the bill permitted the President to appoint military personnel as members of the new Commission, and likewise permitted the Commission to employ military personnel. That charge was true, but the provision was merely permissive. Unless the President or the Commission saw fit to appoint them, no one in the Army or Navy would have a place in the enterprise.

I am not saying for a moment it would have been a bad feature to have had them in it, but nevertheless the bill did not do it.

These matters were all set forth, but the censure continued nonetheless. There was never any substantial basis for these complaints. The issues raised were utterly unreal.

S. 1717 (McMAHON BILL)

The Senate last fall created a special committee on atomic energy. That committee devoted a large amount of time to a study of the subject and to the taking of testimony. Senator McMahon introduced S. 1717, and that bill after many amendments was reported favorably by the committee. It was passed by the Senate last week. That is the bill before you now.

S. 1717, in the content passed by the Senate, does not depart in objectives or in principal provisions from the program suggested last summer by the Stimson committee. There are many differences in detail, and a number of new features have been added in response to later developments. But in the main the treatment is the same—a new civilian agency composed of members appointed by the President—nine in the former bill and five in this bill; part time in the other bill and full time in this one. There are differences in detail but, as I say, a new civilian agency composed of members appointed by the President; aid and encouragement for research; ownership and operation of facilities to produce fissionable materials; ownership of fissionable materials; control of ores that are source materials; issuance of licenses to utilize atomic energy; control of information of a restricted character, with penalties for violations. These are the chief functions of the Commission. The bill calls for civilian control, and the War Department at all times has supported civilian control, notwithstanding statements to the contrary.

S. 1717 contains provisions relative to national defense that are new. I shall comment briefly on them. In the first place, a military liaison committee is set up, composed of representatives of the War and Navy Departments. The Commission is directed to advise and consult with this military committee and keep it fully informed on all atomic energy matters deemed by the Commission to relate to military applications, including the control of information. It is also provided that the military committee may make recommendations on matters relating to military applications, and in case it concludes that action or failure to act on the part of the Commission

is adverse to the responsibilities of the War Department or Navy Department, it may report the matter to the Secretaries of War or Navy, either of whom may take the case to the President for final decision.

In the second place, there is specific authority given to the Commission to conduct research and development work in military application of atomic energy; also to engage in production of atomic bombs and other weapons utilizing fissionable materials, to the extent directed by the President; and the President is empowered to direct delivery of such weapons to the armed forces.

These provisions, in my opinion, are adequate for purposes of national defense. No comparable provisions for participation by representatives of the War and Navy Departments are embodied in the May-Johnson bill. In this respect the bill under discussion goes further in safeguarding national defense than the May-Johnson bill or any other bill on the subject.

S. 1717 gives the Commission authority to protect restricted information in the interest of the common defense or security. As to violations of restricted information, they are punishable only where the offender acts with intent to injure the United States or to secure an advantage for a foreign nation or acts with reason to believe that the information will be so used. In this respect the coverage is not as broad as in the May-Johnson bill, which penalizes any violation of security regulations. It is a question of judgment as to which provision promotes the national security to the best advantage. If S. 1717 should prove inadequate, it can be amended in this respect later.

CONCLUSION

In the view of the War Department this bill is in the national interest. The field of atomic energy has limitless possibilities. At this early stage of development it would be vain to try to frame a measure that will answer our needs for all time. Any bill that is passed now is bound to require later amendments as the situation unfolds and as new applications are realized.

S. 1717 answers the needs as we can appraise them today. It gives adequate attention to the aspects of atomic energy that relate to national defense. I believe that it is sound legislation.

There are urgent considerations in favor of prompt action. We asked for prompt action last year, because of the unfortunate effects of uncertainty on the operations of the project and because of the need of deciding domestic policy on atomic energy before taking action on international arrangements. These factors are even more pressing now, with the United Nations Commission on Atomic Energy due to meet in a few days. In view of the recent passage of S. 1717 by the Senate, it offers much better prospects for expeditious action than the May-Johnson bill or any other bill on the subject of atomic energy. And on those grounds I urge a favorable report.

The CHAIRMAN. Mr. Secretary, do you recall when this matter first came up early last year, I was in Kentucky and called you by long-distance telephone and suggested that speedy action ought to be taken to see to it that legislation was enacted to enable us to protect the military secret of the atomic bomb?

Secretary PATTERSON. I think I do; yes.

The CHAIRMAN. In pursuance of that, the Secretary of War then appointed this committee to which you have referred that went to work on a study of how to make it secure, and what legislation was necessary, I believe?

Secretary PATTERSON. Yes, sir; that was in May of last year. Secretary Stimson and his assistant, Mr. George Harrison, who was giving close attention to this project, came to the conclusion that within a few months bombs would actually be dropped. All indications were that they would be a success. Of course, they might not result in the end of the war. Then again those bombs might have that effect. So it seemed to them that it was time to give study to long-range utilization of the Manhattan project.

The Secretary discussed that with the President, and with the President's approval, he appointed that eight-man committee. That was the start, so far as I know, of all effort and all study having to do with the postwar development of atomic energy.

That committee came to the conclusion that legislation was required and that they would recommend in the legislation that the matter be turned over to a civilian agency, taken out of the War Department, because it had so many possibilities of a peacetime character that the War Department had no mission in relation to it. That was the fundamental point in the study given it by the eight-man committee.

The CHAIRMAN. My view about the matter is that the technique of the atomic bomb and the secrets connected with it constitute a vital military secret; and that that secret ought to be preserved while at the same time we should allow research and development of whatever features there were that might lead to civilian improvements and civilian benefits.

Secretary PATTERSON. I agree entirely with that. I believe that S. 1717 accomplishes and achieves those objectives by placing it in the hands of the Commission on Atomic Energy with the direction to carry out, or with the authority at any rate to carry out military applications, further military applications, and to have a military liaison committee to participate in that activity. The bill does that.

The CHAIRMAN. What authority, Judge, do you think that liaison committee actually has under the provisions of this bill, other than to listen and report and recommend? They cannot enforce anything that they want to do?

Secretary PATTERSON. Of themselves, they cannot. They are supposed to consult, be advised and be kept informed by the Commission. There is supposed to be a two-way traffic of exchange of information, they to advise the Commission of military needs and the Commission to advise them of what they view as the military possibilities. And then they can report anything that they see fit in the way of the committee's action or proposed action or failure to act, to the Secretaries of War and Navy who, if they see fit, can take the matter to the President and the President makes the decision. I think that is a good arrangement.

The CHAIRMAN. In other words, the Secretary of War and the Secretary of the Navy have nothing to do whatsoever except to complain to the President if something is proposed that they do not want done?

Secretary PATTERSON. That is, assuming that they are at loggerheads with the Commission. Then they have recourse to the President.

The CHAIRMAN. Not loggerheads, but where there is an honest difference of opinion about what they can do.

Secretary PATTERSON. That is right; that is what I mean by loggerheads. I do not mean anything personal.

The CHAIRMAN. We have an instance in high places right now where people are at loggerheads, so I do not like to call it that.

Judge, I think your statement commended very highly the House bill, that has been on the calendar for 7 months. I think your statement justifies the bill. Here is my position on this legislation—

Secretary PATTERSON. I can only say this, Mr. Chairman. This bill, S. 1717, was drafted after months and months of work by an able committee in the Senate. Naturally enough, with all of that study devoted to it, and with some 6 months more of development in the background for this bill, it has a number of detailed provisions of a valuable character I believe that neither the Stimson committee in the War Department nor this committee had time to consider. It is still my belief that if prompt action could have been had on the bill that was in this committee last fall, it would have been beneficial. But we did not get prompt action on it.

Now this bill comes out. And I said that in its main features it is so close to the earlier bill, in its main outline, main treatment, that a comparison on those phases between the two bills is not very profitable.

In some ways I think this is a better bill. It certainly goes further in dealing with the national defense aspects of atomic energy than the earlier bill did. There was nothing in the May-Johnson bill creating a military liaison committee, no specific provision in it at all as to how the Army or the Navy would keep posted on what was going on in atomic energy. This bill does and it is better in that feature.

The CHAIRMAN. Did not the May-Johnson bill reserve to the War Department the authority to control the atomic bomb activities, and for that reason they did not need somebody to advise them?

Secretary PATTERSON. It did not give the War Department anything—the May-Johnson bill. It did not give it anything. The charge was made that the War Department was holding onto this thing. We were just thrown out of the window in that bill; that is the plain fact. Or we rather jumped out of the window ourselves.

The CHAIRMAN. Did you not approve it at that time?

Secretary PATTERSON. Yes, sir.

The CHAIRMAN. And General Royal approved it?

Secretary PATTERSON. Yes, sir; that is right.

The CHAIRMAN. And it was reported after long study and after a week's consideration, day after day here, on the question of amendments?

Secretary PATTERSON. That is right.

The CHAIRMAN. Here is my position in the matter, and I wonder if you have any objection to this amendment, assuming that the Senate bill gets to the floor. All I want to do is to get it to the floor of the House so we can act on it in view of some questions that are raised now by the Navy Department and the Department of Justice that you, perhaps, do not know about.

Secretary PATTERSON. No; I did not know that.

The CHAIRMAN. What I think ought to be done is, we ought to report this bill out and with the permission of the House substitute

the House bill, and then let the matter go to conference where we can all get together and have the benefit of counsel on both sides and then work out whatever is necessary, if there are any changes that ought to be made.

Secretary PATTERSON. Of course, I would never counsel hasty action or thoughtless action just for speed. Nevertheless, if the bill impresses the committee as having a good framework—and, as I say, any bill you pass is going to have many future amendments to it, it is bound to—if it impresses you, though, as it does me, as having a good basis, I believe that fairly prompt action is indicated.

The CHAIRMAN. I want prompt action. But let me ask you this. What provision of this bill authorizes the communication of civilian uses to foreign countries or other people throughout the world? Is there anything in it that requires the appointment of inspectors or investigators?

Secretary PATTERSON. No.

The CHAIRMAN. There is nothing in the bill which says that you shall appoint them. What do you think about that?

Secretary PATTERSON. Of course, that operation under the bill here comes under the jurisdiction of the Commission.

The CHAIRMAN. The Commission?

Secretary PATTERSON. Yes, sir. The Commission here has about the same powers on classification of information that is contained in the May-Johnson bill. The May-Johnson bill calls for regulations to be adopted to control information. This bill, S. 1717, provides that information may be freely disseminated by the Commission unless they say it is restricted data and if it is restricted data, then it may not be. It is a different way of expressing the same idea, as I see it.

The CHAIRMAN. Suppose as the result of international negotiation there is an arrangement made by which it is to be shared by other nations and inspectors and investigators are to be appointed. Do you not think the War Department and the Navy Department ought to have some power in the matter of saying who those inspectors should be, through their intelligence services?

Secretary PATTERSON. That, of course, goes into things that no bill before Congress deals with. That goes into international arrangements. This bill, or any bill that you pass, would be subject to treaty.

The CHAIRMAN. You mean to say that international agreements can vitiate the legislation?

Secretary PATTERSON. Well, I understood that treaties were part of the high law of the land.

The CHAIRMAN. They are, but they do not repeal statutes, as I understand.

Secretary PATTERSON. However, that gets into a field that is not covered by any legislation.

The CHAIRMAN. Mr. Thomason, have you any questions?

Mr. THOMASON. Mr. Secretary, in view of the international situation and conferences soon to be held, I think there ought to be very prompt legislation on this subject.

Secretary PATTERSON. I agree.

Mr. THOMASON. This committee is primarily a military committee, of course. This subject is very much larger than that. I do not

think it is so very important whether we are taking up on the floor of the House the House bill or the Senate bill or who the authors may be. It is a question of dealing with this in a very broad and constructive way.

I have read a good part of the hearings since our last meeting the other day, and they are very interesting. It seems to me that in view of the amendment offered to the original Senate bill by Senator Vandenberg and later adopted, together with the views of Admiral Hart and others, the secret of the bomb as well as the way it is to be handled, is pretty well taken care of.

It was interesting to observe, too, after the adoption of the Vandenberg amendment, the Senate's special committee after months of hearings of the greatest scientists of this country and perhaps other countries, passed that bill out unanimously and it later passed the Senate unanimously. So there must be something pretty constructive about it.

I would just like to ask this for the record, although I think it has probably already been answered; but I think we should be very specific about it. Do you as Secretary of War and, of course, speaking for the War Department, say to this committee that in your judgment and in the judgment of the War Department, the secret of the atomic bomb is properly safeguarded by this bill?

Secretary PATTERSON. I believe so. Of course, with any bill that sets up a commission, you have to have sound and efficient administration. We have a right to assume that we will get that. If that is accomplished, I believe the answer to your question is yes.

Mr. THOMASON. Do you say to this committee, in your capacity as Secretary of War, that you are satisfied with the provisions in this bill in section 3, known as the military liaison committee, that the War Department, charged with our national defense and our national security, would be properly informed and properly advised at all times regarding any military matters that the War Department ought to know about and through your representatives on the military liaison committee, those matters could be promptly reported to the President of the United States?

Secretary PATTERSON. Yes, sir; you are referring I think, Mr. Congressman, to paragraph (c)?

Mr. THOMASON. That is right, at the top of page 7 of the Senate bill.

Secretary PATTERSON. Yes.

Mr. THOMASON. In other words, you are entirely satisfied—

Secretary PATTERSON. Paragraph (c) of section 2.

Mr. THOMASON. You are entirely satisfied with the military security that would be provided to this country insofar as it affects the atomic bomb, by the provisions of that section?

Secretary PATTERSON. Yes, sir.

Mr. THOMASON. That is all.

Secretary PATTERSON. I might say that this was not in the original bill and in my testimony before the special committee of the Senate, I commented on section 6, I believe it was, dealing with military applications, pointing out that under section 6 as it then read, the commission was authorized to carry on research and production of military weapons, but that the Army and Navy were excluded. And then this paragraph (c) of section 2 provided for a military liaison committee,

which was later written into the act, and with that I am entirely satisfied.

Mr. THOMASON. That is the Vandenberg amendment.

Secretary PATTERSON. Yes, it is.

The CHAIRMAN. Mr. Short is recognized.

Mr. SHORT. Mr. Secretary, I suppose you approve the report by the State Department, the Lilienthal report, in which Mr. Oppenheimer and Compton and others were involved—in which they distinguished between the dangerous elements of this whole atomic research and the nondangerous elements. I am wondering if the Senate bill, 1717, makes proper provision for private industry to explore and carry on this work, or whether ownership and control are wholly going to be under the Government.

Secretary PATTERSON. No. I think the plan is like that in the May-Johnson bill, differing in detail, however. It provides that licenses may be issued by the Commission for industrial uses. It goes into more detail than the earlier bill does but I think the details are all good. You have got to report to Congress and let Congress take a look at it, I believe, for 90 days before the issuance of licenses.

Mr. SHORT. I was just wondering if the bill goes far enough. And the reason I ask you that question is that some representatives of the industries that worked and cooperated with the Government, contributed their time, and did it all out of patriotism during the war, are very much concerned about the control of this in the future, particularly as to the nondangerous elements for industrial or commercial purposes. They would like to see it done in the traditional way of free competitive enterprise.

Secretary PATTERSON. This whole business was developed with United States money, taxpayers' money, appropriated by Congress. The whole development was a Government development. It seems to me plain that ownership of the enterprise should remain in the Government. I think they do, however, provide for utilization on fair terms under license, with the national welfare paramount, to industrial concerns on terms specified in the act and to be, of course, implemented by decisions of the Commission. I do not think any exception can be taken to that.

The two acts are not far apart on that feature, as I read them.

Mr. SHORT. I wanted to have your views.

Mr. HOLIFIELD. Will the gentleman yield to me?

Mr. SHORT. I yield.

Mr. HOLIFIELD. Is it not true, Mr. Secretary, that section 14 which sets up the joint congressional committee of the House and Senate for a continuing study and for the purpose of future legislation, provides a safeguard by action of the legislative branch, both as to any complaint that the military might have, and as to any complaint that private enterprise might have, in the way of the misuse of the power of licensing by the Commission?

Secretary PATTERSON. I think so.

Mr. HOLIFIELD. I think that is an important feature.

Secretary PATTERSON. I was referring to the part that has to do directly with licenses.

Mr. HOLIFIELD. I was referring to a broader power, as set out in section 14 on page 43, which means that this is not a conclusive act,

that there will be other legislation and that the power resides in Congress to check on the Commission both as to military licenses and commercial licenses.

Secretary PATTERSON. I think that is a good provision, section 14.

Mr. HOLIFIELD. I think so, too.

Secretary PATTERSON. That is new in this act. It was not in the earlier act. It is a good provision.

Mr. SHORT. I yield to the gentleman from New Jersey, Mr. Thomas.

Mr. THOMAS. I would like to ask Mr. Holifield since when has this Congress had any interest in private enterprise?

Mr. HOLIFIELD. I believe my friend is being facetious on that. I think most of our legislation does have an effect on private enterprise.

The CHAIRMAN. A pretty bad effect, sometimes. But that is neither her nor there.

Mr. SHORT. I would like to call the attention of the Secretary to a provision on page 19, line 5:

Provided, however, That no person, corporation, partnership, or association, which had any part, directly or indirectly, in the development of the atomic-bomb project, may benefit by any location, entry, or settlement upon the public domain made after such person, corporation, partnership, or association took part in such project.

Secretary PATTERSON. Well, that is to prevent an inside job, I suppose.

Mr. SHORT. What would you do with a firm or a corporation that has been developing thorium, one of the ingredients of the atomic bomb, since 1906, from monosite sand. Of course, most monosite sand comes from Brazil and India, but we have made discoveries of it in this country in one or two spots. Miners excavating for silver and gold accidentally ran across it.

Will this provision on page 19 prevent that company from going ahead with the development of our own deposits in this country?

Secretary PATTERSON. I do not know. I would have to give some further study to these lines that you specify, Mr. Short. It only has to do with the public land.

Mr. SHORT. I asked that in connection with the conference report that we recently unanimously passed on strategic and critical materials—the stock-piling bill—where we did make provision for departments of the Government to carry on explorations to develop self-sufficiency in this country, no longer to rely wholly or largely upon importations of strategic materials. This ties in more or less with that.

The gentleman from New Jersey [Mr. Thomas], whether he knows it or know, has a company in his district, in Mayfield, and I know of one out in Illinois, that have been developing this thorium for a number of years. They say that with that provision in there they will just quit business and you will not have any atomic bomb, and some of the private enterprises that have developed this bomb—in fact, the one at Oak Ridge, the plant in Tennessee—say that while they were willing during the war to go ahead and let subcontracts, if the Senate bill prohibits the letting of subcontracts, you will have no atomic bomb.

Secretary PATTERSON. I had the impression that this bill had a provision in it or provisions, to encourage the discovery of ores within the United States that would be source materials for atomic energy. I do not have that part of the act right at hand, but I think it does.

Mr. SHORT. I should like you to give further consideration to that provision on page 19 and also to the question whether or not the Senate bill allows the letting of subcontracts.

Mr. SPARKMAN. Will the gentleman yield?

Mr. SHORT. I yield.

Mr. SPARKMAN. Of course, I would like to remind the gentlemen that the provision on page 19 is very restrictive and relates only to entry on public lands. It simply prevents one of these firms who may have worked with it, from having the opportunity to get an undue privilege on public lands. With reference to the matter of subcontracting, I would like to say that when we get into executive session I propose to offer an amendment on page 11, to insert simply these words, in line 18, after the word "contract," "except as authorized by the Commission." That would permit subcontracting, with the permission of the Commission.

Mr. SHORT. That is all right. I am glad you are going to offer it, because it is quite necessary to be put in there; because you know there is no organization in this country that will do this work alone. They will hire the best scientists in the country.

Mr. ELSTON. Will the gentleman yield?

Mr. SHORT. I yield to the gentleman from Ohio.

Mr. ELSTON. On the other hand, no company, no individual, may engage in any exploring operations or experiments, or do anything in connection with the development of atomic energy or the discovery of any of the materials that might be used in the development of atomic energy, without the specific license and consent of this Commission; is that not correct?

Secretary PATTERSON. I believe that is. The earlier bill contained similar provisions on that score. It is intended to vest full control over the ores, the refined substances called fissionable.

Mr. ELSTON. And private industry would have nothing to do with the development of anything unless the Commission saw fit to give them a license?

Secretary PATTERSON. I think that is so.

Mr. ELSTON. And then they go even further, under section 10, and say that information with respect to the use of atomic energy for industrial purposes should be shared with other nations on a reciprocal basis as soon as the Congress declares, in a joint resolution, that effective and enforceable international safeguards against the use of such energy for destructive purposes have been established. That is in section 10 on page 28.

Secretary PATTERSON. I think that is a good provision.

Mr. ELSTON. May I ask one more question? As a matter of fact, does the bill restrict anybody except the American people, American industry and the War and Navy Departments of this country?

Secretary PATTERSON. I do not know that any legislation we could pass could restrict a foreign country.

Mr. ELSTON. I agree that we could not. But the whole purpose of the bill is to restrict American industry, the American people and the War and Navy Departments in their activities in the development of atomic energy or atomic weapons. Our greatest fear today is that some other nation might get this information.

Mr. SHORT. They are working on it.

Mr. ELSTON. So this bill does not in any respect at all keep any other nation from getting the information. In fact, it makes it mandatory that we give the information.

Secretary PATTERSON. No.

Mr. ELSTON. Concerning the development of atomic energy for industrial purposes, to other countries.

Secretary PATTERSON. Well, that section 10 on information means this, that the utmost in the way of circulation of information be had except where the commission marks it restricted and then it throws the safeguards around the restricted information.

The CHAIRMAN. Gentlemen, it will be necessary for the committee to adjourn, as there has been a call of the House.

Judge, I have a rather lengthy letter here from the Attorney General addressed to the Speaker making a great many criticisms of the legislation from the viewpoint of the Department of Justice. He is inclined not to want to delay completion of the legislation, but has made these suggestions, and I think it would be rather fair to you to furnish you with a copy of that so you may look it over and see if you have any recommendation thereon to make to the committee.

Secretary PATTERSON. Thank you.

The CHAIRMAN. Can you return tomorrow morning at 10 o'clock, Mr. Secretary?

Secretary PATTERSON. I would be very glad to. I might say, in urging passage of this legislation, I do not take back a thing that I said about the earlier bill. It was a good bill. Nevertheless it has been misunderstood—and that is not the first time—and I am perfectly willing to pocket any pride in that legislation and take this bill, S. 1717, which is a good bill. It will result in early passage and getting this thing underway, and I recommend this bill.

The CHAIRMAN. I take the same position, Judge, but I think there are so many vital things that we ought to look into. The committee will adjourn until tomorrow at 10 o'clock.

(Whereupon the committee adjourned to meet on Wednesday, June 12, 1946, at 10 a. m.)

ATOMIC ENERGY

WEDNESDAY, JUNE 12, 1946

HOUSE OF REPRESENTATIVES,
COMMITTEE ON MILITARY AFFAIRS,
Washington, D. C.

The committee met, pursuant to notice, at 10 a. m., for further consideration of S. 1717, Hon. Andrew J. May (chairman) presiding. The CHAIRMAN. The committee will please come to order. Do you have any further statement, Judge?

STATEMENT OF HON. ROBERT P. PATTERSON, SECRETARY OF WAR—Resumed

Secretary PATTERSON. I have no further statement to make, Mr. Chairman.

The CHAIRMAN. Mr. Thomas.

Mr. THOMAS. Mr. Secretary, have you conferred with the Secretary of the Navy in connection with S. 1717?

Secretary PATTERSON. Only in a general way, and I was conferring just now with Assistant Secretary Kenney, of the Navy, who is here. That also was very brief.

Mr. THOMAS. I mean, during the time the bill was being prepared, did you confer with the Secretary of the Navy?

Secretary PATTERSON. I talked to him from time to time, never in very great detail.

Mr. THOMAS. Did you confer with the Secretary of State?

Secretary PATTERSON. Not on the provisions of the McMahon bill; no. I have conferred with him on atomic energy.

Mr. THOMAS. Did you confer with the Attorney General?

Secretary PATTERSON. Of course, his interests are mainly in foreign relations, in that aspect of it.

Mr. THOMAS. How about the Attorney General—did you confer with the Attorney General?

Secretary PATTERSON. I do not think I ever conferred with the Attorney General about it.

Mr. THOMAS. Now, when we had the other bill before us, the one that we voted out, in your testimony you made this statement, and I quote from the hearings before the Committee on Military Affairs before the House of Representatives on atomic energy in connection with H. R. 4280, where you said:

In the opinion of the interim committee, the legislation you now have is the soundest and most comprehensive that could be drawn to cover all those phases of domestic control of atomic energy that require action in the interest of national security, world peace, and the promotion of human welfare.

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You recall making that statement on that bill?

Secretary PATTERSON. Yes, sir.

Mr. THOMAS. Now you come in and say practically the same thing in connection with S. 1717.

Secretary PATTERSON. I think I pointed out yesterday that you have 8 months' more experience at this time than you had last October and that the draftsmen of S. 1717 therefore have the advantages of 8 months' more experience with the project and that much longer time in which to draft a bill.

Mr. THOMAS. That is just the point I was leading up to. Why the hurry now? Do you not think that maybe with 8 months' more experience we may be able to effect a better bill?

Secretary PATTERSON. No, sir. While the 8 months' experience has been of advantage in drafting a bill, there have been some very serious disadvantages from an 8 months' delay. You can imagine what goes on in a project where the future of it is just shrouded in uncertainty and the drifting away from the project that will take place where men who are working in it do not know what the United States is going to do about it.

There are various decisions of the highest importance to be made, some of them of a long-range character. It is not right to ask General Groves and his people to make those decisions when it is practically certain that they are not going to be responsible for the project in days to come. No; it has been a matter of great embarrassment that there has been no permanent legislation written yet on this bill.

Mr. THOMAS. Is that your only reason, though, for hurrying legislation?

Secretary PATTERSON. No. Then there is the international aspect of it, too, with the United Nations Commission on Atomic Energy about to meet. I think that is also an element that presses for speed. I think I said yesterday that I thought it would have been well if we had had legislation passed, actually passed, last November; but when we pressed for that—well, we did not get it.

Mr. THOMAS. Supposing, in the drafting of this bill, we should give the Army and Navy veto power on the consideration of the Commission in connection with atomic energy, would you be in favor of that?

Secretary PATTERSON. No. I am content with the veto power in S. 1717 as given to the President, in effect to protect national defense.

Mr. THOMAS. But would you not include the Army and Navy?

Secretary PATTERSON. As the bill provides, he may act on the suggestion of the Secretary of War, the Secretary of the Navy, or both.

Mr. THOMAS. Yes; but in the meantime, either unwittingly or otherwise, a member of this Commission or an employee of the Commission might give away some very great secrets. Do you not think it would be better to permit the Army and Navy to be closer to the picture all the time?

Secretary PATTERSON. They are given by this bill a consultative capacity and security regulations, and measures for security of information are to be adopted by the Commission. I think that is right; it ought to be the prime responsibility of the Commission.

Mr. THOMAS. The thing that bothers me, Judge, is that I think there is a desire on the part of some people to forget the security angle

of it and forget the atomic bomb end of it and forget that it is a weapon that is probably doing more to bring about peace than anything else right at the present time, and going all of the way over the other way and opening the door to other nations in the world and saying, "Here we are"; or, at least, "You can come in and have some of this."

Secretary PATTERSON. I think there is that tendency in some quarters; I agree with you; but I do not think that tendency prevailed in the writing of this bill, S. 1717. I think the bill devises adequate safeguards against the activities of the people you mentioned.

Mr. THOMAS. Do you not think, though, with so much unrest in the world, that it would be better for us to just delay a little while longer until things are more peaceful?

Secretary PATTERSON. Delay in writing legislation?

Mr. THOMAS. Yes.

Secretary PATTERSON. No. I want to see this enterprise go forward with good vigor, and it will go forward to the best advantage if you give them some legislation without delay.

Mr. THOMAS. We are making atomic bombs now, are we not? That has been in the newspapers. I think it is common knowledge.

Secretary PATTERSON. The project is in operation; that is true.

Mr. THOMAS. Do you not think we should do everything we possibly can to safeguard that project and not open the doors with some legislation so that you might permit somebody else to come in?

Secretary PATTERSON. I think you will promote the project to best advantage if you pass this bill promptly.

Mr. THOMAS. I do not understand it; I do not see why.

Secretary PATTERSON. I just said that in my humble opinion, it would have been wise to have done it last November.

Mr. THOMAS. And you said by a delay of 8 months we got a better bill.

Secretary PATTERSON. But I have said also that the delay was to the detriment of the operations of the project.

Mr. THOMAS. Who wanted this legislation, in the first place? Did the War Department want the legislation, did the President want it, or who wanted it?

Secretary PATTERSON. The War Department wanted it, and the President wanted it; both. We said so last October when we came down here. I am not charging any delay to you gentlemen. You acted promptly.

Mr. THOMAS. That is all I have, Mr. Chairman.

The CHAIRMAN. Mr. Brooks

Mr. BROOKS. I have no questions, Mr Chairman.

The CHAIRMAN. Mr. Martin.

Mr. MARTIN. Judge Patterson, I am quite disturbed by this provision making the Commission five full-time civilian members. Apparently from the Senate report on Senate 1717, page 11, it is very definitely limited to civilian membership.

Secretary PATTERSON. Yes; it is.

Mr. MARTIN. I am wondering whether the War and Navy Departments have thought of changing that provision to enable a representative of the War and Navy Departments to take a position as one of the commissioners.

Secretary PATTERSON. Well, of course, we did think of that; and the May-Johnson bill gave the President leave to use military personnel among the nine men on the Commission that was provided by the May-Johnson bill.

Mr. MARTIN. Now, that leave was not given in this bill, as far as the Commission is concerned?

Secretary PATTERSON. No; as far as the Commission is concerned, that leave does not appear in this bill. Of course, there was nothing mandatory, either, in the May-Johnson bill. The President could have appointed nine civilians and it would have been entirely inside of the terms of the act. It was only discretionary.

Mr. MARTIN. This bill apparently makes it mandatory that there not be nine.

Secretary PATTERSON. That is right. The bill at least does not take the case out of that 1870 act.

Mr. MARTIN. Would the War Department be opposed to any amendment to this bill authorizing one or possibly two members of the Commission to be representatives of the armed forces?

Secretary PATTERSON. We did not advocate it, and we do not advocate it. We believe that the national-defense aspects—and they are important on atomic energy—are adequately cared for by that paragraph in section 2, providing for the Military Liaison Committee.

Mr. MARTIN. I call attention to one statement on page 11 of the Senate report, as follows:

The decision to limit membership eligibility to civilians was adopted by the committee in keeping with the established traditions of the Government.

I wonder what other potential weapons in history have been so strictly limited as to direct military participation?

Secretary PATTERSON. Well, I think the theory of this act is that the President has the function of taking care of military interests in the operations involved here.

You notice not only does he make decisions under that paragraph in section 2, but also under section 6 he tells the Commission how many weapons to produce and also directs deliveries of them to the armed forces. That is on page 22.

Mr. MARTIN. That is contemplating the operation or functioning of the program under the direction of the President. What I am asking about here is what is the tradition referred to as being in line with the making ineligible of direct representatives of the national defense on such a commission as this? Do you know of any case where the armed services have been specifically barred from a commission controlling any weapon or a potential weapon?

Secretary PATTERSON. That is not exactly the way it is, Mr. Martin. They are not specifically barred. There is no language in this act taking the case out of the 1870 act, and, therefore, in effect, they are ineligible, an officer in active service is ineligible, for membership on the five-man Commission.

Mr. MARTIN. Exactly that. Unless we put some provision in here and except them from the 1870 act they will be ineligible and barred from the Commission.

Secretary PATTERSON. I have agreed that that does not state it specifically.

Mr. MARTIN. The application of the 1870 act to a measure controlling a weapon, or a potential weapon, of this character seems rather out of step with tradition. I know of no case in our history where the armed forces are barred in such an effective way from participation in the development or the management of the development of a weapon.

Secretary PATTERSON. If this were exclusively a weapon, I would heartily agree with that.

Mr. MARTIN. You will admit it is a potential weapon, Mr. Secretary.

Secretary PATTERSON. Oh, yes; and thus far its only application has been that of a weapon.

Mr. MARTIN. My viewpoint is from that of national defense and the effect on national defense of the barring of men who are best qualified to deal with national defense from serving on a commission having control of such a potential weapon.

Now, let us go down a step to the general manager and the division managers operating under him. There is one division there in section 2 of the bill—section 2 gives this Commission outline, and then under that there is subsection 4 (a), which deals with the general manager and the four division heads. One of those divisions is the Division of Military Application. Now, does the act of 1870, unless we make some exception here, bar a direct representative of the armed forces from serving as head of the Division of Military Application?

Secretary PATTERSON. I should say that it did bar him.

Mr. MARTIN. Is that in keeping with the traditions of our Nation?

Secretary PATTERSON. Well, I think so. There are plenty of cases where in the last war weapons were developed, say, by OSRD, the Office of Scientific Research and Development.

Mr. MARTIN. That was developmental work. This is the Division of Military Application. This has not a thing to do with the development. This is the Division of Military Application.

Secretary PATTERSON. They do not mean applications in the field.

Mr. MARTIN. What do they mean? They say "application."

Secretary PATTERSON. Oh, no; they mean military utilization of atomic energy. That is what they mean. They mean research and development of new weapons.

Mr. MARTIN. And that must be by a man who has no direct connection with our armed forces?

Secretary PATTERSON. I do not think that this is necessarily in violation of our traditions. There have been a good many weapons developed by military personnel and a good many weapons developed by civilian personnel just in the last 5 years.

Mr. MARTIN. I grant you that, but to have all representatives of the armed forces barred from this Division of Military Application of such weapons, to have them barred from that important position in the military field, strikes me as rather farfetched from the best development of our national defense, and that is the only approach I am making here.

Secretary PATTERSON. I think we probably are putting different constructions on military applications. As used in this paper it means to me improvements, experiments, and research and development for more powerful weapons. It does not mean at all how the armed forces are going to use them. That is not the business of this Atomic Energy Commission.

Mr. MARTIN. They make such a fine distinction here as to say that, "The Commission shall require each such division to exercise such of the Commission's powers under this act as the Commission may determine, except that the authority granted under section 3 (a) of this act shall not be exercised by the Division of Research," and section 3 (a) has to do with research and development.

Secretary PATTERSON. This Commission has absolutely no power over the employment of atomic weapons in the field.

Mr. MARTIN. That leads me to think that research and development is not what they intended to include under military application.

Secretary PATTERSON. I am sure they do, because you go over to section 6 and it empowers the Commission to make research and development of military applications.

Mr. MARTIN. Here we have the specific statement in the proposed bill, "except that the authority granted under section 3 (a) of this act shall not be exercised by the Division of Research." I think they are taking research and development out from under these divisions here that we are talking about, but I am trying to get down to what is meant by military application, and why is it taken away from representatives of the armed services.

Secretary PATTERSON. Military application means, as I see it, the research, development, and production of these atomic bombs. That is what it means, improvement in atomic bombs.

That would be the military application of atomic energy and then they turn them over to the armed forces as directed by the President and from that time on the Commission may have advisory powers, or it may forget the thing, if they know what goes on, where control is passed then to the armed forces. They do not mean military application by what goes on at Bikini this summer.

Mr. MARTIN. But now accepting your construction, is it your opinion that the military application, as you have defined it as that of research and development and construction or production of the military phases of atomic energy, is best handled by men having no connection with the armed forces?

Secretary PATTERSON. I think when you give them the Military Liaison Committee that is provided for on page 7, and when you read section 6

Mr. MARTIN (interposing). That is purely advisory there. I am talking now about the Director of this Division of Military Application, a \$14,000 executive.

Secretary PATTERSON. Well, I believe that you have got to have this atomic energy enterprise handled as an entity. Therefore you have got to have it under some one body.

Mr. MARTIN. Is there any objection to our making a military man eligible to the Office of Director of Military Application?

Secretary PATTERSON. Well, I have no objection myself.

Mr. MARTIN. That is all.

Secretary PATTERSON. I would have none. There is certainly force in what you say, although I think the bill is adequate.

The CHAIRMAN. Mr. Elston, do you have any questions?

Mr. ELSTON. Judge, you say that there is necessity for very prompt action at this time in the enactment of this legislation. Now, can you give us any reasons why it is essential that we proceed to enact this bill immediately?

Secretary PATTERSON. Well, you may dismiss what I say, Mr. Elston because I always come down here with urgent cases. Sometimes I get urgency and sometimes I do not, and still we seem to bump along, but to direct myself to your inquiry, I submit that the considerations favoring promptness in this are these:

The operation of the enterprise by us has been injured and will be injured further by delay. There is absolutely no congressional act on atomic energy.

As I explained yesterday it was committed to the War Department as a war project simply by direction of the President in 1942. Congress has never acted on it. All you have done is appropriate funds in very general language without any reference to this particular project, so that we have been acting without any guide at all.

It is a matter of such enormous importance to the Nation and to the whole world that the will of Congress and the policy of Congress in regard to this ought to be declared without delay.

It has had an affect upon the personnel of the enterprise, and there has arisen uncertainty and doubt as to what the future of the project is to be and what the will of Congress is to be upon it.

It has also embarrassed those in charge of the project in making decisions that are urgently required, decisions that may affect the future, and also we have these arrangements on an international basis going forward, and we do not even know what our own domestic policy is going to be.

How can those people who represent us on the United Nations Commission make commitments as to what the United States will do on a reciprocal basis when we have not even got control of atomic energy within our own borders?

Mr. ELSTON. Well, have any other nations passed any legislation similar to this?

Secretary PATTERSON. I cannot say, but that would have not a great deal of bearing on it, in our opinion, because we are farther along the path than any other nation. We are the only nation which has actually got a plant in operation.

Mr. ELSTON. What about Great Britain and what about Russia?

Secretary PATTERSON. They are nothing like we are; they are nowhere nearly along the path that we are. We are years ahead of them.

Mr. ELSTON. Do you not think it would be better to come to some international understanding and have some definite international policy laid down before we begin to enact legislation to carry it out?

Secretary PATTERSON. No, sir. This act makes allowance for that, and the act is subject to any international arrangement to be made. Therefore there is no need for that.

Mr. ELSTON. At the present time there is no international understanding or policy with respect to dealing with atomic energy?

Secretary PATTERSON. Only insofar as it was laid down last December and then in the London meeting in January of the United Nations they did agree upon certain broad proposals there and agreed to form the United Nations Commission.

Mr. ELSTON. Would not a better plan be for them to agree on a policy and then have all interested nations to enact some kind of legislation?

Secretary PATTERSON. That is putting the cart before the horse.

Mr. ELSTON. It seems to me it is just the reverse.

The CHAIRMAN. You think the horse ought to be before the cart anyway, regardless, Mr. Secretary?

Secretary PATTERSON. Yes. I do not see how we can commit the Nation on an international level to what we will do when we cannot even say what our own citizens may do or may not do in regard to atomic energy because we have no legislation on that point.

How can we say that a nation should be an exporter or an importer or something like that of these atomic energy materials or equipment when, for all I know it is perfectly legal in this country for anyone to do as he pleases right today on atomic energy?

Mr. ELSTON. Well, can you not trust American industry to do what is right?

Secretary PATTERSON. In the main, yes; but you still have got to have laws on it.

Mr. ELSTON. You never had any laws regulating the use of electricity or gunpowder.

Secretary PATTERSON. I do not agree with you on that.

Mr. ELSTON. Or other forms of power, but we got along all right.

Secretary PATTERSON. I think we have a lot of laws directing the control of those activities.

Mr. ELSTON. Yes; but we never had any law that restricted industry from research or development in the field of electricity or any other form of power.

Secretary PATTERSON. This is supposed to encourage, and I think does encourage, research and development by private industry.

Mr. ELSTON. It only would encourage them if the Commission does see fit to give them the right to go ahead.

Secretary PATTERSON. They are directed to.

Mr. ELSTON. There is not anything in this bill that would compel the Commission to give industry the green light to go ahead and develop the industrial use of atomic energy. They could give it to one company and refuse to give it to another company.

Secretary PATTERSON. This bill does not provide that. This bill, like the May-Johnson bill, provides that it shall be done on the broadest possible basis, on an equitable basis.

Mr. ELSTON. It is entirely within the discretion of the Commission. There is no appeal beyond the Commission.

Secretary PATTERSON. There is no appeal above the Commission, I think that is true.

Mr. ELSTON. Their decision is final. If they want to exclude one company and include another company they can do it and nothing can be done about it.

Secretary PATTERSON. I do not think there is any language in the act that would permit an arbitrary decision like that.

Mr. ELSTON. I do not see anything that would prevent it. There is no appeal from the decision of the Commission.

Secretary PATTERSON. They provide, however, for appeals within the Commission.

Mr. ELSTON. It is an appeal within the Commission, but if the Commission ultimately makes a decision you cannot go beyond that. That is too much like the OPA.

Secretary PATTERSON. If they were to launch out on a course like you described, Mr. Elston, they would be violating the provisions of

section 5 and certainly section 7. In section 7, then, they have procedure for the utilization of atomic energy which gives Congress a chance to make its will known about the matter by providing a 90-day cooling period.

Mr. ELSTON. Those cooling periods do not seem to be very popular right at the moment.

Mr. SPARKMAN. Will the gentleman yield at that point?

Mr. ELSTON. On the cooling-off period?

Mr. SPARKMAN. I did not ask for that, but since you give me that opportunity you gentlemen voted for it.

Mr. ELSTON. I certainly did, and I will vote that way again.

Mr. SPARKMAN. Judge Patterson, under the utilization title of this bill Congress always retains control, does it not?

Secretary PATTERSON. Yes, sir.

Mr. SPARKMAN. And also in setting up the Joint Committee, it is recognized that Congress shall retain control and further than that is it not true that the Commission has to report periodically to the President of the United States and to the Congress?

Secretary PATTERSON. Yes.

Mr. SPARKMAN. In order that we may keep constantly advised as to what progress is being made?

Secretary PATTERSON. Yes.

Mr. ELSTON. Is not that exactly what a number of other Government agencies do?

Secretary PATTERSON. Yes.

Mr. ELSTON. And does not Congress have a check on all Government agencies? There is nothing new in that.

Secretary PATTERSON. I think the Joint Committee on Atomic Energy as provided for in section 14 is somewhat of a novelty.

Mr. ELSTON. That just specifically sets up, Judge, what actually would happen anyhow?

Secretary PATTERSON. Yes.

Mr. ELSTON. It requires the same review by the Congress and the Congress can review the activities of any agency.

Secretary PATTERSON. Yes.

Mr. ELSTON. The thing that we are up against today is that we have laid down in the law certain rules, limitations, and restrictions on Government agencies, and they do not pay any attention to them.

Secretary PATTERSON. I think this Joint Committee on Atomic Energy, of course, is intended to keep Congress adequately informed. I think that is the purpose of that Committee. Of course, it is not the administrative body.

Mr. ELSTON. Judge, I do not want to prolong the questioning on that particular point, but you maintain, do you, that the War Department needs this legislation in order to go ahead and conduct research into weapons and to go ahead and develop weapons such as the atomic bomb? You have done an excellent job, a magnificent job under just an Executive order, and there is nothing today that would prevent you from going ahead and doing the same thing if Congress gave you the authority that you mentioned a moment ago. In other words, if Congress gave you the legislative authority that you already have by Executive order. Now, if you had that authority the people in these plants that you speak of would know where that plant was

going and there would not be any difficulty at all in going ahead and developing atomic weapons, would there?

Secretary PATTERSON. I believe there would. The need has been felt in the War Department since the close of the war, say since last September, for a declaration by the Congress of a long-range policy on atomic energy.

I agree with you that we can operate it. We have been operating it since the close of the war. We can operate it in June, July, August, and so forth, but I think if it is to be operated to the best advantage not only for war purposes, but for broad-scale development, that it would be better if an agency like the agency described in this bill were given the responsibility for it.

Mr. ELSTON. Although such an agency was never before set up?

Secretary PATTERSON. That is true.

Mr. ELSTON. In fact, before you had the Navy Department and War Department to go ahead and develop weapons, and you mentioned at the outset that there had been some criticism of the previous legislation because it had the appearance of giving too much control to the War Department, the Army, and the Navy. Now, the minority views of this committee are not along that line. As a matter of fact, the minority views of this committee are that the War Department and the Navy Department were, perhaps, not given enough authority in the matter. There was objection to turning everything over to a civilian agency, and now we are going even further, and we are turning over more to a civilian agency than was contemplated in the May-Johnson bill. The War Department now has control completely closed on them.

Secretary PATTERSON. No; I think there is a better provision and a better means provided by this act for participation by the military in future developments of atomic energy than in the May-Johnson bill. The charges you mentioned were always without foundation, utterly without foundation, Mr. Elston.

Mr. ELSTON. I agree with you 100 percent—

Secretary PATTERSON. But faced with the text of the act they could not say a word.

Mr. ELSTON. But as it is now if this legislation passes you would have to get down on your knees for authority from a civilian Commission on which the War and Navy Departments are not even represented. While I do not think we are quite in that bad a position, I think the concern on the part of the people that are working in these projects has arisen by reason of the fact that there has been so much talk about legislation, and if the matter had been permitted to go along there perhaps would not have been that apprehension on their part.

Secretary PATTERSON. I agree with you that that is arguable.

Mr. ELSTON. Now, would you mention one thing that has happened which has been detrimental or injurious to this country by reason of the fact that prompt action was not taken on the May-Johnson bill?

Secretary PATTERSON. No one specific act, no.

Mr. ELSTON. Now, Judge, I want to ask you about the constitutionality of the law. Do you maintain this proposed act is constitutional?

Secretary PATTERSON. It would not occur to me to doubt it.

Mr. ELSTON. Are you familiar with Supreme Court decision in the Shechter case which held NIRA unconstitutional?

Secretary PATTERSON. In general.

Mr. ELSTON. Now, the Supreme Court of the United States in that case held the act was unconstitutional because Congress had delegated to an agency of the Government the power to write codes to provide that certain acts should be punished. In this proposed act we go much farther than Congress ever attempted to go in the NIRA because in this proposed act we give to this Commission the power and the authority to make regulations the violation of which shall be felonies, not misdemeanors, but felonies.

Do you think the Congress has the power to delegate to any agency the right and the authority to make a law which will imprison a person in a penitentiary for a period of more than 1 year and a day?

Secretary PATTERSON. I have read this proposed act and given it some study. It did not occur to me that there was any undue delegation of authority to this Commission by Congress. The part on penalties and enforcement is reasonable in every way, I believe.

Mr. ELSTON. Let me call your attention to this section, Judge. You may have overlooked it because you have a tremendous amount of work to do. Section 15 (b) provides:

Whoever willfully violates, attempts to violate, or conspires to violate, any provision of this Act other than those specified in subsection (a) and other than section 10 (c), or of any regulation or order prescribed or issued under sections 5 (b) (4), 10 (d), or 12 (a) (2), shall, upon conviction thereof, be punished by a fine of not more than \$5,000 or by imprisonment for not more than two years, or both.

Does not that confer upon this Commission the power to make regulations, or even orders, and if they are violated the violator can be sentenced to the penitentiary or fined as much as \$20,000?

Secretary PATTERSON. Well, the \$20,000, of course, is an aggravated offense, to cover what is, in substance, treason.

Mr. ELSTON. Let us leave it at \$5,000. The \$20,000 is for a more aggravated offense, that is true, but the imprisonment for not more than 2 years and the fine of \$5,000 may apply for the violation of an order of the Commission?

Secretary PATTERSON. I have not traced down what the other provisions are in the sections that are enumerated, sections 5 (b), section 10 (d) or 12, but it is not surprising to me at all, and I think I can find you many more other statutes enacted by Congress along similar lines.

Mr. SHERIDAN. Will the gentleman yield?

Mr. ELSTON. Yes.

Mr. SHERIDAN. On what basis does the gentleman think that the Supreme Court would be consistent?

Mr. ELSTON. Of course, I would say to the gentleman from Pennsylvania that at the time the Supreme Court of the United States declared NIRA unconstitutional we had some lawyers on the bench. Maybe they would not today.

Mr. SHERIDAN. Of course, judge, the penalties that Mr. Elston objects to were carried also in the May-Johnson bill which was reported out, and is it not true that the Selective Service and Training Act carried similar penalties.

Secretary PATTERSON. Why, yes. Hundreds of acts do. I have no doubt of that at all.

Mr. SHERIDAN. Practically every act that has been passed setting up an enforcement agency to enforce certain things has carried similar penalties, has it not?

Secretary PATTERSON. An act would not be worth much if it did not.

Mr. SHERIDAN. And, of course, it is always subject to court review.

Mr. ELSTON. There are many acts on the statute books today that have not been declared unconstitutional because they have not been tested. They have been passed in recent years where there has not been an opportunity to test them, but the NIRA was tested. If there is any difference between the authority given in that act and the authority given in this proposed act I would like to know what it is.

Secretary PATTERSON. Well, the power to pass orders and regulations would not amount to much if they could be violated without any penalty attached to their violation.

Mr. ELSTON. Judge, I grant you that that is true, but the law says that Congress must indicate the standards and Congress has not done that in this proposed act. They have given them general authority to enact any regulation or order they see fit to carry out the general provisions of this proposed act, and for the violation of any one of those orders they have provided penalties.

Secretary PATTERSON. I think this act does go into great detail. I rather think that if it were subject to any criticism under any head it would be too much detail rather than too little.

Mr. ELSTON. I think if you will examine NIRA you will find that it does not go into as much detail as that act went into.

Now, is there anything in this act that would prevent the Commission from giving away the secrets of the atomic bomb?

The CHAIRMAN. Do you mean any penalty on the Commission for doing it?

Secretary PATTERSON. Yes; of course, what the Commission will do depends upon the quality of administration that it gives to any statute, but certainly the provision here on security of information covers it.

Mr. ELSTON. To what section are you referring?

Secretary PATTERSON. I am referring to section 10.

It shall be the policy of the Commission to control the dissemination of restricted data in such a manner as to assure the common defense and security. That is a charge by Congress to the Commission not to give away important secrets that have to do with defense and security information.

Mr. ELSTON. Now, let us follow what comes next:

Consistent with such policy, the Commission shall be guided by the following principles:

(1) That information with respect to the use of atomic energy for industrial purposes should be shared with other nations on a reciprocal basis.

Secretary PATTERSON. And—

as soon as the Congress declares by joint resolution that effective and enforceable international safeguards against the use of such energy for destructive purposes have been established.

That put it entirely within the power of Congress.

Mr. ELSTON. Well, Congress only passes some legislation or some resolution setting up international safeguards, but when Congress does

that there is not anything to prevent the Commission from giving away the secrets of the atomic bomb. In fact, the section just read requires them to do it, not necessarily the secrets of the atomic bomb, but that information with respect to it shall be shared with other nations on a reciprocal basis.

Secretary PATTERSON. It forbids any action in that connection until joint action by Congress.

Mr. ELSTON. That means giving them information with respect to the use of atomic energy, with respect to the industrial use of it, to other nations. Now, as a matter of fact, the whole purpose of this bill is to give away information in respect to atomic energy, is it not?

Secretary PATTERSON. No, sir.

Mr. ELSTON. What other purpose does the bill have?

Secretary PATTERSON. It has a lot of other purposes but the very words you mentioned are conditioned upon Congress declaring later by joint resolution certain things. There is nothing for the Commission to do until in fact Congress has taken further action. That seems to be very plain.

Mr. HOLIFIELD. On page 4, in lines 18 to 20, provision is made that the President can remove any member of the Commission for inefficiency, neglect of duty, or malfeasance in office, which would clearly give the President a check on the Commission, and in other places the Commission is directed to do certain things.

Mr. ELSTON. It would do a lot of good to remove a member of the Commission after he had given away the secrets of the atomic bomb.

Mr. ALMOND. Mr. Secretary, on page 21 under (d) general provisions, beginning on line 17 it provides:

The Commission shall not distribute any fissionable or source material to any person for a use which is not under or within the jurisdiction of the United States or to any foreign government.

It has been suggested that that provision be amended by adding to the bill after the word "Government" in line 20—

or to persons within the jurisdiction of the United States where issuance thereof would be inimicable to the common defense and security.

Do you think that would be a wholesome and protective amendment?

Secretary PATTERSON. I agree with that objective. Of course, if a person whom the Commission believed to be hostile to this Nation could get fissionable material under this language without the words you mentioned I would be in favor of the words being added, but I take it that the Commission has power to do that under the bill as it stands.

Mr. ALMOND. Do you not think it would be safer, though, to make a positive restriction in that direction and have the Congress speak there positively stating that that shall not be done?

Secretary PATTERSON. If there is any possibility of it being done without that language being added I would be in favor of the language being added. I have the impression, however, that the Commission has power to deny materials to such a person already under the act. If there is any doubt about it I think language ought to be added to make that clear.

Mr. ALMOND. That is all.

The CHAIRMAN. Mr. Johnson.

Mr. JOHNSON. I think you ought to clear up here just about the secret of this bomb. When hearings were held by the committee before, if I got the correct interpretation of the witnesses' language, they said that it was common knowledge among the scientists of the world as to atomic energy. They said that all the real secret, if there is one, is the manner in which the bombs may be made. Is that a correct statement?

Secretary PATTERSON. I do not think it is quite correct. I think there is widespread information on the basic scientific data. On the industrial processes resulting in the release of atomic energy or in the production of the materials from which the bomb is made there are a great many secrets.

Mr. JOHNSON. And is it a fact that the United States and perhaps Britain, in part, are the only ones who know those secrets?

Secretary PATTERSON. I think we are the only ones.

Mr. JOHNSON. In other words, the industrial know-how is still a secret?

Secretary PATTERSON. A great many facts in it are certainly still secrets.

Mr. JOHNSON. Suppose this occurred, just looking ahead into the future, that we entered into some kind of an international agreement in this sort of form, that the international security organization would have a right to make bombs. I assume in that case we would tell them the secrets, the industrial secrets that we have as to how they shall be manufactured and, of course, the countries would all agree that they would be not only the places where the secret reposed but where the bombs could be made, is that right?

Secretary PATTERSON. You are going to have Mr. Baruch before you. I think he is a specialist in that. You are getting me off on to some fields that are quite different from the matters, of course, covered in the bill today.

Mr. JOHNSON. Well, the language in here contemplates that very thing, as I understand it, some of those sections which said it would make necessary international safeguards, and is it not the very basic idea of the United Nations that there shall be a common security agency to protect all the nations? Is not that correct?

Secretary PATTERSON. That is one of the plans.

Mr. JOHNSON. Well, they would be the ones who would have to handle the atomic bomb. What I am looking forward to is this condition if a nation withdrew from that she would have all of the secrets that the international group had and they could use those secrets on us and on others. Would not that logically follow?

Secretary PATTERSON. There are reasons along that line, perhaps, but I would prefer not to get into that, Mr. Johnson, if you will excuse me, because it has nothing to do with the provisions of this S. 1717. It has to do with United Nations action.

Mr. JOHNSON. I want to ask you one more question. In 1922 we sat down and determined to reduce the size of the navies of the world, and we all agreed to that, and we scrapped the greatest bulk of shipping. In less than 10 years one nation withdrew from that agreement. Now, could we not have a repetition of that very thing in the plan we have here?

Secretary PATTERSON. Well, perhaps you could, but what has that to do with the merits of this bill?

Mr. JOHNSON. It has to do with the merits of the bill. This bill is a step to get us into an international group.

Secretary PATTERSON. It is more than that, of course. This measure would be necessary if you had complete failure of all efforts on the international level.

Mr. JOHNSON. That is right, but is this not the basic underlying idea of this bill: First, that we are to control absolutely the material and the processing and construction of atomic bombs and other atomic energy uses?

Secretary PATTERSON. Yes, sir.

Mr. JOHNSON. That is complete control in every detail?

Secretary PATTERSON. Yes, sir.

Mr. JOHNSON. Is that not just a step, then, if we are going to build up world security, after we have gotten control of all this, to turn it over to an international group of which we are a party?

Secretary PATTERSON. That may be, and yet to govern the relation in this country between our own citizens, and so on, this act is necessary, or an act like it.

Mr. JOHNSON. You think it is so dangerous to let loose that we must control it; is that the idea?

Secretary PATTERSON. Yes, sir.

Mr. JOHNSON. The idea is, that from the viewpoint of materials and atomic energy, to let the public handle it without complete regimentation?

Secretary PATTERSON. I think that is so, in any appreciable quantities.

Mr. JOHNSON. Would the security groups in our country, the Army and Navy, would they have any real control over it after that happens, except just to go to the President, who has a million other things to do without worrying about Army and Navy troubles.

Secretary PATTERSON. I think the machinery set up in this act will function and will work without resort to the President, but provision for resort to the President, recourse to him, is provided in the act.

Mr. JOHNSON. Does not the report that the Secretary of State issues here, does that not merely contemplate that this is just one of the steps finally to get this thing in the lap of an international group?

Secretary PATTERSON. It has other objectives, too, as we have just discussed. That is one of the objectives.

Mr. JOHNSON. In your responsibility as Secretary of War, do you not think you can weed out of this act the fact that some day this will be out of your hands, it will be in the hands of a foreign group of which you are only one member?

Secretary PATTERSON. The War Department has supported efforts to control atomic bombs by compact of nations.

Mr. JOHNSON. We just want to try to explore the fact that we might some day find ourselves without any weapons of this kind, and the secrets and the weapons in the hands of a foreign group. Is that not what could happen?

Secretary PATTERSON. That could happen.

Mr. JOHNSON. There is that possibility. There is that danger there in the whole program. Is that not true?

Secretary PATTERSON. Yes, sir. You must do the best you can on control of this force.

Mr. JOHNSON. The real control, if it will work, I think it is your opinion and mine also, that the real control, if it will work, is to have it where the family of nations can handle it.

Secretary PATTERSON. Yes, sir.

Mr. JOHNSON. That is really what we are aiming at, is it not?

Secretary PATTERSON. Yes, sir. If you do not have that, the time will surely come when everybody has atomic bombs.

Mr. JOHNSON. In this bill, do you read the language to mean that if we perfect the necessary treaties that the Commission without any further permission of Congress can turn over the secrets of the manufacture of atomic bombs?

Secretary PATTERSON. I do not understand that; no.

Mr. JOHNSON. I am assuming there is a treaty in which we develop an international police force and equip them with the appropriate weapons of that day. Do you still think we need further action by Congress to turn those secrets over?

Secretary PATTERSON. That involves two sections of this bill. There is a section that makes this act subordinate to international agreements. Is that?

Mr. JOHNSON. That refers to restricted data.

Secretary PATTERSON. No; there is a section here. Then there is another section 10, which Mr. Elston was just discussing which does require further congressional action before such information can be released.

Mr. JOHNSON. Mr. Secretary, will you look on page 29, please, subsection (1). It says that restricted data as used in this section means all data used in the manufacture and so forth of atomic weapons—

but shall not include any data which the Commission from time to time determines may be published without adversely affecting the common defense and security.

In that section, they have the determination of that, and not you.

Secretary PATTERSON. Yes; just as we have had it down to the present time. The War Department has had it, and we have released a great deal of data and have exercised the power here committed to the Commission.

Mr. JOHNSON. Is it your idea on the other one, here, if we effect an international agreement whereby we agree to give these weapons to an international police force, this Commission can do that without any further act of Congress, or the President can do it also?

Secretary PATTERSON. They cannot release this information to be shared with other nations on a reciprocal basis until—

the Congress declares by joint resolution—

I am reading at the top of page 29—

that effective and enforceable international safeguards against the use of such energy for destructive purposes have been established.

Mr. JOHNSON. That is reciprocal arrangement. I am talking about the situation where we have the United Nations Security Force organized. We turn over the atomic weapons to them, and the manner of making them. Can that all be done if it is under a treaty without any further conduct on the part of the Congress or the President?

Secretary PATTERSON. It shall mean any treaty approved by the

Senate or international agreement approved by the Congress. That is on page 26. If that is done and it conflicts with any provisions of this act in that respect, it shall be deemed of no further force and effect. That is what it says.

Mr. JOHNSON. Whatever the treaty arrangements are, that would be the binding law, on everybody in our country, with reference to atomic energy and atomic weapons?

Secretary PATTERSON. I think so.

Mr. JOHNSON. In the bill, I do not remember the section, there is a very broad reference to patents. I have mentioned this to you. Is it your construction, or could you put one in the record later, that anybody who wants to get a patent that in any way has something to do with atomic energy or atomic principles, no matter how remote from the manufacture of a bomb, must clear through this Commission?

Secretary PATTERSON. I suspect you are right on that. Section 11 covers patents and inventions and it covers about seven pages. I honestly do not know all of the details of those seven pages.

Mr. JOHNSON. I wonder if somebody could put something in the record on that.

Secretary PATTERSON. The May-Johnson bill was very short on that. I think it gave the Commission power to acquire any patent.

Now this goes into great length, as to compensations and a great many matters. I can be of no real aid to you on that patent question.

Mr. JOHNSON. Has the War Department acquired all patents as affect this fissionable material or affecting atomic bombs; have we acquired all of them?

Secretary PATTERSON. We have acquired practically all of them, I believe. We have gotten all that we could.

Do you mean have we made an effort to get them into Government control? Yes; we have.

Mr. JOHNSON. Have you gotten all of them, though?

Secretary PATTERSON. Do you mean have we gotten all inventions?

Mr. JOHNSON. Yes; all patents; those that are actually patented by the Patent Office.

Secretary PATTERSON. It is my impression that we have virtually all of them.

The CHAIRMAN. Are there any further questions?

Mrs. LUCE. I have just a general question, Mr. Secretary: As between giving this atomic baby to the free American enterprise system to develop into a kind of Henry Ford, you are satisfied with this decision of Solomon which splits and baby neatly into two parts and sutures it together and hands it over to a commission; is that correct? It is not in your mind the best possible compromise to split the baby?

Secretary PATTERSON. I have said that I am in favor of the passage of the bill.

Mrs. LUCE. May I ask you if you are in effect in favor of splitting the baby?

Secretary PATTERSON. I do not think the bill splits the baby.

Mrs. LUCE. Then in effect the baby is given to the Government.

Secretary PATTERSON. It has always been with the Government. The people as a whole have put every nickel into this enterprise. It has been under Government control from the outset. The War De-

partment has had it nearly 4 years. As I have explained, a year ago, in developing plans for postwar use, we said that it was time, on account of the vast possibilities in many fields that atomic energy would have application to, it would be taken over by a civilian agency. We say that then and we still say it.

Mrs. LUCE. I understand that. Then that really does make the development of this energy and new form of production—that does make the position of atomic energy in our Nation's life unique?

Secretary PATTERSON. Yes; I think it does.

Mrs. LUCE. In other words, this is a radical new departure for the American people when they take a great new resource and put it hedged around with tremendous restrictions in the hands of a five-man commission. That is a very new departure in American life.

Secretary PATTERSON. This goes further, I believe, than anything in the past. I think it is necessary to do so on account of the tremendous force and the vast possibilities in this energy; also, it is unique in the speed with which it was developed and the manner in which it was developed. Electric power did not come along that way at all. All kinds of people were experimenting in that and in all kinds of places and under all kinds of conditions. This one, however, from 1942 on, was a war measure exclusively developed under control of the War Department and the taxpayers' funds went into this, to the exclusion of all other funds.

Mrs. LUCE. Then would you also add, Mr. Secretary, that the fact that we are turning it over to a commission is an indication that we still contemplate probabilities that it will be used destructively rather than that it will be used in the ways of peace?

Secretary PATTERSON. No, the hazards in the way of peace alone are so considerable, the dangers from abuse of it are so tremendous that you have to have strict control by an administrative body in any event.

Mrs. LUCE. Do you think more than 45,000 people a year might be killed experimenting with it? That is the number that get killed by automobiles, and nobody has proposed socializing the Ford plant, just because thousands of people get killed. Industrial accidents far outweighed our losses in the war, but no one advocated socializing industry because of that particular danger.

Secretary PATTERSON. I believe the devotion of public money also to this enterprise makes it appropriate and fitting that the Government's interest in it, for the whole Nation, be recognized by vesting these powers in a commission. There was no private capital, nothing came out of your pocket or mine, except as we paid taxes for this.

Mrs. LUCE. May I ask you, if you could imagine—and this requires some imagination—a completely peaceful world as of tomorrow, with all peace treaties signed, everyone reasonably satisfied with their frontiers, trade agreements and so on, would it not be your inclination, as quickly as possible, to return the development of atomic energy to proper private initiative?

Secretary PATTERSON. Did you say "Return it"?

Mrs. LUCE. Yes.

Secretary PATTERSON. It has never been there.

Mrs. LUCE. In any event, do you not think it would be proper to "give" it to private initiative?

I believe it was due to the public laboratories in this country that made it possible for you to take it over.

Secretary PATTERSON. Yes, but it was always maintained by Government funds and under Government contracts. A great deal of it went on, but it went on as a division of the Manhattan project.

Mrs. LUCE. May I just repeat my question: In the event of peace in the world, do you still think that this great, new source of energy should be, in effect, owned by a commission which is not even socialistic, it is a commissariat.

Secretary PATTERSON. Yes. Do you mean barring all war, supposing war were safely outlawed and out of the picture, would you still have a plan like that in this bill?

Mrs. LUCE. Yes.

Secretary PATTERSON. I would say yes.

Mr. ELSTON. Following up the questions asked by Mrs. Luce, of course you do not contend, Mr. Secretary, that the atomic bomb and all other secrets of atomic energy were developed after the war started. Scientists had been working on this for a great many years and they were not working under Government supervision, and they were not working at the expense of the taxpayer.

Secretary PATTERSON. No, but there was very little progress made prior to 1940.

Mr. ELSTON. It was the ideas that were thrown together after we got into the war that brought about the atomic bomb.

Secretary PATTERSON. The expenditure of \$2,000,000,000 of public funds produced progress in 3 years that, in more normal times, would take 50 years.

Mr. ELSTON. It was all done without this kind of a commission.

Secretary PATTERSON. It was all done by the War Department, by the Government.

Mr. JOHNSON. As a matter of fact, was not the first bomb cracked out at the University of California under the direction of Dr. Lawrence, and that paved the way for all this work, did it not?

Secretary PATTERSON. Will the gentleman repeat his question?

Mr. JOHNSON. The first atom was split at the University of California. Dr. Lawrence was the man in charge of the work out there.

Secretary PATTERSON. I think Dr. Lawrence played a leading role certainly in the whole thing. Whether that was the very first or not, I cannot say—of course, California would claim it, all right.

Mrs. LUCE. Mr. Chairman, may I say just one more word: Mr. Secretary, I am not suggesting that I am not for this bill, because I think it is the best possible compromise we can make in this tragic problem in the kind of a world in which we live, but I just wish to suggest, I do not believe that it is the thing you would do if it were not the kind of world we have.

The CHAIRMAN. Mr. Secretary, we wish to thank you very much. We are sorry to have kept you so long.

Our next witness will be the Honorable W. John Kenney, Assistant Secretary of the Navy.

**STATEMENT OF HON. W. JOHN KENNEY, ASSISTANT SECRETARY
OF THE NAVY**

The CHAIRMAN. You may proceed with your statement, Mr. Kenney.

Mr. KENNEY. Before discussing the position of the Navy Department on the provisions of S. 1717, a bill for the development and control of atomic energy, I wish to state that the Navy Department has not yet been advised by the Bureau of the Budget as to whether or not the views expressed in this statement are in accord with the program of the President. I would also like to add that my discussion will be directed primarily toward the military aspects of the bill and how it affects the Navy Department.

At present there is no international arrangement guaranteeing this Nation against attack by atomic munitions. It is to be hoped that in time fully effective arrangements to that end can be established. Even then there are grave doubts as to whether any such arrangements are inherently possible of providing complete security. In the absence of such arrangements, or in the event of the failure to function properly in practice, this Nation must be prepared to defend itself. A considerable share of the responsibility for defense rests with the Navy. The Navy cannot discharge that responsibility unless it has adequate opportunity, within the limits of any international agreements, to prepare for the use of munitions as effective as those which may be used against us. Nor can the Navy, when danger to the Nation has arisen, receive weapons developed exclusively and secretly by a civilian commission and use them effectively. For the effective use of any weapon not only is the warhead required but, in addition, the military characteristics of the weapon as a whole must be investigated, tested, and developed. Joint research must be conducted on which the military applications can be based. Vehicles suited to carry it must be developed around the size, weight, and other characteristics of the weapon. Safety devices and precautions must be incorporated suitable to the manner of use, the personnel who will use it, and the ships, planes, or ground stations which will transport, launch, or store it.

Men must be selected and trained to use it with maximum efficiency. All this takes time and continuity of effort under the supervision of the organization which will in case of necessity be responsible for the employment of the weapon. Therefore, the Navy has an interest in being able to follow closely all work done in the field of atomic munitions in the next few years.

With respect to the use of power, as distinguished from the use of explosives, the Navy is in a unique position. The Navy is the greatest user of power and the largest power engineering organization in the world, which gives it an interest in the development and application of atomic energy for power uses. In addition, the fact that ships must carry their fuel makes it probable that the first general use of atomic power will be at sea rather than ashore. This development will be a tremendous and vitally important task to which the existing ships and other facilities of the Navy will be useful, if not indispensable, and will foreseeably carry with it an enormous ancillary program of redesign and complete readaptation of the ships so

powered. The effectiveness of any Navy is measured largely by its mobility and consequent ability to concentrate force when, where, and for as long as needed. This ability varies directly with ship's speed and fuel capacity. To defend the Nation's interests successfully, a Navy must be equal or superior to other navies in this respect. Failure to excel in this jeopardizes the safety of the Nation. Research, development, and engineering on a large scale must be integrated in the Navy's program to accomplish this.

Any legislation enacted for the development and control of atomic energy should recognize these important interests of the Navy, and, in our opinion, the provisions of S. 1717, as amended by the Senate, are satisfactory in most respects. The two points of most interest and concern to the Navy are—

(1) Whether the armed services will have adequate opportunity to be heard in the deliberations of the Atomic Energy Commission, and

(2) Whether the armed services will be free to conduct an energetic program of research and development in those phases of the field of atomic energy, for which they are largely responsible.

The provisions of section 2 (c) of S. 1717, under which a military liaison committee would be established, sufficiently insure that the views of the War and Navy Departments on matters affecting the armed services are given consideration in the deliberations of the Atomic Energy Commission. That provision in S. 1717 achieves the same objectives as would have been achieved if the Army and the Navy each had one representative on the commission of nine members proposed in H. R. 4566, the so-called May-Johnson bill. Although the "straw man" issue of military control versus civilian control of the Atomic Energy Commission has been raised and argued by others, the Navy Department has consistently been in favor of civilians having the power of decision in the affairs of the Atomic Energy Commission, although the Navy has been equally insistent on recommending that any legislation enacted contain provisions insuring that the War and Navy Departments have a voice in the affairs of the Atomic Energy Commission.

I think there are two interests that must be reconciled. The field of research and development is primarily a scientific field and one that is not susceptible of what we might term "military domination," but, on the other hand, it must be recognized that the military departments have certain responsibilities in the protection of military interests. I think a lot of the confusion and talk about the so-called military control features of the May-Johnson bill failed to recognize and evaluate both of those two interests.

The CHAIRMAN. What authority or power does the liaison arrangement in the Senate bill 1717, what power does that give either the Army or Navy to have anything to say about this?

Mr. KENNEX. That section provides that the Commission shall advise and consult. You will notice it places an obligation on the Commission to advise and consult with the committee, that is, the military liaison committee, "on all atomic energy matters which the committee deems to relate to military applications." That includes the developments relevant to the manufacture, use and storage of bombs.

The CHAIRMAN. What can you do about it?

Mr. KENNEY. There is also an obligation imposed on the commission to keep us informed. [Reading:]

If the committee at any time concludes that any action, proposed action, or failure to act of the Commission on such matters is adverse to the responsibilities of the Departments of War or Navy, derived from the Constitution, laws, and treaties, the committee may refer such action, proposed action, or failure to act to the Secretaries of War and Navy. If either Secretary concurs, he may refer the matter to the President, whose decision shall be final.

In other words, the forum is present in which we can present our case; namely, the President of the United States, and an obligation is imposed upon the Commission both to advise and consult with, and to keep the military liaison committee fully informed, so that the forum may be used when deemed necessary by the Armed Services.

The CHAIRMAN. How would you like to have written in there substantially this: "In advance of any final decision to advise and consult"?

Mr. KENNEY. I would have no objection to that because I would assume that the obligation to keep the Army and Navy informed on all such matters would result in requests for advice before any conclusive action is taken.

Mr. SHERIDAN. Would that not be superfluous, that under the present provisions of the bill, that when your liaison committee reports to the Secretary of the Navy or the Secretary of War, he has to concur in their conclusions and then the decision of the President is final, that decision of the President is final over and above any decision of the committee.

The CHAIRMAN. Is there anything requiring concurrence by the Army or Navy?

Mr. SHERIDAN. I believe I read that in the bill. Does the Secretary have to concur?

Mr. SPARKMAN. He does not have to concur, but if either Secretary protests the action of the Commission, he then may appeal to the President and the President has final authority.

Mr. KENNEY. That is correct, Mr. Sparkman. If the military liaison committee thinks it should or does disapprove the action of the Commission, they can refer it to the Secretary of War or Navy and have either of those Secretaries consider it. If one should object, he can then take it up with the President whose decision will be final.

Mr. SPARKMAN. If they concur, there is no need to carry it on.

Mr. KENNEY. No, then the armed services would have had their opportunity to speak.

Mr. HOLFIELD. Mr. Chairman, may I question the witness on this point: That the language contained in the clause which says, "which the committee deems to be of military interest," that particular clause gives to the military liaison committee a broad, over-all control, or, you might say, jurisdiction, in regard to approaching the President on any matter which they deem to be of military application.

Mr. KENNEY. That would be the way I would interpret it.

Mr. HOLFIELD. The Vandenberg amendment, of course, which that is, gave full protection in the eyes of the military to their right to go into and investigate and have knowledge of and complain, if necessary, for any violation of the military concept of security.

Mr. KENNEY. It is our belief—I will use the word “correlative”—that the correlative rights of the military regarding atomic energy are protected in section 2 (c).

Mr. SHERIDAN. May I refer the Under Secretary to the top line of page 8, in following through the duties of the liaison committee, wherein the committee may refer such action, proposed action, or failure to act to the Secretaries of War and Navy—

If either Secretary concurs, he may refer the matter to the President, whose decision shall be final.

Mr. KENNEY. I construed that as meaning that if either the Secretary of War or the Secretary of the Navy concurs in the opposition of the committee to the action of the Commission, he may then refer it to the President.

Mr. SHERIDAN. The decision of the President is then final?

Mr. KENNEY. Yes. The decision of the President on military matters should be final under any circumstances, because the President is the Commander in Chief.

It should be noted under section 2 (c) the Atomic Energy Commission has the duty of advising and consulting with the Military Liaison Committee—

on all atomic energy matters which the committee deems to relate to military applications, including the development, manufacture, use, and storage of bombs, the allocation of fissionable material for military research, and the control of information relating to the manufacture or utilization of atomic weapons.

In the opinion of the Navy Department, this and the other provisions of section 2 (c) constitute an effective mechanism whereby the armed services will be informed of, and will participate in, the work of the Atomic Energy Commission having to do with military applications in the atomic energy field. Therefore, the Navy Department strongly supports those provisions of the bill and urges that they be reaffirmed by the committee and by the House of Representatives.

If the provisions of section 2 (c) are retained, the Navy Department has no objection to the provisions of section 6 under which the Atomic Energy Commission would control in the first instance the production of atomic weapons. As we understand it, the civilian Commission would have the initial power of decision over such production, but the Military Liaison Committee would act in an advisory and consulting capacity to the Commission and would be able to appeal through the Secretaries of War and the Navy to the President if the committee disagrees with “any action, proposed action, or failure to act” (sec. 2 (c)) of the Commission on the ground that the lawful responsibilities of the War and Navy Departments are being jeopardized.

In addition to that voice in the military applications of atomic energy, section 6 (a) provides that the President “may direct the Commission to deliver such quantities of weapons to the armed forces for such use as he deems necessary in the interest of national defense.” The effect of all those provisions is to leave the final power of decision over all questions involving military applications to the President, and the Navy thinks that such an arrangement is desirable in view of

the President's position as Commander in Chief of the armed forces and his responsibility for the conduct of the foreign affairs of the Nation.

The second question of prime importance to the Navy Department concerns the provisions of S. 1717 that might be construed to relate to the research and development activities of the Navy in the field of atomic energy.

At that point, I would like to point out that one of the express purposes of the bill is a program of assisting and fostering private research and development to encourage maximum scientific progress.

The Navy Department is vitally interested in the development and use of atomic energy for many purposes, particularly as a source of power in ship propulsion. Plans are already under way whereby an extended program of research and development will be undertaken in the near future in the field of atomic power for use in ship propulsion. Our plans contemplate that eventually such a program will be carried out by projects placed with governmental organizations, including naval laboratories, and by means of contracts with private educational institutions and commercial organizations.

During the course of consideration by the Senate of the provisions of S. 1717, the Navy was concerned lest the language of section 3 of the bill be construed in such a way as to raise questions concerning the legal authority of the Navy Department to undertake such research and development activities, particularly by means of contracts with nongovernmental organizations. We were assured by the Senate Special Committee on Atomic Energy that, correctly interpreted, section 3 confers power on the Atomic Energy Commission to enter into research and development contracts in the designated fields, and to conduct research in those fields through its own facilities, and does not exclude other governmental agencies from entering into such contracts and conducting such activities in their own laboratories, if those other agencies are otherwise authorized by law to perform such activities. As we understand it, the Navy Department will be able to continue its research and development activities in the broad field of atomic energy and continue to enter into research and development contracts with nongovernmental organizations providing for such research and development work without receiving prior approval of its own programs by, or prior clearance of its proposed contractual arrangements from, the Commission.

Mr. ELSTON. Do you find any provision in S. 1717 that gives you that right or authority; does not S. 1717 require you to go to the Commission for all authority?

Mr. KENNEY. I would not construe that this way.

One of the express purposes of the act is to authorize "A program of assisting and fostering private research and development to encourage maximum scientific progress." We then find on page 23 in section 7 (a), which is the provision with respect to the issuance of licenses, this sentence:

Nothing in this section shall be deemed to require a license for the conduct of research or development activities relating to the manufacture of such equipment or devices or the utilization of fissionable material or atomic energy or for the manufacture or use of equipment or devices for medical therapy.

I think when you read this whole act in its entire context, taking into account the report of the Senate Special Committee on Atomic

Energy to which I have heretofore referred, that it is clear that the field of fundamental research is free. Activities in the field of atomic energy only come under the jurisdiction of this Commission at the time you get to the point of production, or at the time you need to require the use of fissionable material. There is one slight inconsistency on that point, Mr. Elston, which I should like to point out. At page 27, lines 16 and 17, in section 9 (a) (2) it is stated that, as to all property owned by the Government and in the custody of Government agencies, the President shall direct the transfer to the Commission "of all facilities, equipment and materials, devoted primarily to atomic energy research and development."

It is my understanding that what the drafting committee of the Senate meant in those two lines was that the Commission would take over certain existing research facilities of the Manhattan District of the War Department; namely, Oak Ridge, and other similar facilities, and not that they would then step out next month and take over new research facilities that were being developed by the Army or Navy or other Government agencies.

Mr. ELSTON. The bill provides that everything shall be turned over to the Commission, including atomic bombs as may have been developed, everything used and useful in the development of atomic bombs. Everything is turned over to the Commission. Therefore, how would it be possible for the Army and Navy to proceed with their plans for the development of atomic weapons without the consent and authority of the Commission?

Mr. KENNEY. That is why I raised the point that I think the language in lines 16 and 17 must be changed so that it is clear that it does not include the taking over of all of those properties, which are presently being used or will be used by the Army and Navy in our own research. The bill itself, I think, clearly indicates that we are to be free in the field of research at this time. The committee of the Senate concurred in that interpretation of the bill.

Mr. ELSTON. That is not the law, though. The interpretation of the committee is not the law.

Mr. SPARKMAN. Would it cure the inconsistency that you point out, to simply insert the word, "all 'existing' facilities and equipment"?

Mr. KENNEY. I think you must go a little further than that, because I think we in the Navy have some existing facilities which are used now in fundamental research which I do not believe that it is contemplated that the Commission would take over. I would like to take that up with the drafting committee and find out specifically what they had in mind. Probably the better thing to do would be to enumerate specifically the various things they contemplated taking over. This language here is quite broad.

Mr. JOHNSON. Is it your interpretation that in the future, if you wanted to experiment in atomic weapons in one of your navy yards that this law would not stand in your way, or would you have to get a permit from this Commission to do so?

Mr. KENNEY. If we wanted to do research work in the field of development of atomic weapons, we would be free to do so. If it required the use of fissionable material, we would then have to come to this Commission. In that section that I referred to before, the President has the power to direct the delivery of certain quantities of

weapons to the armed forces for such use as he deems necessary in the interests of national defense.

Mr. JOHNSON. Then your answer is that in order to make a bomb in any navy yard you have to clear through the President, then?

Mr. KENNEY. To do the research work, no, except that if the use of fissionable material is required. Once we get beyond the field of research into the field of production, then we come to the Commission.

Mr. ELSTON. Why is there any necessity for the section setting up a Military Liaison Committee if you already have the authority to go ahead with research and development?

If you read the section about the Military Liaison Committee, it would indicate that the Commission has complete and absolute authority and the reason for setting up the liaison committee is so that the committee, if it wants to do something, must consult the Commission to get their authority. They do not limit it simply to the production of fissionable material. That section is broad. It would seem to include everything, every activity in the War and Navy Departments; it would have to be discussed with the Commission, and the Commission would have to give its authority before you could proceed with anything.

Mr. KENNEY. I would not so construe it in the field of research to be performed by the Navy, rather than by the Commission. I would so construe it to apply to the field of production to be performed by the Navy, and I think there are a lot of the things we are talking about here that go beyond the field of research. I would construe the bill as a whole to limit the Navy's power only in the field of production.

Mr. ELSTON. Can you point out to me anything in the Military Liaison Committee section that indicates that it does not include research?

Mr. KENNEY. This section, subsection 2 (c), does not specifically refer to the problem of research to be performed by the Navy. It merely sets forth what shall be the functions of the Military Liaison Committee and their relationship to the Commission in the work of the Commission.

Mr. SHERIDAN. How about page 10, section 4, subsection (c), wherein is included the phrase "Ownership and operations"?

Mr. KENNEY (reading):

The Commission shall be the exclusive owner of all facilities for the production of fissionable material other than facilities which (A) are useful in the conduct of research and development activities in the fields specified in section 3, and (B) do not, in the opinion of the Commission, have a potential production rate adequate to enable the operator of such facilities to produce within a reasonable period of time a sufficient quantity of fissionable material to produce at atomic bomb or any other atomic weapon.

Mr. SHERIDAN. In your experimentation in ordnance and production of munitions, would it not be reasonable to expect the Navy Department to produce fissionable material enough to produce one bomb?

Mr. KENNEY. Yes.

Mr. SHERIDAN. Then under that, all the material you use or facilities, would become the property of the Commission, would it not?

Mr. KENNEY. Well, again it gets to the question of quantity. In our research laboratories, we ordinarily would not manufacture enough there to in any way involve production. It is only when we

get out into the field of production that the Commission steps in. The field of research is left open.

Mr. SHERIDAN. You would naturally want to produce one bomb. Line 24 prohibits one atomic bomb or one weapon. Now you and I have been around the research laboratories for ordnance in the Navy and the Army and you know they have more material than to be used in one instrument. Would that not all become the property of the Commission?

Mr. KENNEY. Yes. The Navy would then have to go to the Commission and obtain a license or contract to operate such facilities.

Mr. SHERIDAN. That goes right back to Mr. Elston's suggestion.

Mr. ELSTON. Right there, Mr. Kenney, if your interpretation of the act is correct, why is there any necessity for setting up a Division of Military Application within the Commission?

Mr. KENNEY. If I may continue with my statement, I will go into that question, as to the proper function of those divisions of the Commission in the field of research.

Mr. ELSTON. What would the director of a Division of Military Application have to do, if you have already the authority to go ahead and conduct all sorts of research? What would he do?

Mr. KENNEY. To be perfectly frank with you, Mr. Elston, I am not clear in my own mind from a reading of those sections as to just exactly what was intended by them; and I would like to suggest that, for the correct interpretation of those sections, you possibly talk to Mr. Newman, whom I believe is here in the committee room today, who was one of the men who worked on the drafting of the bill. I have some doubts in my own mind as to just exactly what those sections mean.

Mr. MARTIN. Do you mean the section creating the Director of Military Application?

Mr. KENNEY. Yes, sir; that is right.

To continue with my statement: In the opinion of the Navy Department, it is essential that the authority of the Navy Department to conduct such research and development activities be clearly expressed within the legislation itself or in the committee's reports.

S. 1717, in its present form, thus satisfactorily covers the Navy's primary interests in having a voice in the affairs of the Atomic Energy Commission and in being able to conduct its own research and development programs without undue interference from the Commission. In studying the provisions of S. 1717, however, some other questions were raised, and I wish to bring the following points to the attention of this committee for your consideration:

(1) In section 2 (a) (4) (B), four divisions are established to handle the work of the Commission, and it is stated that "the authority granted under section 3 (a) of this section shall not be exercised by the Division of Research." At no other place in the bill is there any mention of where within the Commission the authority granted under section 3 (a) for entering into research and development contracts is to be exercised, and it seems that provisions should be made somewhere in the bill for the exercise of this authority.

(2) The words "fissionable material" are used several times in sections 1 (b) (4), 2 (c), 3 (a), and 4 (a), but are not defined until later in section 5 (a) (1). If such definitions are to be placed through-

out the bill, it would seem preferable to define the words in the section where first used. On the general question of definitions, however, it is noted that many terms are defined in various sections throughout the bill, and there also is a general section, section 17, entitled "Definitions." It would seem to make for a clearer understanding of the bill if all definitions now scattered throughout the bill were covered in section 17.

(3) The exemption of contracts of the Commission from the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) provided for under certain conditions in many of the other provisions, probably also should be provided for in section 5 (b) (6) page 18, lines 11 to 19 for contracts covering exploratory operations, and so forth. Also, it would seem preferable to have a general provision exempting the contracts of the Commission from the provisions of section 3709, rather than by the repetition of the same language in five or six separate places. That is merely my suggestion as to how it be done, if that is what Congress wishes to do, Mr. Chairman.

(4) Also of great importance to the Navy are the provisions of sections 5 (a) (4), 5 (c) (2), 5 (d) (1) and 7 (c) under which the Commission apparently would be unable to prohibit the distribution of fissionable or other materials and licenses to persons within the boundaries of the United States on the ground that they are deemed to be undesirable from the national security viewpoint. It is extremely important that the Commission have the specific authority within its discretion to refuse to distribute fissionable or other material to residents of the United States of questionable loyalty. Therefore, the Navy urges that the words "or to persons within the jurisdiction of the United States where issuance thereof would be inimical to the common defense and security" be inserted at the end of section 5 (d) (1), page 21, line 20; and section 7 (c), page 26, line 5.

The CHAIRMAN. Have you drafted those amendments which you want to submit for the committee's consideration?

Mr. KENNEY. We have suggested that the words "or to persons within the jurisdiction of the United States where issuance thereof would be inimical to the common defense and security" be added.

The CHAIRMAN. Have you drafted any amendments to the form of your statement, there?

Mr. KENNEY. Yes; I have those. The specific language has been set forth in my statement, Mr. Chairman.

The CHAIRMAN. That is the very question you have not answered. I know they are in your statement, but have you written out the actual language?

Mr. KENNEY. Yes; and I have recommended that the language be inserted at the end of line 20 on page 21 and at the end of line 5 on page 26.

(5) Also important to the Navy Department is the licensing provision of section 7 under which the Commission will exercise stringent controls over the manufacture of "any equipment or device utilizing fissionable material or atomic energy"—page 23, lines 11 and 12—and the utilization of "fissionable material or atomic energy with or without such equipment or device"—page 23, lines 12 and 13. These provisions are far reaching in their consequences because in future years their effect will be to give the Commission the power of life or

death over many industries. In view of its importance, therefore, it seems advisable at this time to reconsider certain of the provisions of section 7 (c) which are in effect a modification of the existing anti-trust laws.

Mr. ELSTON. You make a statement, here that in future years, the effect of this provision, that is, the licensing provision, will give the Commission the power of life or death over many industries. As a matter of fact, it would give the Commission the power of life or death over all industries; would it not?

Mr. KENNEY. I would not think so; no. My point here is directed primarily to the provision of the act which would give the Commission the power to refuse to grant a license where, in their opinions, the license might serve to maintain or foster the growth of monopoly, restraint of trade, unlawful competition or "other trade position inimical to the entry of new, freely competitive enterprises in the field." I have a great deal of question in my mind as to whether you should give decisions of a judicial character of this kind to a commission which is scientific in nature. Also, the bill does not set forth what are the standards of restraint of trade, unlawful competition, or monopoly to which it has referred.

Mr. ELSTON. Do you think we should give to any Commission the power of life or death over any industry in this Nation?

Mr. KENNEY. I believe that, because of the unique character of the problem that we have here, the powers given to the Commission with the modifications that I speak of here, are not too broad.

Mr. ELSTON. Now, Mr. Kenney, while you are here, let me ask you about the matter I was touching on before, because I think that is one of the vital parts of the bill. You seem to think that the bill will not retain the Army and Navy Departments, and it will permit them to go ahead with research and development. Let me call your attention to the Senate report which accompanied the bill, on page 12, where they refer to the Military Liaison Committee. This is what it says in that report:

A Military Liaison Committee appointed by the Secretaries of War and Navy is to consult with the Commission on all activities relating to the military applications of atomic energy. This provision has been adopted to give the armed forces a proper voice in such matters as development, manufacture, storage, and use of bombs, allocations of fissionable materials for military research, control of information relating to the manufacture and use of atomic weapons.

Now is that not all-inclusive?

Mr. KENNEY. That is all-inclusive, Mr. Elston, but I still feel that it does not unduly restrict us in our activities. Principally what they are talking about there is the control of the issuance of fissionable material, and the work of the Commission itself. To that I referred before. I think that is perfectly proper. We are there required to give the Commission information as to what we are doing in our research field, and I certainly feel that the Commission is entitled to that information.

Mr. ELSTON. Does that which I have just read not indicate that whatever authority you got you get from the act itself and you get it through the means of the Military Liaison Committee?

Mr. KENNEY. Our power of research we get under our own statutes. There are certain other powers, certain production rights, which are put by this bill exclusively under the control of the Commission.

Mr. ELSTON. Of course, this act would set aside and repeal any existing law, because this is special legislation. When the Senate committee files a bill and makes a report, and the report accompanies the bill and it explains a section which you admit and I can certainly see is not clear, and they say what I have just read, does it not look like the Army and the Navy must go to the Commission for every type of authority, and that your only means of getting that authority is to proceed through the Military Liaison Committee?

Mr. KENNEY. The committee has also said on page 19 of that same report:

In military research, as distinguished from production of atomic weapons, the committee has adhered to the general principle of allowing great latitude and freedom. The armed services, as well as private individuals, are permitted to engage in independent military research, and under the provisions of section 3 are to be assisted by the Commission in their activities. It is not the intent of the committee to restrict the existing powers of military departments in entering into research and development contracts with nongovernmental organizations provided that all such contracts are in all their aspects subject to provisions of this bill. All military research is subject to inspection and reports as provided in section 10. The Commission itself is directed to engage in military research, working through its Division of Military Application, in close cooperation with the Departments of War and Navy.

I construe that as making the Army and Navy subject only to certain provisions of the bill; those methods and manners of control to which I have already alluded in connection with the control of and issuance of fissionable material and certain licensing of production.

Mr. MARTIN. Mr. Kenney, do you have any objection to lifting the ban against representatives of the armed forces in the membership of the Commission?

Mr. KENNEY. The Secretary of the Navy in appearing before the Senate committee advocated that representatives of the War and Navy Departments should be members of the Commission. That committee heard his testimony and deliberated for a certain length of time on the subject.

Mr. MARTIN. That is the Senate committee?

Mr. KENNEY. Yes; that is the Senate committee.

There had been a great deal of discussion about what they term the undue influence of the military on this Commission.

The CHAIRMAN. Whom do you believe ought to have something to say about a matter of international importance like this?

Mr. KENNEY. Let me make one point here; I think it would be desirable if the President is free to appoint a War Department representative and a Navy representative as members of the Commission; however, I am perfectly willing to defer to the decision made by the Senate because I feel our interests are adequately protected in subsection 2 (c) to which I have previously referred.

Mr. MARTIN. Regarding this general manager and his four assistants in section 2 of the bill that you referred to a moment ago; subsection (4) (B). Those four division heads are so important that they are provided a salary of \$14,000 per annum. We notice that one of them is head of the Division of Military Application, under the general manager, who is functioning under the Commission. Now, my question is, Do you think it better for our national defense to retain the law in its present form which bars a member of the armed

forces from serving in the capacity of director of military application?

Mr. KENNEY. I think it would be preferable, Mr. Martin, to leave the hands of the President and the Commission free for such appointments. If the Commission wished to appoint a military man to that position, I think it should have the right to do so.

Mr. MARTIN. The law now makes the military man ineligible, and the hands of the President are not free unless we free them.

Mr. KENNEY. My own feeling is that I think the President and the Commission should be free to make the choice as to whether that man should be a military man or not.

Mr. MARTIN. As a matter of policy, do you think that we would gain in the matter of our national defense to make provision whereby the President may appoint a representative of the armed forces in that position?

Mr. KENNEY. That is a question of personalities. Under some circumstances a civilian would be a far better man to put in the position.

Mr. MARTIN. Let us talk about generalities. I cannot see the reason for putting a bar against the participation of the armed forces in that particular job, or on the membership on the Commission itself.

Mr. KENNEY. I agree with you on that, Mr. Martin. We have expressed our feeling on that previously. I think Secretary Patterson has also expressed his feeling on that by originally supporting the May-Johnson bill.

Mr. MARTIN. What is your feeling on that?

Mr. KENNEY. I think it would be desirable that the hands of the President and the Commission be free.

Mr. ELSTON. Perhaps it is because of that bar against the Army and Navy having any voice in the matter, other than as you have indicated, that has made the communistic organizations of this country and elsewhere so enthusiastically in favor of this bill.

Mr. CLASON. This is entirely different from the conception of the way the bomb should be handled under the British system; is it not? As I read the statement of the Prime Minister on October 29 in the House of Commons, they were turning over the development of atomic energy to the service departments under the Minister of Supply, and they were talking to the Prime Minister about between £30,000,000 pounds and £40,000,000 for the development of atomic energy, not only for military purposes, but for civilian purposes.

Mr. KENNEY. I think it is always extremely difficult to compare what we do with what the British do, because our forms of government are somewhat different. Their Ministry of Supply happens to be a civilian organization. I do not agree that that is a proper and efficient organization for the procurement of military material. Therefore, I think it is extremely difficult for us to compare what is being proposed in this bill with what Great Britain is doing.

Mr. CLASON. Great Britain is using her governmental funds for the development of research in atomic energy for the benefit of the shipbuilders and for automobile builders and everybody, are they not; whereas, in this country, by this bill, you will almost prevent any private concern like General Motors from daring to spend any sum of money, such as \$120,000,000 when at any moment their license may be taken away from them, provided they get such license. They may not even get a license. What is there to protect industry under this

bill? Can General Motors or anybody go in and say, "We want to go ahead and do some research work, and get a license, and spend a lot of money on making engines for ships or for automobiles"?

Mr. KENNEY. I assume that when the Congress of the United States establishes a bill and appoints a commission which is to be composed of members appointed by the President of the United States, that those men are going to be men of stature and they are going to exercise their authorities reasonably and in accordance with due process of law.

Mr. CLASON. Should not Congress lay down the license and the law so they will have to give licenses to persons if they meet certain specifications or requirements? Why should we leave it to them, and then to the Supreme Court, which is apparently in such a mess at the present time?

Mr. KENNEY. You have given the Commission the power to lay down regulations. Those regulations would have to meet the test of reasonableness under the Constitution of the United States. Any action over that would have to go before the courts. I do not think that we know enough at this time to express what would be a detailed basis for granting a person a license.

Mr. CLASON. You do not believe the Commission now being discussed has any better chance of being in harmony than a Supreme Court has, do you? Why should not the Congress lay down the rules and laws?

Mr. KENNEY. That would be difficult to do with any exactness at this time because of the subject. With the permission of the committee, I would like to return to my statement concerning certain of the provisions of section 7 (c) which are, in effect, a modification of the existing antitrust laws. This section provides that—

Where activities under any license might serve to maintain or to foster the growth of monopoly, restraint of trade, unlawful competition, or other trade position inimical to the entry of new, freely competitive enterprises in the field, the Commission is authorized and directed to refuse to issue such license or to establish such conditions to prevent these results as the Commission, in consultation with the Attorney General, may determine.

This provision would be an extremely difficult one to administer. In the first place it lays down no standards which the Commission could use as a guide for determination of the banned activities. Furthermore, it would seem inadvisable to give to this Commission—an agency, primarily scientific in character—powers calling for decisions of a technical, judicial nature.

The determination of what constitutes monopoly, restraint of trade and unlawful competition raises some of the most complicated questions under the antitrust laws, and if a provision of this character is required it should be enacted as an amendment to the antitrust and unfair competition laws rather than by the granting of such authority to a body which must by its very nature be untrained in the determination of such matters. Also, no provisions have been included to assure an applicant for a license that the determination of the Commission, which may bar such applicant forever from entering into a broad area of business enterprises, would be made only after a full and a fair hearing and in conformity with due process of law.

Except as I have heretofore indicated, the provisions of S. 1717 are satisfactory to the Navy Department, and we urge that prompt and favorable consideration be given to the bill by this committee.

The CHAIRMAN. With the consent of the committee, we will stand adjourned until 10 o'clock tomorrow morning, at which time we will meet for the purpose of considering amendments to the bill.

(Whereupon, at 12:10 p. m., the committee adjourned, to reconvene Thursday, June 13, 1946.)

ATOMIC ENERGY

WEDNESDAY, JUNE 26, 1946

HOUSE OF REPRESENTATIVES,
COMMITTEE ON MILITARY AFFAIRS,
Washington, D. C.

(Statement by Conder C. Henry before the House Military Affairs Committee in executive session on June 26, 1946, on S. 1717, an act to regulate and control atomic energy.)

STATEMENT OF CONDER C. HENRY

Mr. HENRY. Mr. chairman and gentlemen of the committee, I shall make my comments on S. 1717 brief to a practical end. Before doing so, however, I wish to thank the committee for according me an opportunity to appear before it to express my views on the measure, and I hope that what I am about to say will be of some help in the committee's deliberations.

Perhaps it is unnecessary for me to qualify myself, but I might mention the fact that as Assistant Commissioner of Patents during World War II, I issued a large part of the secrecy orders which were issued under Public Law 700 in applications for patents. Also, I had the privilege of inspecting for the Patent Office the plants at Oak Ridge, Tenn., and at Hanford, Wash., at which were produced the materials for making the atomic bomb. Hundreds of inventions there used had previously been made by private inventors. As to inventions relating to the bomb, I think that they should be viewed as being merely a part of an evolutionary process and as constituting only steps forward in man's upward struggle for the achievement of complete freedom.

Considering the time they were made and the accumulated knowledge available to those who made them, they are not, in my judgment, any more startling or important and are not capable of any more or less beneficial or harmful uses than others made in earlier times and which were accompanied by far less furor. There might be mentioned in this connection, the spinning jenny, the internal-combustion engine, high explosives, the linotype machine, radio, the submarine and the aeroplane. These and many other earlier inventions revolutionized the art of war and the economy of nations, but they were dealt with in this country by practical men under our constitutional processes in such manner as insured their full development and utilization. My entire argument today will be that our experience of the past in dealing with these older inventions is a guide for the future in dealing with this latest one.

The bill before you is concerned with fissionable materials and with atomic energy generally. It endeavors to solve the problems created

by the discovery of this new source of power, and such problems are rendered unnecessarily complicated by the manner they are dealt with in the bill.

I suppose that most of you have been trained in law and perhaps some of you in the mathematical sciences. Lawyers and scientists know that when they are confronted with a problem, the solution of which seems difficult, the method of attack is to divide the problem into its component parts and then solve each part one at a time. Applying this technique to the bill, it will be seen that it does not present one integral problem but three in juxtaposed position, the solution of neither of which is necessary for the solution of the other. As I view the matter, such problems are:

1. The problem relating to the production and control of fissionable materials and byproduct materials. Sufficient facts are known to permit of the solution of this problem now;

2. The problem of forecasting the "political, economic, and international effects of the utilization of atomic energy" (p. 24); and

3. The problem relating to the nationalization of inventions not yet made relating to such energy.

Manifestly, in the 10 minutes time allotted to me it will not be possible to discuss these problems in detail. There are, however, certain broad observations with respect to them which can be made.

First, the problem of controlling production and use of fissionable material is the only problem which is capable of present solution. By injecting into this problem considerations concerning the prospective economic and social effects of the industrial utilization of atomic energy and also concerning patents for inventions which may be evolved in the future, the factors necessarily involved in the solution of the main problem are greatly clouded.

Insofar as the bill provides for the control and policing of the production and use of atomic energy on a scale which would constitute a hazard to life or health, and for the disposal and licensing of fissionable material, I think that for the most part it admirably accomplishes the purpose. However, I am unable to see any logic or justifiable reason for incorporating in a bill designed primarily for dealing with the very practical problem of policing the production and use of fissionable materials now in existence, provisions for a new patent policy and for studies of the future social effects of inventions not yet made. These three matters should, in my judgment, be dealt with separately in separate measures as involving unrelated considerations.

Please project your minds backward to the year 1900. I suppose that in 1900 many of you gentlemen were launched on the careers which placed you among the policy makers of the Nation. At that time we did not have many telephones, and no electric refrigerators, radios, aeroplanes, submarines, or articles made of plastics, and the automobile was just being introduced. Inventions in these fields constitute the basis of huge industries which provide enormous investment outlets and jobs for millions of people.

Suppose there were a law on the statute books dating back to that year such as is represented by the bill before you, can it be truthfully said, or can you believe, that we would have achieved the industrial supremacy we now enjoy, or would have made discoveries which insured our success in two world wars? Such a law would have closed the field to private citizens to make and secure patents for inventions

relating to automobiles, for example, out of which sprang the military tank. It also would have enabled sociologists and economists from the very beginning to raise their raucous voices against any progress in the field of automotive transportation because of the misapprehensions they may have entertained about the impact automobiles would have on the established livery-stable and horse-breeding industries as well as on the expected dislocation of people occasioned by the decentralization of urban populations into outlying communities because of the easier and faster method of transportation. More importantly, it would have destroyed the incentives provided by the Constitution to make new discoveries and to invest speculative capital needed to develop them into marketable products. In this connection, I wish to comment briefly on these incentives.

In effect our patent laws simply provide that if a man will spend his time and money in discovering something of the kind named in the patent statutes which is new and useful, he may receive a patent (not a reward) for it, by which he may exclude others for a limited time from making, using or selling his new invention. Essentially, he must make a discovery and, therefore, add something to the sum of human knowledge. Furthermore, when he receives his patent, he must establish a new enterprise, or sell his invention to someone else, if he expects to recoup the money spent in making the invention in the first place. The Government does not spend anything. Its purpose is accomplished by providing the incentives which induced the disclosure of the unknown to the public and the establishment of the new enterprise.

Over 2,400,000 patented inventions were made since our Government was founded as a result of these incentives, and substantially all of our industrial economy is built on them. Unquestionably, they insured our success in the inventive type of warfare in which we were engaged during both world wars.

By removing the incentives provided by our patent laws, the bill is a radical departure from anything known in our history. The only parallel I can find to it is the Soviet patent law. That law provides, in part, as follows:

69. If the invention or technical improvement is accepted for utilization, the inventor or individual who proposed the technical improvement receives, depending on the technical significance, savings or any other effect produced by his invention or technical improvement upon the national economy, and the degree of perfection of this invention or technical improvement, a remuneration in accordance with the instruction approved by the Council of People's Commissars of the USSR.

* * * * *

71. All utilized inventions and technical improvements, as well as the remuneration paid for them, are noted in the Labor Book of the inventor or individual who suggested the technical improvement.

72. The inventors have, other conditions being equal, a priority for positions as scientific workers in scientific research and experimental institutions and enterprises related to the field in which their invention has been made.

The above quotation is from *Sobrainie Postanovlenii i Rasporiazhenii Pravitelstva Soyuza Sovetskikh Sotsialisticheskikh Respublik*, March 25, 1941, No. 9, article 150, an unofficial translation of which was furnished to me by our State Department.

I am not informed as to whether anything worthwhile has been produced under the Russian law. I do not know nor have I heard of anything.

The adoption of a similar law by the enactment of the bill before you, which substitutes bureautic "rewards" for the exclusive rights provided by present law, would, in my judgment, effectively retard the making of new inventions for the establishment of new enterprises based on them for the utilization of atomic energy for commercial, industrial, and military purposes by private initiative, enterprise and capital. I trust it will be remembered that regardless of what suppressive measures may be adopted by this country in this respect, other countries that are our industrial rivals may continue to pursue a more enlightened policy. The most that we can do to encourage inventors is not too much to demand to insure the continuance of our industrial world supremacy, or even our national security.

Obviously, the bill is predicated on the proposition that foreign nations might gain an advantage by learning from published patents, or as a result of our patent procedures, of new inventions made by citizens of this country. My answer is that full secrecy can be preserved without modification of our patent laws and that few such inventions will be produced if the incentives to produce them are destroyed. No departure from our historic patent policies are necessary for security purposes, and no such proposal was either advocated or adopted during the recent period of hostilities. Ample security is possible, and was secured during the war period, without departing from any of our established fundamental patent practices.

Underlying this bill, gentlemen, is the idea of fear, virtually confessed in its preamble. Because of this fear, unwarranted change in the normal course and direction of American business philosophy is advocated.

My recommendation is that the patent provisions of this bill be eliminated, especially since under present law the government now has the right to use any patented invention, although the patent owner may not consent to such use. This recommendation I believe to be entirely consistent with the findings of the section of patent, trademark and copyright law of the American Bar Association which, acting through its committee on patent law division (of which I am a member) and its Council, with the full knowledge and consent of the Board of Governors of the Association, drew up a resolution disapproving those portions of S. 1717 which provide for the compulsory licensing of patents and prohibits the creation of patent property for certain subject matter. Copies of that resolution were sent to all members of this committee.

I've endeavored to amend the bill to accomplish these purposes. In making these amendments, the intention was to deal with the problem as Congress has always dealt with similar problems, that is, by stating the known facts and then by dealing with them. The first thing to fall by that standard was the vague generalities of the preamble. I will leave those suggested amendments with the Committee for such use as it may deem fitting, and I feel sure that the reasons which I have not given for some of such amendments will readily suggest themselves.

I thank you.

SUGGESTED AMENDMENTS TO S. 1717

Cancel section 1 and substitute therefor:

"FINDINGS OF FACT AND DECLARATION OF POLICY

"SECTION 1. Congress finds (a) that research which led to the invention or discovery of the atomic bomb opened up new fields for further research and invention for the industrial and commercial utilization of the explosive chain-reacting fissionable materials used in the bomb and of the nonexplosive substances produced as byproducts of the manufacture of such materials; (b) that it is essential for the national defense and public welfare to secure the vigorous, expeditious and expending national and private exploration and development of these new fields; (c) that this can best be done by the time tested constitutional methods which in the past have promoted the progress of the sciences and useful arts and thereby contributed to the industrial achievements of the Nation and to the waging of successful war; (d) that the only plants for quantity production of such materials are now owned by the Federal Government; and (e) that because of the nature of such materials it is necessary for Government inspection, regulation, supervision or control not only of all such activities to the extent necessary for the safety of the Nation and for the protection of the life and health of the people, but also of source materials.

"Accordingly, it is hereby declared to be the policy of Congress (1) to retain ownership or control of its plants in which were produced the materials for the manufacture of the atomic bomb and for assemblage of the bomb, and to conduct or sponsor research in fields involving the production and utilization of nuclear energy; (2) to regulate or control the use and distribution of source materials; (3) to encourage free research in the field of nuclear energy and to further the making and use by private initiative, enterprise, and capital of new inventions or discoveries for the practical utilization of nuclear energy for scientific, industrial, and commercial purposes; and (4) to control such activities concerned with the release and utilization of nuclear energy as are on a scale which would constitute a national hazard. The primary objectives of this act, therefore, are to provide for the continued operation or control of its plants in which fissionable materials are produced and in which the atomic bombs were assembled, to control source materials for the production of nuclear energy, to promote the national defense and general welfare by furthering the acquisition of knowledge relating to nuclear energy, and to the making of new inventions or discoveries concerning the practical utilization of nuclear energy, and to protect the health and safety of the inhabitants of the United States."

On page 10 cancel subsection (c) under section 4 commencing with line 16 and substitute the following therefor:

"(1) OWNERSHIP OF PRODUCTION FACILITIES.—The Commission is authorized to own and operate facilities for the production of fissionable material. Private ownership or operation is expressly forbidden except under license by the Commission, provided, however, that no license for operation or ownership is required for facilities which (A) are useful in the conduct of research and development activities in the fields specified in section 3, and (B) do not, in the opinion of the Commission, have a potential production rate adequate to enable the operator of such facilities to produce within a reasonable period of time a sufficient quantity of fissionable material to produce an atomic bomb or any other atomic weapon."

On page 13, line 16, insert after the word "reaction" the following: "employing nuclear chain fission".

On page 14, line 20, insert after the word "material" the following: "owned by it".

On page 16, line 25, and page 17, line 16, cancel the words "are unimportant" and substitute therefor: "do not constitute hazards to national health or safety".

On page 17, line 6, cancel the words "inconsistent with the national welfare", and substitute the following: "constituting a hazard to national health or safety".

On page 17, lines 22 and 23, cancel, "to the extent it deems necessary to effectuate the provisions of this Act." and substitute: "upon determination that such action is necessary in the interest of the common defense and security."

On page 18, line 18, after the word "inspections" insert the following: "of the use of such materials."

On page 21, line 2, after the word "materials" insert "owned by it".

On page 23, line 9, after the word "sections" insert "4", and on line 13 after the word "device" insert "when such manufacture or use constitutes a hazard to national health or safety".

On pages 25 and 26, cancel all of the part of page 25 which starts with line 7 and that part of page 26 which ends with the period in line 2 of that page and substitute therefor the following: "The Commission in issuing licenses shall grant them for a period not to exceed 5 years in accordance with such procedures as the Commission may establish and may be renewed on the expiration of such period. The granting of licenses shall be in such a manner as to encourage competition and where licenses are granted the Commission will not as a condition precedent require the dissemination of technical information and data concerning activities carried on pursuant to such licenses."

Page 24, lines 4 and 5, cancel the Commission's estimate of the social, political, economic, and international effects of such use.

Cancel all of the patent provisions starting with line 8 of page 32 and ending with the last line on page 38.

On page 48, after subsection (a) of section 17, insert a new subsection (b) as follows:

"(b) The term "nuclear fission" shall be construed to mean that process which takes place in nuclei wherein the nucleus is split into fragments, at least two of which contain a substantial fraction of the mass of the original nucleus."

On page 49, line 19, after the word "device" insert "peculiarly adopted for and"

On page 50 add a new paragraph, section 20, after line 23 reading as follows:

"SEC. 20. This Act shall expire three years after the date of its approval."

Renumber sections and subsections accordingly.

X

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