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CHAPTER 45
Three Remarkably Similar Reports on the Safe-Dose Fallacy

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Part 1. Demolition of a Dream

In one critique of the First Edition (Skolnick 1995, p.367), the radiologist Dr. Stephen Feig suggests that low-dose diagnostic x-rays may be incapable of inducing any breast cancer. Feig asserts that any risk at all from mammography is "hypothetical" and, "With such low levels of radiation, there may be much less or even no risk."

If Dr. Feig were the only remaining distributor of the no-risk dream about low-dose radiation, we would not devote a chapter to it. But even some medical schools are still teaching radiologists that cancer-induction by diagnostic radiation is uncertain and just assumed. For example, the following statements come from the 1996 Radiology Syllabus for students at the University of California San Francisco Medical School (Goldberg 1996, p.129):

"High doses of ionizing radiation can produce breast cancer, but this has been demonstrated only at doses above 90 rads." (This claim, invalidated by several studies including the A-Bomb Study, also slipped into *The Lancet*, in Hulka 1995, p.885). The Syllabus adds: "There is absolutely no evidence ... that breast cancer is caused by mammography."

The no-risk, safe-dose dream about ionizing radiation has been powerfully demolished by three major analyses: NRPB 1995, UNSCEAR 1993, and Gofman 1990. (NRPB is Britain's National Radiological Protection Board; UNSCEAR is the United Nations Scientific Committee on the Effects of Atomic Radiation.) This chapter provides excerpts from all three. Because UNSCEAR and NRPB embrace much of the analysis in Gofman 1990, we will begin in Part 2 with Gofman 1990.

Does It Really Matter?

What makes it so important to settle the threshold (safe-dose) issue for ionizing radiation? The widespread exposure.

Low-dose ionizing radiation is not an exotic carcinogen and mutagen which exposes just a *small* segment of the population. There is universal exposure from natural sources and from nuclear pollution, and there is voluntary exposure, occupationally and medically. Speaking about exposures from diagnostic medical x-rays, UNSCEAR warns (1993, p.228):

"Although the doses from diagnostic x-ray examinations are generally relatively low, the magnitude of the practice makes for a significant radiological impact." UNSCEAR has appropriately acknowledged the *aggregate* impact of millions upon millions of low-dose exposures, year after year, in medical practice. And not just in the USA. (Details in Chapter 48.)

Part 2. Gofman 1990: Proof There Is No Threshold Dose or Dose-Rate

The no-risk speculation about low-dose radiation, illustrated at the outset of this chapter, has been tied for a long time to the fact that cell-nuclei have massive capacity to repair DNA damage (Chapter 42, Part 2). Once upon a time, nearly everyone (myself included) hoped that carcinogenic lesions might invariably be repaired --- correctly --- whenever the repair-system was not overwhelmed by "too much" radiation-induced damage all at once.

In the 1970s, however, it was already clear that perfect repair of injured human chromosomes did *not* occur, even when low total doses of radiation were received very slowly from weapons-testing fallout or chronic occupational exposures. And some evidence was already solid that radiation-induced human *cancer* is associated with very low doses and dose-rates. But might there be a safe dose (no-risk dose) at even lower levels?

Between 1970 and 1990, it was frequently asserted that the safe-dose issue could never be settled, because of the limits of epidemiology. In Gofman 1990, however, we were able to prove, by any reasonable standard of biomedical proof, that no safe dose or dose-rate exists with respect to radiation carcinogenesis.

The key breakthrough lies in recognizing that the relevant way to define the lowest possible dose and dose-rate of radiation is *not* in fractions of a rad. The *relevant* definition occurs in "tracks" per cell (Gofman 1971, pp.275-276; Gofman 1981, pp.405-411; Gofman 1986, pp.6-14). We will show why, by explaining "tracks" in Section 2a, below.

2a. The Least Possible Amount of Damage to Repair

• - **(1)** "The dose from low-LET ionizing radiation is delivered by high-speed electrons, traveling through human cells and creating primary ionization tracks" (Gofman 1990, p.18-2).

• - **(2)** When genetic molecules are damaged by ionizing radiation, each cell-nucleus attempts to un-do the damage by repair. The damage done by a single primary ionization track is the *least possible* damage which the repair-system ever can face. "Fractional tracks do not exist. Either a track traverses a nucleus somewhere (one nuclear track) or it does not (zero

nuclear track)" (1990, p.19-2).

• - **(3)** "For disproof of any safe dose or dose-rate, it is more important to establish the dose in terms of the average number of tracks per nucleus, than to establish it in terms of rads. The reason is that the lowest conceivable dose or dose-rate with respect to repair is not a millionth or any other tiny fraction of a rad or centi-gray. The lowest conceivable dose or dose-rate is one track per nucleus plus sufficient time to repair it" (1990, p.18-3,4).

• - **(4)** "Because the minimal event in dose-delivery of ionizing radiation is a single track, we can define the least possible disturbance to a single cell-nucleus: It is the traversal of the nucleus by just one primary ionization track" (1990, p.19-1). The traversal is complete in a tiny fraction of one second.

• - **(5)** "Single, primary ionization-tracks, acting independently of each other, are never innocuous with respect to creating carcinogenic injuries in the cells which they traverse. Every track --- without help from any other track --- has a chance of inducing cancer by creating such injuries" (1990, p.18-2).

• - **(6)** "... Any lesion which can be inflicted in a nucleus by a *pair* of tracks, can also be inflicted by a single track acting *alone* ... The earlier parts of this chapter leave no doubt that events [injuries] at multiple, separate sites are certainly producible by a single track, acting alone" (1990, p.19-8).

2b. What Dose in Rads Delivers an Average of ONE Track / Nucleus?

• - **(7)** Because a single primary track represents the least *possible* challenge to the repair-system in a cell-nucleus, we wanted to find out if there is solid human evidence of radiation-induced *cancer* as a result of doses which deliver just one track or a few tracks per nucleus. If such evidence exists, it indicates that repair is *not always perfect* even when the challenge is about as low as it can ever get. In other words, it would be *direct* evidence that the hypothesis of a no-risk dose is false, with respect to radiation-induced cancer.

• - **(8)** So a necessary step in our analysis was figuring out what dose in rads (cGy) delivers an average of ONE primary track per cell-nucleus. Chapters 20, 32, and 33 in Gofman 1990 show how such doses were derived, step-by-step. The doses vary with the diameter of the cell-nucleus and with the energy of the radiation.

• - **(9)** The values in the box apply to cell-nuclei with an average diameter of 7.1 micrometers (p.20-3). The heading "Medical X-rays" refers to diagnostic x-rays with an average energy of 30 KeV, generated when the peak kilovoltage across the x-ray tube is 90 KeV. The heading "596 KeV Gammas" refers to gamma rays from radium-226 and daughters. Several additional sources of radiation are evaluated in Tables 20-M and 20-"0" of Gofman 1990.

Radiation	Average number of tracks per nucleus	Tissue-dose in rads (centi-grays)
Medical X-rays	1 track	0.75 rad
	10 tracks	7.48 rads
	134 tracks	100.00 rads

596 KeV Gammas	1 track	0.34 rad
	10 tracks	3.40 rads
	294 tracks	100.00 rads

From Gofman 1990, Table 20-M.

• - **(10)** When the AVERAGE number of primary tracks per nucleus is one, then:

37 percent of cell-nuclei experience no primary track at all;
37 percent of cell-nuclei experience one primary track;
18 percent of cell-nuclei experience two primary tracks;
6 percent of cell-nuclei experience three primary tracks;
1.5 percent of cell-nuclei experience four primary tracks;
Half-percent of cell-nuclei experience more than four primary tracks.
(From Table 20-N of Gofman 1990).

2c. How Many Tracks at Once Can Overwhelm the Repair System?

• - **(11)** In our 1990 analysis, we reviewed the existing experimental evidence on what radiation doses are required to overwhelm the repair-system for genetic molecules. In Gofman 1990, p.18-4, we quote Albrecht Kellerer, one of the leading experts on the issue:

"There is, at present, no experimental evidence for a reduction of the repair capacity or the rate of repair at doses of a few gray [a few hundred rads] which are relevant to cellular radiation effects" (Kellerer 1987, p.346). And: "There is little or no evidence for an impairment of enzymatic repair processes at doses of a few gray. Studies, for example by Virsik et al on chromosome aberrations, have established characteristic repair times that are substantially constant up to 10 Gy [1,000 rads], that is, up to the highest doses investigated" (Kellerer 1987, p.358).

• - **(12)** We also reviewed the existing evidence on the time required to finish repair (Gofman 1990, Chapter 18). Numerous studies indicate that cell-nuclei finish whatever repair they can perform on genetic molecules within 3 to 6 hours, even after doses of 100 to 400 rads.

• - **(13)** "The dazzling speed of repair has an extremely important implication for settling the threshold issue. It means that certain *high*-dose evidence can reveal a great deal, as we will explain" (Gofman 1990, p.18-5).

2d. Existing Human Evidence of Cancer from Minimal Doses

• - **(14)** The relevant high-dose evidence comes from studies of breast-cancer rates among women who received serial fluoroscopies in the course of pneumo-thorax treatment for tuberculosis (see Chapter 15 of this book, and see entries in the Reference list for Boice 1977, Boice 1978, Boice 1981, Boice 1991, Howe 1984, Hrubec 1989, MacKenzie 1965, Miller 1989, Myrden + Hiltz 1969).

Because the women had so many fluoroscopic exams over months and years of treatment, their breasts accumulated radiation doses ranging from about 150 rads to over 1,000 rads

(Gofman 1990, Chapter 21). But each exposure delivered single doses of 1.5 to 7.5 rads at a time. Such doses deliver, respectively, an average of just 2 or 10 tracks per cell-nucleus, as we see from paragraph 9 above.

• - **(15)** These are very nearly the lowest *possible* doses and dose-rates, with respect to challenging the repair-system in a cell-nucleus. If the repair-capacity of cell-nuclei is not overwhelmed by the tracks from hundreds of simultaneous rads (paragraphs 11 and 12, above), we can regard 10 tracks per nucleus, on the average, as nearly minimal.

• - **(16)** Referring to the Nova Scotia Fluoroscopy Study of female tuberculosis patients, we wrote (1990, p.21-2):

"If carcinogenic injury was produced in the irradiated women at their first fluoroscopy exposure-session, but if repair-systems were able to perform flawless repair afterwards, then that particular exposure-session would have left no residual harm, in terms of any increased risk of future breast-cancer." And:

"Similar carcinogenic injury inflicted at *every* subsequent fluoroscopy session would also have been without residual harm, if a flawless repair-system operated at a total dose per exposure-session of 7.5 rads. And thus, after accumulating 850 rads in this fashion, the irradiated women would have had *no* radiation-induced breast-cancer." And:

"The Nova Scotia Study is certainly not a high-dose study; at every critical step along the way, it is a test of how perfectly the repair-system can un-do carcinogenic injury produced by 7.5 rads, or 10 nuclear tracks on the average --- a *low* dose and dose-rate." Between exposures, ample time elapsed for completion of repair-work (paragraph 12).

• - **(17)** The repair-system *failed* the test, conclusively, not only in the Nova Scotia series of women, but also in additional pneumo-thorax series in Canada and in Massachusetts. The evidence of excess breast-cancer in the fluoroscoped women is very solid, and shows a positive dose-response. This evidence of radiation-induced human cancer is widely acknowledged and cited, but not many people recognize that it shows *repair-failure* even after a challenge which was *minimal*.

• - **(18)** Our disproof of any threshold dose or dose-rate includes six additional studies from the mainstream literature which show radiation-induced cancer when the average number of tracks per cell-nucleus ranged from 0.3 track to 12 tracks (Gofman 1990, Table 21-A). They are the Israeli Scalp-Irradiation Study (Modan 1977, 1989); the Stewart In-Utero Studies (1956, 1958, 1970); MacMahon's In-Utero Study (1962); the British Luminizer Study (Baverstock 1981, 1983, 1987); Harvey's In-Utero Study of Twins (1985); Modan's Study of Breast-Cancer in the Scalp Irradiation Study (1989). The evidence against any threshold embraces infants in-utero, children, adolescents, young women, high-energy gamma rays, medical x-rays, acute single doses, acute serial doses, and chronic occupational doses.

• - **(19)** "In recent years, it has been fashionable to suggest that epidemiologic investigations can not usefully address the low-dose radiation question. The epidemiologic studies described here make it apparent that this is incorrect ... When the effort is made to evaluate the doses in such studies, in terms of tracks-per-nucleus, then it becomes evident that studies whose doses are not `next-to-zero' are nonetheless studies of truly minimal doses and dose-rates" (Gofman 1990, p.21-19).

2e. Failure of Repair: "The Troublesome Trio"

• - **(20)** It is the *combination* of epidemiology with track-analysis which reveals that we already know that (a) repair has failures even when the repair-system has the least possible challenge, and (b) the failure has *cancer* consequences. We do not need impossible-to-obtain studies at doses like 10 milli-rads or 10 micro-rads --- because the least possible challenge to the repair-system occurs at much higher doses.

• - **(21)** "One can look with awe, humility, and gratitude at a system of repair with the capacities demonstrated by the DNA repair-system. But an independent analyst, or a realist of any stripe, does not casually dismiss the troublesome trio: Unrepaired lesions. Unrepairable lesions. Misrepaired lesions" (1990, p.18-6). And:

"One cannot fault the repair-system in cell-nuclei for leaving a relatively small number of injuries unrepaired, or misrepaired, or for having some inherent inability to repair every conceivable type of injury inflicted at random by the tracks of high-speed electrons ... " (1990, p.18-6)

• - **(22)** "... the human epidemiological evidence on dose versus cancer-response provides no support for the speculation that repair makes each rad less carcinogenic as dose falls. If that were the net result of repair, the shape of dose-response would be concave-*upward*. But what is seen in the A-Bomb Study and in others is *not* concavity-upward. The finding is either supra-linearity or linearity --- both of which are inconsistent with the speculation that repair processes make each rad less carcinogenic as dose and dose-rate fall" (1990, p.18-6, 18-7).

• - **(23)** "Our entire experience with human radiation carcinogenesis should have made it evident that the problem we might be facing is that --- regardless of dose-level --- some fraction of radiation injury to nuclei is unrepaired ... some fraction is unrepairable ... and some fraction is misrepaired" (1990, p.18-7).

2f. Not "Hypothetical": Fatal Cancers from Minimal Doses

• - **(24)** "The radiation-induced cancers arising from the unrepaired lesions at low doses do not wear a little flag identifying them as any different from cancers induced by higher doses of radiation, or induced by causes entirely unrelated to radiation. Therefore, threshold proponents cannot argue that the cancers arising from the lowest conceivable doses of radiation will somehow be eliminated by the immune system or any other bodily defenses against cancer. Such an argument would require the elimination of cancer in general by such defenses. Instead, we observe that cancer is a major killer ... So the proposition would lead to a non-credible consequence, and must be rejected" (Gofman 1990, p.18-2).

• - **(25)** What about the speculation that low radiation doses may induce a net health benefit, by stimulating DNA repair or by stimulating the immune system? "When excess fatal cancer is observed in humans after such exposures [minimal doses and dose-rates], the excess has occurred *despite* any possible stimulation of the repair- and immune-responses by low-doses. The *net* result is injury, not benefit. I wish it were otherwise" (1990, p.18-2).

• - **(26)** "By reasonable standards of proof, the safe-dose hypothesis is not merely implausible --- it is disproven ... We conclude with a warning: Disproof of any safe dose or

dose-rate means that fatal cancers from minimal doses and dose-rates of ionizing radiation are not imaginary. They are really occurring in exposed populations. Proposals, to declare that they need not be considered, have health implications extending far beyond the radiation issue ..." (1990, p.18-18).

Part 3. UNSCEAR 1993: "Highly Unlikely That a Dose-Threshold Exists"

UNSCEAR 1993, written by the United Nations Scientific Committee on the Effects of Atomic Radiation, is a 922-page report (with no index) which presents a lot of valuable information and analysis.

Although authors of its nine big sections (called "annexes") are not identified, the total international membership of the Committee is identified on page 29. The biggest delegations are from Canada (9), China (7), France (9), Germany (7), Japan (11), Russian Federation (12), United States (11). Staff and consultants are identified on page 30.

Pagination in the report is consecutive from beginning to end, but paragraph numbers start over with each annex. Below, we will separate the page number and the paragraph number by a slash.

• - **(27)** In its introduction, the report states: "The combination of epidemiology and radiobiology, particularly at the molecular and cellular levels, is a useful tool for elucidating the consequences of low doses of radiation" (1993, p.27/184). That very combination is the essence of our proof, above, that there is no threshold dose with respect to radiation carcinogenesis.

• - **(28)** UNSCEAR also affirms our premise in paragraph 24, when it states: "Epidemiological studies of human groups exposed to low-LET radiation show that a range of neoplasms are represented in excess and, broadly, that these do not differ markedly from those arising spontaneously in the population ... no unique neoplastic signature of human radiation exposure is, as yet, apparent" (p.578/153).

3a. The Smallest Possible "Insult" at the Cellular Level

• - **(29)** UNSCEAR 1993, like Gofman, recognizes the importance of using an *appropriate* definition of the lowest possible radiation dose or dose-rate. And it embraces our "microdosimetric approach to defining low doses and low dose rates" (p.680/321):

"Photons deposit energy in cells in the form of tracks, comprising ionizations and excitations from energetic electrons, and the smallest insult each cell can receive is the energy deposited from one electron entering or being set in motion within a cell." See paragraphs 1-4 above.

• - **(30)** The only conversion offered by UNSCEAR between tracks and dose in rads (centi-grays) is for cobalt-60, which produces a far more energetic gamma ray than the 596 KeV gammas presented above in our paragraph 9. Says UNSCEAR (p.680/321):

"For cobalt-60 gamma rays and a spherical cell (or nucleus) assumed to be 8 micrometers in diameter, there is an average of one track per cell (or nucleus) when the absorbed dose is

about 1 mGy [0.1 cGy or rad]. The dose, corresponding to one track per cell, on average, varies inversely with volume and is also dependent on radiation quality, being much larger for high-LET radiation."

• - **(31)** At page 696, UNSCEAR supplies Table 17, "Proportion of a cell population traversed by tracks at various levels of track density." It is like Table 20-N in Gofman 1990. For instance, it shows what percentage of cells experience 0, 1, 2, 3, 4, and more tracks per cell-nucleus, when the average track density is ONE track per cell-nucleus. The percentages are the same as we show in paragraph 10, above.

• - **(32)** The UNSCEAR authors define the region of "definite" single-track action as the dose-region where not more than *two percent* of the cell-nuclei experience more than a single track. "In this dose-region, there are so few radiation tracks that a single cell (or nucleus) is very unlikely to be traversed by more than one track" (p.628/42). For cobalt-60, the two-percent criterion means a tissue-dose of 0.2 mGy. Two percent is an arbitrary choice which seems completely unrelated to the repair-issue --- even though UNSCEAR agrees with us that the repair-issue is a critical part of the threshold-issue, as we will show. However, after choosing cobalt-60 and a dose of only 0.2 mGy (20 milli-rads), the UN authors are correct in saying that there are no corresponding human or animal data (p.628/42).

3b. UNSCEAR: The Carcinogenic Potency of a Single Track

• - **(33)** "The most basic, although not sufficient, condition for a true dose threshold is that any single track of the radiation should be totally unable to produce the effect" (p.630/54).

• - **(34)** "Radiation is able to induce a diversity of genomic lesions, ranging from damage to single bases to gross DNA deletions and rearrangements" (p.578/153).

And: "Biophysical analyses based on Monte Carlo simulations of track structure show clearly that all types of ionizing radiation should be capable of producing, by single-track action, a variety of damage to DNA, including double-strand breaks alone or in combination with associated damage to the DNA and adjacent proteins" (p.632/63).

And: "In all these mechanistic models, a single radiation track from any radiation is capable of producing the full damage and hence the cellular effect" (p.632/64).

• - **(35)** "There is compelling evidence that most, if not all, cancers originate from damage to single cells ... Point mutations and chromosomal damage play roles in the initiation of neoplasia" (p.8/37).

And: "Single changes in the cell genetic code are usually insufficient to result in a fully transformed cell capable of leading to cancer; a series of several mutations (perhaps two to seven) is required ... The whole process is called multi-stage carcinogenesis" (p.8/38). And: "It is possible that radiation acts at several stages in multi-stage carcinogenesis, but its principal role seems to be in the initial conversion of normal stem cells to an initiated, pre-neoplastic state" (p.8/39).

• - **(36)** "... the majority of neoplasms originate from damage to single cells. In principle, therefore, the traversal of a single target cell by one ionizing track from radiation has a finite probability, albeit low, of initiating neoplastic change" (p.556/26).

• - **(37)** Our topic here is real-world human evidence relating to the threshold-issue for radiation-induced cancer. We omit unrelated references by UNSCEAR to dose-response curves induced in various experiments, although we are interested in such experiments (see Gofman 1990, Chapter 23). With respect to the threshold-issue, we quote UNSCEAR:

"Multi-stage models of carcinogenesis could lead to expectations of a dose threshold, or a response with no linear term, under particular, highly restricted sets of assumptions" (p.636/84). But, "it would be difficult to conclude on theoretical grounds that a true threshold should be expected even from multi-stage mechanisms of carcinogenesis, unless there were clear evidence that it was necessary for more than one time-separated change to be caused by radiation alone" (p.633/69).

3c. UNSCEAR: Does "Repair" Deliver a Threshold Dose?

A threshold-dose for radiation-induced cancer is a dose below which there is *no* risk of radiation-induced cancer. A safe dose.

• - **(38)** As long as there are any primary tracks at all occurring in a biological tissue, a radiation dose is occurring. UNSCEAR acknowledges that "the dose and dose-rate region of main practical relevance in radiation protection (0-50 mSv per year) [0-5 rems per year] is characterized by small average numbers of tracks per cell with long intervals of time between them. Effects are, therefore, likely to be dominated by individual tracks, acting alone" (p.628/43). This is precisely the point made in Gofman 1990, p.20-7).

• - **(39)** "Cells are able to repair both single- and double-strand breaks in DNA over a period of a few hours, but sometimes misrepair can occur" (p.625/28).

• - **(40)** "The extent to which radiation-induced DNA damage may be correctly repaired at very low doses and very low dose rates is beyond the resolution of current experimental techniques. If DNA double-strand breaks are critical lesions determining a range of cellular responses, including perhaps neoplastic transformation, then it may be that wholly accurate cellular repair is unlikely even at the very low lesion abundance expected after low dose and low-dose-rate irradiation" (p.634/74).

• - **(41)** "It is highly unlikely that a dose threshold exists for the initial molecular damage to DNA, because a single track from any ionizing radiation has a finite probability of producing a sizable cluster of atomic damage directly in, or near, the DNA. Only if the resulting molecular damage, plus any additional associated damage from the same track, were always repaired with total efficiency could there be any possibility of a dose threshold for consequent cellular effects" (p.636/84).

• - **(42)** "Biological effects are believed to arise predominantly from residual DNA changes that originate from radiation damage to chromosomal DNA. It is the repair response of the cell that determines its fate. The majority of damage is repaired, but it is the remaining unrepaired or misrepaired damage that is then considered responsible for cell killing, chromosomal aberrations, mutations, transformations and cancerous changes" (p.680-681/323).

Part 4. NRPB 1995: Evidence "Falls Decisively" against a Threshold

In October 1995, Britain's National Radiological Protection Board released a 77-page report entitled "Risk of Radiation-Induced Cancer at Low Doses and Dose Rates for Radiation Protection Purposes" (NRPB 1995). Its five authors are Cox, Muirhead, Stather, Edwards, and Little.

• - **(43)** Chapter 2 of NRPB 1995 reviews the existing human epidemiologic evidence and concludes (p.25/61): "It is important to note that the studies of low-LET exposure considered in this chapter are consistent with a linear trend in cancer risks at low doses without threshold." This statement embraces the pneumothorax-fluoroscopy studies (p.13/23).

• - **(44)** Chapter 5 of NRPB 1995 reviews "Cellular and molecular mechanisms of radiation tumorigenesis." There, the authors also state the now-familiar definition of the lowest possible dose and dose-rate from ionizing radiation:

"It may be argued ... that a single radiation track (the lowest dose and dose rate possible) traversing the nucleus of an appropriate target cell, has a finite probability, albeit low, of generating the specific damage that will result in tumour-initiating mutation" p.58/27).

• - **(45)** The authors consider existing evidence relating to the reduction of radiation risk by so-called cellular "adaptive" responses and immune-system responses. In particular, they discuss issues raised in UNSCEAR 1993 and in UNSCEAR 1994 (Annex B). The authors reach the same conclusion that we do: Such cellular responses do not provide any threshold dose with respect to post-repair genetic damage. NRPB concludes (p.75/21):

"Whilst adaptive responses or other protective mechanisms may influence the risk of tumour development, they do not provide a sound basis for judgement that tumorigenic response at low doses and low dose rates of radiation is likely to have a non-linear component which might result in a dose threshold below which the risk may approach zero."

4a. NRPB on Special Difficulties in Repairing Radiation Damage

The NRPB authors understand very well that failure of repair is the key to the absence of any threshold dose. The following excerpts from their 1995 report show they understand that ionizing radiation has the power to induce some *unrepairable* damage to chromosomes and DNA, and that a difference exists between action by primary ionization tracks, and action by the free radicals which are produced by normal cellular metabolism (see p.292 of this book).

• - **(46)** "Radiation-induced damage to DNA nucleotide bases and to the sugar-phosphate backbone on one strand of the DNA duplex closely resembles the cellular damage that occurs through normal endogenous metabolic processes" (p.59/28).

"It is generally accepted that, in the absence of exogenous agents, each cell in the human body sustains 5,000 to 10,000 DNA damage events per hour [they cite Ames 1989 and Billen 1990], principally as a consequence of thermodynamic instability and attack by chemical radicals produced via endogenous biochemical reactions; this damage is believed to contribute to natural cancer risk" (p.59/29).

• - **(47)** "On this basis, arguments have been made [they cite Billen 1990 and Abelson 1994] that the small increment of additional cellular DNA damage resulting from low dose radiation exposure will have an insignificant effect on the frequency of gene and chromosomal

mutations, and by implication, on cancer risk. This would be a valid hypothesis if the DNA damage resulting from spontaneous endogenous processes were to be *identical* with that induced by ionising radiation. There is, however, strong evidence that this is not the case and, consequently, that the hypothesis lacks credibility" (p.59/30).

• - **(48)** "The vast majority of endogenous DNA lesions takes the form of DNA base damage, base losses, and breaks to one of the sugar-phosphate backbone strands of the duplex. Such single-strand DNA damage may be reconstituted rapidly in an error-free fashion by cellular repair processes ..." (p.59/31).

• - **(49)** "In contrast, although a single ionising track of radiation will also induce single-strand damage when an energy-loss event takes place in close proximity to one DNA strand, a cluster of such loss events within the diameter of the DNA duplex, of about 2 nanometers, has a significant probability of simultaneously inducing coincident damage to both strands. In support of this, an approximately linear dose-response for double-strand break induction by low-LET radiation is observed, confirming that breakage of *both strands* of the duplex may be achieved by the traversal of a *single ionising track* and does not demand multiple-track action ..." (p.59/32). And:

"There is also evidence that a proportion of radiation-induced double-strand breaks are complex and involve local multiply damaged sites --- LMDS [they cite Ward 1991-a] ..." (p.59/32).

• - **(49)** "A given fraction of radiation-inducible double-strand damage will be repaired efficiently and correctly, but error-free repair of all such damage even at the low abundance expected after low dose exposure should not be anticipated" (p.60/33). And:

"Unlike damage to a *single*-strand of the DNA duplex, a proportion of double-strand lesions --- perhaps that component represented by LMDS --- will result in loss of DNA coding from *both* strands. Such losses are inherently difficult to repair correctly, and it is believed that misrepair of such DNA double-strand lesions is the crucial factor underlying the induction of chromosomal aberrations and gene deletions that represent the principal hallmarks of stable mutations induced by ionising radiation of various qualities" (p.60/33). And:

"Double-strand DNA losses may in principle be repaired correctly by DNA recombination, but there is evidence that radiation-induced DNA damage may be subject to error-prone illegitimate DNA recombination which can result in the forms of gene and chromosomal mutations that are known to characterise malignant development" (p.60/33).

• - **(50)** "The importance of DNA double-strand damage and its repair for the radiation response of cells is further supported by studies indicating, firstly, that the repair of such damage is the principal determinant of dose and dose-rate effects after low-LET radiation and, secondly, that genetically determined cellular radiosensitivity is predominantly associated with deficiencies in DNA double-strand break repair. Finally, there is evidence that it is the difference in the *quality* and not the *quantity* of induced DNA double-strand lesions that principally provide for the increased biological effectiveness of high-LET radiation such as alpha particles compared with low-LET radiation such as x-rays and gamma rays; these observations are best explained by experimental and computational data indicating that, overall, DNA double-strand lesions in cells induced by high-LET radiation are more complex and less likely to be repaired correctly than those induced by low-LET radiation ..." (p.60/34).

• - **(51)** "In summary, a coherent argument may be assembled that at low doses and low dose rates of low-LET radiation, DNA single-strand damage either is repaired in an error-free fashion or is an insignificant component of tumour risk. For double-strand DNA damage, there is good reason to believe that repair has an error-prone mutagenic component irrespective of damage-abundance and, by implication, will, even at very low doses, contribute to tumour risk" (p.60/36).

• - **(52)** "It may be concluded ... that existing data from both in vitro and in vivo [radiation] studies support a linear rather than a threshold-type response for neoplasia-initiating gene mutations" (p.61/38).

4b. NRPB's Conclusion on a Threshold Dose

• - **(53)** "It is concluded ... that data relating to the role of gene mutations in tumorigenesis, the monoclonal origin of tumours, and the relationship between DNA damage repair, gene/chromosomal mutation and neoplasia are well established and broadly consistent with the thesis that, at low doses and low dose rates, the risk of induced neoplasia rises as a simple function of dose and does not have a DNA damage or DNA repair related threshold-like component" (p.75/21). And:

• - **(54)** The following statement by the NRPB authors is remarkably similar to paragraph 26 above:

"In consideration of a broad body of relevant cellular and molecular data, it is concluded that the weight of the evidence, in respect of the induction of the majority of common human tumours, falls decisively in favor of the thesis that, at low doses and low dose rates, tumorigenic risk rises as a simple function of dose without a low dose interval within which risk may be discounted" (p.68/80).

Comment:

In view of parts 2, 3, and 4 of this chapter, we hope that editors at JAMA, *Lancet*, and elsewhere will stop helping to distribute the deadly safe-dose fallacy.

# # # # #

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May 11, 1999
LETTER OF CONCERN.

To Whom It May Concern:

During 1942, Robert E. Connick and I led the "Plutonium Group" at the University of California, Berkeley, which managed to isolate the first milligram of plutonium from irradiated uranium. (Plutonium-239 had previously been discovered by Glenn Seaborg and Edwin McMillan.) During subsequent decades, I have studied the biological effects of ionizing radiation --- including the alpha particles emitted by the radioactive decay of plutonium.

By any reasonable standard of biomedical proof, there is no safe dose, which means that just one decaying radioactive atom can produce permanent mutation in a cell's genetic molecules. My own work showed this in 1990 for xrays, gamma rays, and beta particles (Gofman 1990: "Radiation-Induced Cancer from Low-Dose Exposure"). For alpha particles, the logic of no safe dose was confirmed experimentally in 1997 by Tom K. Hei and co-workers at Columbia University College of Physicians and Surgeons in New York (Proceedings of the National Academey of Sciences (USA) Vol.94, pp.3765-3770, April 1997, "Mutagenic Effects of a Single and an Exact Number of Alpha Particles in Mammalian Cells").

It follows from such evidence that citizens worldwide have a strong biological basis for opposing activities which produce an appreciable risk of exposing humans and others to plutonium and other radioactive pollution at any level. The fact that humans cannot escape exposure to ionizing radiation from various natural sources --- which may well account for a large share of humanity's inherited afflictions --- is no reason to let human activities INCREASE the exposure to ionizing radiation. The fact that ionizing radiation is a mutagen was first demonstrated in 1927 by Herman Joseph Muller, and subsequent evidence has shown it to be a mutagen of unique potency. Mutation is the basis not only for inherited afflictions, but also for cancer.

Very truly yours,

John W. Gofman

John W. Gofman, M.D., Ph.D.
Professor Emeritus of Molecular and Cell Biology

Preventing an Exercise in Self-Defeat: The Relevance of Medical Radiation to Nuclear Pollution.

John W. Gofman, M.D., Ph.D., Professor Emeritus of Molecular & Cell Biology, Univ. of Calif., Berkeley; Chairman of Committee for Nuclear Responsibility; April 2000.

• Part 1. An Extraordinary Note, Received Dec. 1999

• In November 1999, CNR Books published my study entitled "Radiation from Medical Procedures ..." (details in the box, below). In December 1999, I received an extraordinary note from a scientist who is a leading figure in the effort to contain or recapture the radioactive poisons already created by the production of nuclear electricity, and created by the production of nuclear weapons. His message, stripped to its bone and re-stated, was:

• "That study of medical radiation has tied you up for quite a while. Now that you've finished it at last, we certainly hope that you'll return as soon as possible to the really IMPORTANT work of analyzing the latest data from the A-Bomb Survivor Study!"

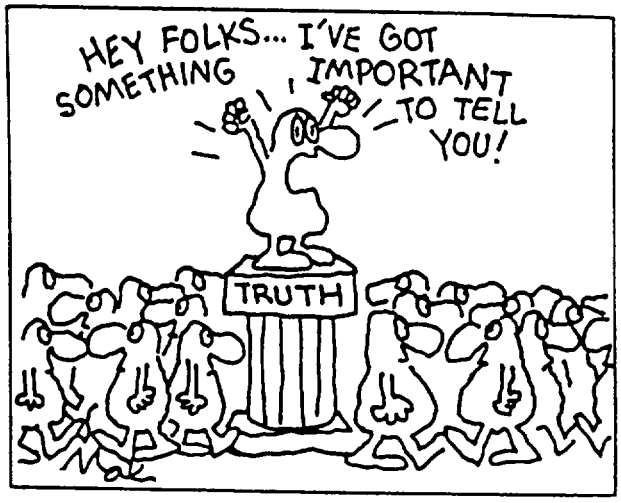
• His assumption was that a study of medical xrays must be irrelevant to nuclear pollution, and that his mission depends on studies like the A-Bomb Survivor Study.

• Because his assumption (which we have encountered more than once) will be SELF-DEFEATING for the important work against nuclear pollution, and because that work must NOT be defeated, I must express my worries about that kind of thinking.

• Part 2. What Do All Radiation Issues Have in Common?

• There is ONE THING which all radiation issues have in common, whether your own current interest is:

Xray overdosing during 250 million yearly xray exams ...
Nuclear waste storage ... Nuclear waste clean-up ...
Nuclear waste incineration ...
Release of radioactive waste into commerce, landfills ...
"Permissible" levels of nuclear pollution ...
Application of the No-Trespass Principle ...
Application of the Precautionary Principle ...
Application of truly Informed Consent ...
Radiation exposure of nuclear workers, medical workers, airline personnel, military personnel ...
Compensation for past exposure ...
Shut-down of existing nuclear power plants ...
Fallout from Chernobyl ... from Three Mile Island ... from A-bomb testing ...



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Meaningful citizen participation in decisions ...
Selection of members on radiation committees ...
Establishment of Adversary Science to ensure balance ...
Protection of radiation Whistle-Blowers ...
Revelation of past cover-ups ...
Plutonium aboard fallible space-rockets ...

• The unifying concern is the HARM TO HEALTH, to present and future generations, which results from exposure to ionizing radiation --- regardless of the particular path of exposure.

• Part 3. The Biologically Unnatural Feature

• Ionizing radiation, whether it be from xrays, gamma rays, beta particles, alpha particles, or other forms, has a unique and biologically unnatural feature.

• The common feature is this: Biological damage from ionizing radiation is always initiated by the travel through cells of a high-energy high-speed charged particle (the "primary" particle) --- something which simply does not occur within the natural biochemistry of cellular operations.

• Along its track, the primary particle kicks additional particles ("secondary electrons") into traveling too --- which also does not happen in natural biochemistry. As the primary and secondary particles "shed" their energy onto other substances, they slow down. In general, the average distance which the particles travel, between energy deposits, becomes shorter.

• These energy deposits are comparable to small bombs or grenades, causing local havoc inside human cells. As the distance between these grenades becomes shorter, the frequency rises of complex, NON-repairable injuries to the genetic DNA molecules and chromosomes in the irradiated cells. The NON-repaired injuries have the causal role in the subsequent cases of Cancer and Coronary Heart Disease.

Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease: Dose-Response Studies with Physicians per 100,000 Population, by John W. Gofman. November 1999. Library of Congress 99-045096.
Available from online booksellers, library distributors, and the publisher. 699 pages.
Hardcover $35, ISBN 0-932682-97-9. Softcover $27, ISBN 0-932682-98-7.

• Part 4. Key Insights on Health-Harm: Xray-Based

• Because ALL types of ionizing radiation do their damage in the same way (Part 3, above), insights gained from the study of people exposed to one type of ionizing radiation apply also to the other types of radiation (with minor modifications).

• So, it would be scientific lunacy for persons working on nuclear pollution to reject the knowledge gained from studying the health-harm from medical xrays. For example, some of the most important insights in the whole scientific effort have been based on medical xrays:

• Medical xrays provided Alice Stewart's evidence, in 1956-1958, that pre-birth exposure to ionizing radiation increases the risk of childhood Cancers and Leukemia.

• Exposure to medical xrays, in therapy of the painful spinal disease "Ankylosing Spondylitis," provided the first evidence in the 1960s that nearly ALL kinds of human Cancer would probably turn out to be inducible by ionizing radiation. This early warning was correct.

• Human exposure to medical xrays provided the type of evidence which made it possible in 1990 for us to prove, by any reasonable standard of biomedical proof, that there is no safe (risk-free) dose-level or dose-rate of ionizing radiation with respect to causing Cancer. And much of the same evidence was subsequently used in 1995 by the British National Radiological Protection Board, to conclude that "the weight of the evidence falls decisively" against any threshold (safe dose).

• Now, in 1999, data from human exposure to medical xrays provides the first powerful evidence that exposure to ionizing radiation is a cause of Coronary Heart Disease. This discovery is clearly as important as the discovery that exposure to ionizing radiation is a cause of Cancer.

• How could anyone assume that all the discoveries above have no relevance to exposure by nuclear pollutants? Such an assumption would be an irrational denial of the essential feature of ionizing radiation. Everyone concerned about nuclear pollution has a HUGE stake in knowledge gained from studies of medical xrays.

• Part 5. Warning: Studies Where Bias Can Enter

• One of the most exciting scientific aspects of my new study, based on medical xrays, is that it uses immensely trustworthy databases. There is no chance that the databases are biased with respect to finding a strong or a weak effect of ionizing radiation.

• Few people seem to appreciate how unusual and important this is. (Clearly the issue was not recognized as important by the scientist who urged me to return to analysis of the A-Bomb Survivor Database.)

• So, I am going to try to explain the importance, and I hope that the explanation will be treated as a very serious warning for future years, too.

• Human Radiation Exposure: Rarely Measured

• It has not been easy, over the past 30 years, to find RELIABLE data to analyze, about the health effects of ionizing radiation. Why not?

• One of the big reasons is that the AMOUNT of exposure (dose) has rarely been fully measured, if measured at all. That statement is true for the Atomic-Bomb Survivors in Japan, the nuclear workers in the USA, Britain, France, and the USSR, the military personnel exposed by weapons-related activities, the clean-up workers at Chernobyl and the near-by populations, the population around Three Mile Island, the people living "downwind" of the Nevada Test Site and other nuclear activities, and people exposed to medical xrays.

• If the radiation dose for each participant in a study was not measured properly or not measured at all, it is quite easy for database-makers to assign high doses to some people who really received low doses, and to assign low doses to some people who really received high doses. Or, database makers may assume that all participants of a certain type received the SAME dose, when the dose for those participants really had a ten-fold range. It does not require many mistakes of these sorts (either innocent, or intentional) to make ionizing radiation appear to be a "weak" carcinogen.

• The First Duty of Any Objective Scientist

• "Even Einstein himself will get false results from false databases." So, it is the FIRST obligation of all objective scientists to assure themselves, before they start an analysis, that the data themselves are trustworthy. If they have doubts, they have a duty at least to explain the basis for doubt to the readers.

• It would be irresponsible to ignore the fact that many (most) important radiation databases have been assembled and "managed" thanks to funds from sources which are far from neutral about the findings which arise out of those databases. It would not be responsible to rely, for information about the hazards of smoking, on databases sponsored by the tobacco industry.

• And yet such reliance is tacitly accepted by my colleagues, when it comes to radiation databases. During the past decade, I have often expressed my deep disappointment that so many analysts have been willing to use databases on the nuclear workers, after those databases were under the control and management of the Dept. of Defense and other sponsors who have had motive, opportunity, and means to manipulate the data before releasing the databases for "open" analysis.

• Under those circumstances, analysts cannot possibly meet their duty to assure that the data are not tainted. By TOUCHING such data, they debase the standards of credible epidemiological research, in my opinion. By contrast, the last time I analyzed data on nuclear workers (1979), I was able to use Dr. Thomas Mancuso's Hanford database BEFORE his data were seized and impounded by the Dept. of Energy.

• Broken Rules: Destroying the Barriers against Bias

• Many rules of research exist in order to create BARRIERS to bias. The most basic rule of credible biomedical research is that the input (e.g., dose-estimates) cannot be replaced after any results are known. If people are free to re-arrange the input, obviously they can produce whatever new "result" they LIKE. Therefore, I have protested use of the Spondylitic Study AFTER its data were retroactively altered with respect to dose-estimates.

• The Atomic-Bomb Survivor Study has, since 1986, undergone the most massive retroactive alteration one can imagine. All the doses have been re-evaluated, participants have been suddenly added from a "reserve," and the original cohorts of participants have been shuffled ... and not just ONCE! Retroactive tinkering with the database has become chronic. Who funds this tinkering? The U.S. and Japanese governments.

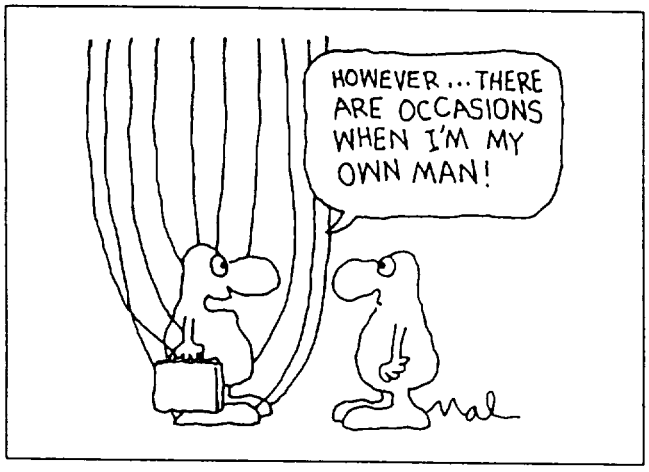
• It is disgraceful that almost no analyst except myself has tried to stop this mishandling of a unique human resource --- one which was providing health information from events which will never be repeated. In the journal Health Physics, and in my 1990 book, I demonstrated how it would be possible to preserve the credibility of the A-Bomb Survivor Database, while also exploring the impact of revised dose-estimates. The method is called "constant-cohort, dual-dosimetry analysis."

• The Price of "Going Along" --- A Health Tragedy?

• But other analysts prefer to use only the altered databases. They consent, by their silence, to send the unaltered database to oblivion. Perhaps they pardon themselves by saying, "But the study is still giving answers which I LIKE!"

• So what! Genuine scientific inquiry is about TRUTH. No scientist would wish to make radiation appear more harmful, or less harmful, than it REALLY is.

• If today my colleagues permit oblivion for the LEGITIMATE A-Bomb Survivor Database and tolerate the destruction of the standard barriers against bias, tomorrow they will have to accept as VALID whatever results come out of the database's hundredth version in some future year (say 2020) --- yet they will be powerless to know whether the results are valid or contrived (biased).



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• What or who is going to prevent the alteration of potentially all the important radiation databases? Silence on the issue of trustworthy databases could result in a tragedy for human health.

• Part 6. Joy over Two Totally Trustworthy Databases

• You can hardly imagine my joy when finally I figured out a way to evaluate the impact of medical radiation upon cancer mortality in the USA, from two databases which I could totally TRUST to be unbiased with respect to the topic.

"PhysPop" --- Defined

• Because medical xray doses were not measured in the past, and are rarely measured today, both past and current dose-estimates are highly uncertain. But we recognized that the problem (of estimating the impact of medical radiation on national age-adjusted cancer mortality-rates) might be solved by using data which ARE available --- namely, the number of Physicians per 100,000 Population ("PhysPop") in each of the nation's Nine Census Divisions.

• Physicians (not patients) order xray procedures. As the density of physicians goes up per 100,000 population, more xrays will be ordered per 100,000 population. This common-sense premise is supported by surveys reported in 1988. In each Census Division, the population's average per-capita xray dose will be approximately proportional to the Census Division's PhysPop value for the same year.

• Thus, the nine PhysPop values are a valid indicator of the RELATIVE magnitude of annual per-capita xray dosage received by the nine populations of the nation's Nine Census Divisions. However, we had to ascertain that PhysPop would be a valid indicator of ACCUMULATED per-capita xray doses, not just the doses received in a single year. It turns out that the relative magnitude of PhysPop values was remarkably STABLE, among the Nine Census Divisions, from 1921 to 1990.

• Two Totally Neutral, Trustworthy Databases

• Because we were able to use the PhysPop database for dose, we are totally confident that we have been able to use data which are absolutely free from bias with respect to xray dose. After all, the PhysPop values in every state were collected and published from 1921 to the present day by the American Medical Association, for completely different purposes. The AMA statisticians clearly had no idea that anyone would ever use the PhysPop values to evaluate the impact of medical radiation upon cancer mortality, by Census Divisions.

• In addition, we are totally confident that the mortality rates by Census Divisions, collected for Vital Statistics by the U.S. Government, ALSO are absolutely free from bias with respect to whether medical xrays have a big or a small impact on cancer mortality, by Census Divisions.

• Probably the Strongest Study Ever Done on Radiation

• These two databases permit our study to begin in 1940, by "enrolling" all 150 million inhabitants of our Nine Census

Divisions into the study. (The study ends in 1990, when the combined population was 247 million.) By contrast, the A-Bomb Study has about 90,000 participants --- which severely limits its power to discern provable differences between dose-groups.

• Our PhysPop study is probably the largest, statistically strongest, prospective study of radiation health-effects ever done --- and it was done with assuredly neutral data. One should go where the trustworthy data are, and we did.

• Part 7. Preventing an Exercise in Self-Defeat

• Our PhysPop study revealed not only that medical xrays are an extremely important cause of the nation's past and present cancer mortality, but it produced the first powerful evidence that ionizing radiation is also an extremely important cause of the OTHER biggest killer in the nation: Ischemic/Coronary Heart Disease.

• To assume that these striking findings are irrelevant to issues of nuclear pollution, because the insights derive from medical xrays, would be a serious mistake (Part 4, above). It would be SELF-DEFEATING to ignore undeniably strong findings from any immense, neutral, highly credible database --- in favor of perpetual dependence on marginal findings from the A-Bomb Survivor Database, the nuclear worker databases, and other databases with unreliable dose-estimates, retroactively altered input, and pro-nuclear management.

• It would make good sense to avoid an exercise in SELF-defeat. The stakes for posterity are very high.

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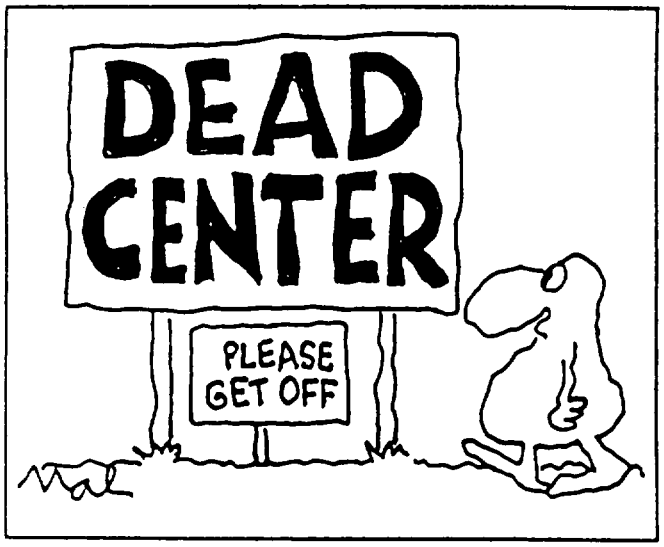

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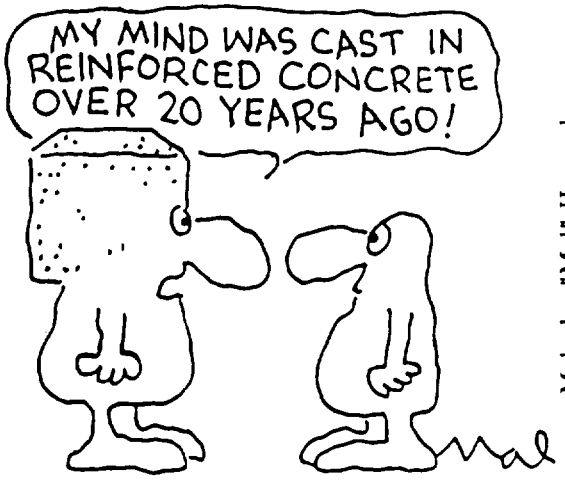
Internet http://www.ratical.org/radiation/CNR/

A New, Low-Cost Way to Shake a Mistaken Mindset

• The position of governmental health agencies, for a half-century, is that ionizing radiation makes only a small contribution to our rate of Cancer (and no contribution at all to our rate of Coronary Heart Disease). This official and widely promoted position continues to trickle down and to dominate the mindset of anti-cancer organizations, advisory panels on nuclear pollution, health insurance companies, professional societies, medical faculties, and the press/media.



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• Now, there is a new, low-cost way to challenge this harmful mindset. People can readily distribute the 32-page Executive Summary of "Radiation from Medical Procedures" to members of pollution advisory panels, environmental groups, local cancer-action groups, local physicians, local chapters of professional groups, local college faculties, local consumer protection groups, local holistic medical groups, local media and columnists, etc. The "trickle-up" from a million copies would do a lot to undermine the mistaken mindset. That's one way that "alternative" medicine became "mainstream."

• The Executive Summary is a professional item saddlestitched in a glossy cover. CNR is pleased to be able to make bulk quantities of the Executive Summary available at the following prices (each price includes shipping the total order to a single address by Book Rate):

- 5 copies @ $1.50 = $7.50.
- 5 to 50 copies: Each $1.50.
- 50 to 100 copies: Each $1.30
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What Is Humanity's Most Harmful Law?

The Law of
CONCENTRATED BENEFIT over DIFFUSE INJURY

by John W. Gofman and Egan O'Connor, November 1993

The law of Concentrated Benefit over Diffuse Injury can be stated as follows:

A small, determined group, working energetically for its own narrow interests, can almost always impose an injustice upon a vastly larger group, provided that the larger group believes that the injury is "hypothetical," or distant-in-the-future, or real-but-small relative to the real-and-large cost of preventing it.

1 • The Surprising Aspect of This Law

Many scholars have written about this extremely important axiom before --- it is not original with us. The fact that narrow special interests are always at work for their own benefit AT THE EXPENSE OF OTHERS is not at all surprising, given human nature. And it is not surprising that the victims select what appears to be the strategy of least cost to themselves.

The surprising aspect is the failure of so many victims --- especially in peaceful democracies --- to appreciate the AGGREGATE consequences which inevitably accrue, when each small injustice has such a high chance of prevailing.

2 • The Real Scope of the Injury

We regard Concentrated Benefit as the most harmful law of all humanity. Is this correct?

The terrible feature of this law is that each incremental injustice has a very high chance of prevailing. So, even when new injuries or injustices truly are small, the aggregate abuse can accumulate to tragic proportions after the axiom of Concentrated Benefit has operated on behalf of various narrow interests again ... and again ... and again.

We often wonder at the vast abuse which the general public has failed to prevent: Tyrannies, wars, genocides, mass starvations, proliferation of nuclear weapons, intimidation by well-armed international and local thugs, corrupted democracies, corrupted markets, massive thefts via inflation, inadequate schools, unnecessary poverty, destruction of wildlife, and gross pollution, to name a few.

Why do people tolerate this severe abuse, when they so vastly outnumber the few beneficiaries?

The main explanation, in our opinion, is the operation of Concentrated Benefit over Diffuse Injury, insidiously and incessantly. By the time people think, "We're just not going to take this anymore," the costs and personal dangers of reversing the abuse have usually grown too. Moreover, there is no inherent limit to the scope and number of attempted abuses, whereas citizens have inherently limited resources to resist.

3 • Pollution Fights: What Every Activist Soon Learns

Narrow, special interests can prevail via government force, via direct force, or via deceit. Direct force is used by gangs

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and tyrants, but polluters achieve their aims "peacefully" by using both deceit and the force of government on their behalf.

This essay explores some strategies in the environmental movement toward the law of Concentrated Benefit --- with emphasis on the problem of pollution at LOW levels.

The axiom of Concentrated Benefit over Diffuse Injury accounts for the current promotion of a "de minimis" policy toward nuclear (and other) pollution. A de minimis policy asserts that society should not concern itself with trivia. (Latin: De minimis non curat lex. The law does not concern itself with trifles.) A de minimis policy toward POLLUTION asserts that poisonous discharges and human exposures below a certain level should be treated as non-existent --- because their consequences are allegedly trivial.

Trivial. That is the essence of the axiom. Triumph for each injustice is virtually assured if the advocates succeed in presenting it as trivial.

When polluters and their agents accuse citizens who oppose them ("activists") of being Chicken Littles and hysterics and ignorant extremists, the polluters are working for a public perception that the injury is trivial.

And because the general public can not afford to do battle against TRIVIAL injustices, citizen activists against pollution know that their chances of prevailing are improved if they can show that the pollution constitutes a calamity for the community. Anyone who has been an activist for a year has learned how the axiom of Concentrated Benefit over Diffuse Injury "demands" proof of a calamity.

4 • The Meaning of "No Safe Dose"

As a result of the axiom, we receive appeals again and again from citizen-groups who need an expert to swear that nuclear pollution in their locality is (or will be) a calamity. And since we are well known for stating that human evidence proves, "There is no safe dose of radiation," it is natural that we hear from these groups.

The word "safe" means free from risk of injury. Existing human studies combined with nuclear track-analysis show that every dose of ionizing radiation confers a risk of carcinogenic injury, even at the lowest possible total dose and dose-rate (Gofman 1981, Gofman 1990). Government statements are false when they say that it is impossible to know what happens at very low doses of ionizing radiation.

Our statement that there is no safe dose of ionizing radiation does not mean that every dose --- regardless of its size --- produces the SAME amount of hazard or qualifies as a calamity. Our books show again and again that the size of a radiation risk is tied to the amount of the accumulated dose and the number of people who receive it.

"Two billion people on the planet have no electricity. But they want it --- and how they get it is going to be one of the most critical environmental issues of the next century." • - Neville Williams, Solar Electric Light Fund (cited in 1993 by Sustainable Technologies International, Box 1115, Carbondale CO 81623).

Even after a nuclear accident as severe as Chernobyl, it is unrealistic for an irradiated population to feel, "We are all doomed," or "The children are all doomed." Although the aggregate number of Chernobyl-induced cancers will be very large --- at least a million over all time --- this will occur not because everyone in fallout areas has a HIGH personal risk of cancer from Chernobyl. It will occur because there is no safe dose, and therefore the accident creates a small extra risk of cancer for MANY people (over 500 million exposed individuals, inside and outside the ex-USSR).

The fact that the enormous health consequences of the Chernobyl accident are diffused among so many people is what allows powerful operation of the law of Concentrated Benefit over Diffuse Injury. Governments which sponsor nuclear power can say that personal cancer-risks even from Chernobyl are small. This assurance is supposed to inactivate public resistance to "routine" levels of nuclear pollution.

5 • Kiev's Children: Their Fate Was "Blowing in the Wind"

It would be much harder for people to obscure the health consequences of nuclear pollution if the wind and weather during the Chernobyl accident had happened to concentrate most of Chernobyl's fallout on Kiev, an ancient city of about two million people only some 50 miles south of the reactor-site. This could easily have happened, with a different combination of weather and a somewhat less powerful explosion (giving less altitude to the radioactive plume).

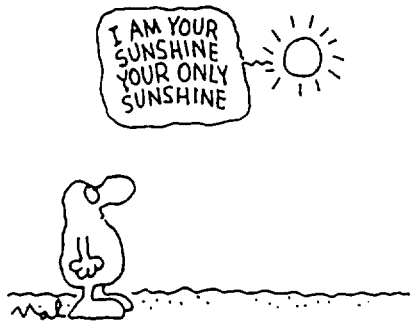
With very unlucky circumstances for Kiev, the whole-body doses from Chernobyl could have been high enough in that city to cause radiation-induced cancer sometime during the lifespan of one-third of all the young children exposed during the accident there. What sort of dose would do that? The answer is approximately 17.5 whole-body rems, average, per child (Chapter 5 in CNR's forthcoming book). Fortunately for Kiev (and for the nuclear power industry), the city was spared from such exposures, and the fallout was diffused over an enormous area inside and outside the ex-USSR.

6 • If the Sum Matters, Then Each Contribution Matters

Even when there is no safe dose of a pollutant, the individual risks and also the collective risks from a single local source of pollution or from a single release can be low --- but that does not necessarily mean that small releases of such pollutants are "born trivial."

With respect to nuclear pollution and every other type of persistent pollutant which lacks a safe dose, the following point deserves emphasis again and again:

What counts biologically is the SUM of all the injuries over time from ALL the combined sources and events which release persistent poisons (radioactive or other) into the biosphere. If the SUM matters biologically, then each contribution to the sum matters. Whoever consents to the small releases is consenting automatically to their worldwide SUM, whatever it turns out to be.



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It follows that there should be no need for citizen-activists to argue that each small source of pollution by itself, in isolation, constitutes a calamity. Unless activists object to releases of "even one molecule," their opposition to small sources is both rational and morally imperative.

7 • De Minimis Policies on a Global Scale

Suppose that the United States adopts a de minimis policy toward pollution. Then every other nation is also entitled to such a policy. A likely result:

Polluters worldwide will actually release MORE (not less) of their total poisons by the simple technique of sub-dividing them in time and space, so that the consequence of each proposed release, by itself, can be convincingly presented as "too trivial to count at all."

We can expect the total poison produced by human activity to increase a great deal as living standards rise, at least for 2 billion very poor people. Moreover, as population expands from the current 5 billion toward 10 billion people, the total quantity of poisons produced by human activity is likely to increase by a very great deal.

Legalized and non-legalized releases of even a "trivial" fraction of a growing total could still be devastating.

8 • "But Humans Are Living Longer Than Ever!"

Devastating? With regard to poisonous emissions at very low levels, claims are made that diffuse injury to humans has never been proven and therefore is probably just imaginary. Suggestions that unproven means unreal are false. Dangerously false.

Pollutants which are mutagens, for example, injure the health of FUTURE generations. Genetic afflictions whose cause is not identified can build up gradually, over many generations of exposure. For this and other reasons, the cause-effect relationship between certain pollutants and human health problems can be real but NEVER provable.

Humans need some humility about unforeseen and unforeseeable consequences of messing with the ecosystem. In a system, by definition, everything is connected to everything else. It is said that toad populations are declining, worldwide. If true, then why? What else is occurring that we have not measured yet? What is next?

A familiar response of polluters and their defenders is that HUMANS are living longer than ever.

So? Increases in human lifespan might continue right up until the ecosystem which supports us collapses (if it ever does). There are many reasons for the increase in longevity, including sanitation, pharmaceuticals, and nutrition. Perhaps

we would be living even longer and in better health if it were not for pollution. Longevity and good health are not the same thing. (For example, many neurotoxins and genetic afflictions cause misery but not early death.)

With respect to debate over de minimis policies toward pollution, the song that "humans are living longer than ever" is a deceitful use of truth. Deceit is sometimes a sophisticated substitute for force used by people intending to PREVAIL.

" What's wrong with emotion? According to Webster's Dictionary, emotion simply means a strong feeling. Of course we feel strongly or emotional when we're engaged in struggles to protect the species and life-support systems of this planet ... To be called 'emotional' should not be something to run from ..."

• - Michael C. Colby (in 1993), editor, Safe Food News, RD 1, Box 30, Marshfield VT 05658.

9 • The Inherent Imbalance of Forces

The fundamental law of Concentrated Benefit over Diffuse Injury always operates in favor of specific polluters, not ever in favor of the general public.

This does not mean that citizens ALWAYS lose. For example, citizens have battled the Yucca Mountain nuclear waste repository to a current standstill. The odds against successful opposition were enormous at the outset, many years ago. But determined citizens, even without an immediate personal stake in the outcome, changed the odds little by little. We are in awe of their selfless and effective work.

On the other hand, all of us have an obligation not to let an occasional success blind us to reality. Citizens have inherently limited time and resources, whereas the number of abuses attempted upon them HAS NO INHERENT LIMIT. Thus, for every success, there are necessarily tens, or hundreds, or thousands of other abuses which are neglected. In addition, each success inspires well-funded campaigns by narrow, special interests to reverse the cumulative successes and --- in our field --- to cultivate the perception that people against nuclear (and other) pollution are fanatics who impose huge and unfair costs on society.

10 • A Win-Win Strategy --- with Limits

Correctly or not, polluters believe in a huge benefit for themselves from de minimis policies and lenient "permissible" releases. By polluters, we mean owners and employes from top to bottom in a polluting industry.

The polluters' belief in a huge benefit is the focus of action by many environmental organizations, which work to provide the polluters with an equally attractive benefit which can be achieved with less pollution. More efficient use of energy with equal or greater profits. Utility-owned solar energy instead of nuclear power. More efficient manufacturing with less waste-production and with equal or greater profits. Cost-effective recycling. No decrement in employment.

This strategy of coping with the axiom of Concentrated Benefit is sometimes truly a win-win affair. "Both sides" achieve what they want. Although CNR was a leader for some of these proposals in the early 1970s, we also must point out that an exclusive focus on the axiom's "benefit" side has limits.

"Emotional" Assertions about Human Rights

The win-win strategy tacitly assumes that the victims have the burden of creating a solution, and that the aggression (pollution) must continue if the victims can not think up and arrange an attractive substitute which pleases the aggressor. This strategy avoids "emotional" assertions about the RIGHT of ordinary people not to be dumped upon, not to be used in biological experimentation, and not to have the common heritage of ozone, acquifers, and remaining wildlife injured. But in the end, it may be impossible to avoid the issue of genuine human rights. An example:

When the need is to contain nearly 100 % of an activity's poison, the per-unit cost of containment is usually much higher for the last 10 % contained than the per-unit cost for the first 90 % contained. This makes better containment inherently unattractive to polluters. The chance of cost-effective recycling for the last 10 % of the poison is very low (and is non-existent for radioactive pollutants). The alternative of passing the extra containment cost along to customers is also unatttractive. Why? Because (in general) the higher the price of something, the less people will buy of it.

In short, the hope of crafting a win-win solution on the crucial issue of ubiquitous, low-level emissions is often unrealistic. Without taking a stand on the human rights issue, what ground is there to stand on?

11 • Some Morally Dubious Strategies against Pollution

In contrast with the win-win strategy, some ways of coping with the law of Concentrated Benefit are morally dubious. We are shocked whenever a major environmental group appears to concede a right to POLLUTE. We quote an example from an influential group in 1991:

"The key to creating an environmentally sustainable global economy is partially to replace income taxes with environmental taxes --- taxing such environmentally destructive activities as burning fossil fuels, the use of pesticides, and the discharge of toxic wastes."

While it is true that sufficient taxation would reduce destructive activities, how does the proposal differ (in moral terms) from taxing homicide? "It's OK to commit premeditated random mayhem, provided you do less of it." Beside this, it would be difficult to create sufficient political support for punitive levels of taxation (not just lipservice). A difficult but morally better goal might be creating support for the position:

"Low-level pollution must stop because narrow special interests (polluters) have NO RIGHT to impose trespass, experimentation, or diffuse injury upon the general public and its common property."

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"I've seen more people win what they wanted by informing themselves about the nature of the problem and the process that they're involved in, and then expressing their goals in terms of their feelings ... Our emotions were put into us by the evolutionary process for good reason ... I often hear government officials or corporate officials say this person is 'just an hysterical housewife.' I have high regard for hysterical housewives. I think they're a very good force in American society. And I think we need more of them."

• – Peter Montague, Ph.D., (in 1993), director of the Environmental Research Foundation, POB 5036, Annapolis MD 21403.

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A Great Big Pitfall

The taxation approach is morally similar to the provision of the Clean Air Act which establishes "emissions allowances" for sulfur-dioxide from electric power plants. Utilities which bring emissions below the required levels obtain pollution credits (issued by government) to use for expansion or to sell to other utilities. The goal is to achieve a net reduction in total emissions, and to do it at plants where reduction is most cost-effective. Fine. Nonetheless, a market in government-issued pollution-credits is a statement that pollution at certain levels is not only legal but also morally legitimate.

If "environmental taxes" and "pollution-credits" succeed in reducing pollution, then it would appear that the policies help meet our moral obligation to future generations not to pollute and not to destroy the ecosystem. It can be argued that any strategy which moves society in the right direction must be morally right.

But when environmental taxes and pollution-credits legitimize pollution, they work in FAVOR of low-level pollution and de minimis policies. This is the WRONG direction. We repeat: If the SUM of individually small acts of pollution is what counts biologically, then no contribution to the sum is negligible.

12 • A Worthwhile Task for All of Us

The "iron law" of Concentrated Benefit over Diffuse Injury is so powerful in every aspect of life, and some of its consequences are so abominable, that victims are sometimes driven into strategies which they find morally distasteful. Such strategies are, themselves, a type of debasement and humiliation.

We have hope that humans can develop loftier strategies. A necessary requirement is that most people RECOGNIZE the nature of the universal law which favors injustice over justice --- even in peaceful democracies. Since this type of education so rarely comes "from the top," either grassroots activists will do it, or it will not occur. The ground for inventing good and effective strategies will be much more fertile when everyone is so aware of the axiom that it enters the folklore ... when just the two words, "Concentrated Benefit," can communicate the ages-old dilemma and the dynamics of it.

Successful solutions to the dilemma are far more likely to come from the grassroots than from prominent intellectuals who so often depend today, directly and indirectly, on approval from one special interest or another. We note that the "founding fathers" of the United States were less beholden to special interests than today's professional intellectuals. The founding fathers actually addressed the law of Concentrated Benefit.

The preamble to the United States' Constitution speaks of a government which would promote the GENERAL welfare, meaning that laws would benefit the population at large, not benefit small sub-sets at the expense of the general public. In the text of the Constitution, its authors tried to LIMIT the areas of government activity --- limits which (if they had been honored) would have greatly reduced opportunities for narrow interests to "persuade" elected officials to operate on behalf of the narrow interests.

13 • A Central Goal, an Earth-Shaking Achievement

It is hard to imagine a more beneficial achievement in human history than the future development of GENERIC ways for the public to cope with the law of Concentrated Benefit over Diffuse Injury, and thus to prevent endless repetition of its many dreadful consequences (see Part 2).

Some years ago, an interviewer suggested to one of us (jwg) that it is too difficult for grassroots people to solve the BIG problems. He thought it was futile. I still answer now, as I answered then:

Of course it will be difficult to solve the big problems of humanity. But can you, or I, or anyone justify directing all our efforts toward solving trivial problems --- just because the ones we all really need to face are difficult?

# # # # #

• – We encourage you to reprint this essay in whole or in part. Permission granted.

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Confirmation that Ionizing Radiation Can Induce Genomic Instability: What is Genomic Instability, and Why Is It So Important?

John W. Gofman, M.D., Ph.D., and Egan O'Connor, Executive Director, CNR. Spring 1998.

Malcolm "Mal" Hancock

• Genomic instability --- also called "genetic instability" and "chromosomal instability" --- refers to abnormally high rates (possibly accelerating rates) of genetic change occurring serially and spontaneously in cell-populations, as they descend from the same ancestral cell. By contrast, normal cells maintain genomic STABILITY by operation of elaborate systems which ensure accurate duplication and distribution of DNA to progeny-cells (Cheng 1993, p.124), and which prevent duplication of genetically abnormal cells. These systems ("metabolic pathways") involve an estimated 100 genes (Cheng 1993, p.142).

• Why is genomic instability so important? Many (not all) cancer biologists now believe that genomic instability "not only initiates carcinogenesis, but also allows the tumor cell to become metastatic and evade drug toxicity" (Tlsty 1993, p.645), and "The loss of stability of the genome is becoming accepted as one of the most important aspects of carcinogenesis" (Morgan 1996, p.247), and "One of the hallmarks of the cancer cell is the inherent instability of its genome" (Morgan 1996, p.254).

• Although these observations are far from new, they certainly did not receive the attention they merit until recently.

Part 1 • A Deep Insight from 1914, Slowly Confirmed

• It was the year 1956 when the normal number of human chromosomes per cell was firmly established as 46. Soon thereafter, it became clear that cells of advanced cancers have often evolved an abnormal number of chromosomes ("aneuploidy").

• Such observations were consistent with the prediction of Theodor Boveri (Boveri 1914), a great German embryologist who postulated that malignancy is the result of inappropriate balance of instructions (genetic information) in the tumor cells. Such "imbalance" can result not only from numerical chromosome aberrations, but also from structural alterations within the 46 chromosomes. As a leading cause of structural chromosome aberrations (deletions, acentric fragments, translocations, inversions, dicentrics, etc.), ionizing radiation is well-established.

• When my colleagues and I (JWG) initiated a research program in 1963 (at the Atomic Energy Commission's Livermore National Laboratory), to test Boveri's hypothesis, there was very little interest in the concept. Although the techniques for detecting structural chromosome aberrations were extremely crude then, compared with current techniques, we were making gradual progress (Minkler 1970, + Minkler 1971). However, the Atomic Energy Commission became angry with me after a paper I presented at an IEEE Symposium (Gofman 1969), and canceled our funding in the early 1970s (Seaborg 1993, Chapter 8, "Challenge from Within," + Terkel 1995, pp.406-408).

• In October 1976, the journal Science published Peter C. Nowell's classic paper entitled, "The Clonal Evolution of Tumor Cell Populations" --- a paper almost always cited by today's analysts of genomic instability. Among other things, Nowell's 1976 paper discussed evidence, from various analysts, indicating that as tumor cells become increasingly aneuploid, the malignancy becomes increasingly aggressive (Nowell, p.25). Reasoning from the available evidence at that time, Nowell proposed the following model of multi-step carcinogenesis:

• Tumor initiation occurs by an induced change in a single, previously normal cell, which makes the cell "neoplastic" (partially liberated from normal growth controls) and provides

>>>>> GLOSSARY <<<<<

• GENOME. A person's genome is one set of his (or her) genes. The human genes, which control a cell's structure, operation, and division, are located in the cell's nucleus. The full human genome (estimated at 50,000 to 100,000 genes) is present in every cell-nucleus, even though many genes are inactive in cells which have some specialized functions (the "differentiated" cells).

• GENES AND CHROMOSOMES. Genes are composed of segments of DNA. In normal cell-nuclei, the DNA is distributed among 46 chromosomes (23 inherited at conception from a person's father, and 23 from the mother). Each chromosome consists of one very long strand of DNA and numerous proteins, which are required for successful management of the long DNA molecule. The longest chromosomes each "carry" thousands of genes. Every time a cell divides, the cell must duplicate the 46 chromosomes and must distribute one copy of each to the two resulting cells.

• THE CODE. The DNA of each chromosome is composed of units --- "nucleotides" of four different types (A, T, G, C). These nucleotides are linked to each other in linear fashion. The sequence of the four types of nucleotides is critical, because the sequence produces the "code" which (a) determines the function of each particular gene, (b) identifies the gene's start-point and stop-point along the DNA strand, and (c) permits certain regulatory functions. The code of the human genome consists of more than a billion nucleotides.

• THE MITOCHONDRIAL DNA (mtDNA). Outside the nucleus, human cells also have some "foreign" DNA located in structures called the mitochondria. This small and separate set of DNA does not participate in the 46 human chromosomes, and is not part of "the genomic DNA." The mitochondria are inherited from the mother.

the cell with a selective growth advantage over adjacent normal cells (Nowell, p.23).

• "From time to time, as a result of genetic instability in the expanding tumor population, mutant cells are produced ... Nearly all of these variants are eliminated, because of metabolic disadvantage or immunologic destruction ... but occasionally one has an additional selective advantage with respect to the original tumor cells as well as normal cells, and this mutant becomes the precursor of a new predominant subpopulation" (Nowell, p.23). And:

• "Over time, there is sequential selection by an evolutionary process of sub-lines which are increasingly abnormal, both genetically and biologically ... Ultimately, the fully developed malignancy as it appears clinically has a unique, aneuploid karyotype associated with aberrant metabolic behavior and specific antigenic properties, and it also has the capability of continued variation as long as the tumor persists" (Nowell, p.23). And:

• "The major contention of this article is that the biological events recognized in tumor progression represent (i) the effects of acquired genetic instability in the neoplastic cells, and (ii) the sequential selection of variant subpopulations produced as a result of that genetic instability" (Nowell, p.25).

• The recent surge of interest in genomic instability reflects the recognition that the cancer process represents a trip (or set of trips) from the stable genome to the genome with diverse deviations. It has been a long wait for Boveri.

Part 2 • Ionizing Radiation as Cause of Genomic Instability

• Today, laboratory researchers are performing reality-checks on this logic: Genomic instability can be initiated and intensified by any type of genetic mutation (including chromosome aberrations), which mutation alters some of the DNA which maintains genomic STABILITY. Of course, such DNA includes the numerous segments which govern DNA synthesis, cell-division, and the routine REPAIR of the genome --- the "repair genes" (Cheng 1993, p.131; Morgan 1996, p.248).

• When a mutagen has induced genomic instability in a cell, some of the cell's descendants will experience new and unrepaired genetic abnormalities at an excessive rate, even though the descendants themselves received no exposure to the mutagen used in the experiment. This occurs because such cells have inherited a genome which was injured with respect to maintaining genomic STABILITY.

• Very recently, a technique has been developed for efficiently detecting three of the types of chromosome aberrations which are very prominent in genomic instability: Aneuploidy (wrong number of chromosomes), deletions (permanent removal of DNA segments, long or short), and gene-amplifications (extra copies of specific DNA segments). This technique, called Comparative Genomic Hybridization, was first described by Kallioniemi (1992, in Science). However, such a technique does not detect many other kinds of mutations.

• The nature of the genetic code is such that mutations need not be gross in order to have gross biological consequences. For instance, permanent removal of a single nucleotide (a micro-deletion) can totally garble much of a gene's code, by causing what is called a "frame-shift." Then this non-functional gene can be the phenomenon which wrecks part of the system which would otherwise maintain genetic STABILITY.

• Amplification (instead of injury), of the crucial genes in the stability-system, also can permit a cell to escape the controls which otherwise prevent duplication of cells with injured genomes. Evidence is developing that gene amplification is associated with dicentric chromosomes and circular acentric fragments called "double minutes" (DiLeonardo 1993, p.656) --- very well-known products among the consequences of ionizing radiation.

• The sequence, in which various mutations accumulate in tumor cells, may or may not matter. "For example, one or more pre-cancerous mutations might lie dormant until additional mutations create an environment in which the prior changes confer a selective advantage" (DiLeonardo 1993, p.655, citing Kemp 1993, + Fearon 1990, + Temin 1988).

• The fact, that ionizing radiation is a mutagen capable of causing all known types of genetic mutation --- from micro to gross, at any DNA location along any chromosome --- made it utterly predictable that ionizing radiation would be a cause of genomic instability. Indeed, one of the last projects completed by our research group at the Livermore Lab, before the Atomic Energy Commission shut down our work, was a demonstration which showed that ionizing radiation can induce genomic instability. Our experiments used gamma rays and cultured human fibroblasts (Minkler 1971).

• During recent years, multiple experiments have confirmed the fact that ionizing radiation can cause genomic instability. Such results have been observed after both low-LET radiation (such as xrays and gamma rays) and high-LET radiation (such as alpha particles). Among numerous papers, see, for instance:

Kadhim 1992;
Holmberg 1993 (who cites Minkler 1971);
Marder 1993 (especially p.6674);
Mendonca 1993;
Kadhim 1994;
Kronenberg 1994 (radiation dose-response, p.605);
Kadhim 1995;
Morgan 1996 (review).

• In the mass media, some writers have expressed astonishment that radiation-induced genomic instability is not detected until several cell-divisions have occurred after the radiation exposure. They seem to imagine that the delay reflects a mysterious discontinuity between cause and effect. There is NO discontinuity, of course --- a point made explicitly in Kadhim 1992 (p.739). With current techniques, and with uncertainties about where to search closely among a billion nucleotides, it is just not possible to detect every intermediate step.

Part 3 • Implications: Curing vs. Preventing Cancer

• The induction of genomic instability in a cell does not guarantee that it will become malignant. Genomic instability increases the RATE of mutation in that cell and its descendants, and with this higher rate, the cells each have a higher PROBABILITY that at least one of them will accumulate all the genetic powers of a killer-cancer. These powers include the ability to thrive BETTER than normal cells, to invade inappropriate tissue, to adapt to the new conditions there, to recruit a blood supply, to fool the immune system, and many other properties.

• No one claims, yet, that genomic instability must precede every case of cancer. However, genomic instability helps to explain why cancer is sometimes called "at least a hundred different diseases." Indeed, genomic instability means that each case of cancer may develop a genome like no other case. Is it any wonder that individual tumors often differ in behavior from each other?

• Nowell's 1976 paper was certainly not the last one to observe that cancers become increasingly deviant in their genomes, as they "advance." Tlsty 1993 (p.645) cites several more recent papers. Near the end of his paper, Nowell wrote (p.27):

• "The fact that most human malignancies are aneuploid and individual in their cytogenetic alterations is somewhat discouraging with respect to therapeutic considerations ... With variants being continually produced, and even increasing in frequency with tumor progression, the neoplasm possesses a marked capacity for generating mutant sub-lines, resistant to whatever therapeutic modality the physician introduces ... The same capacity for variation and selection which permitted the evolution of a malignant population [of cells] from the original aberrant cell, also provides the opportunity for the tumor to adapt successfully to the inimical environment of therapy, to the detriment of the patient."

And Some Lessons:

(A) • Genomic instability will probably keep cancer hard to cure.

(B) • The quickest path to less cancer-misery in the future would be a policy of reducing exposure to carcinogens.

(C) • Ionizing radiation is almost certainly the most potent carcinogen to which vast numbers of people are actually exposed (see Part 4).

Part 4 • Five Key Facts and Three Restrained Comments

(1) • Ionizing radiation is a mutagen having special properties which make some radiation-induced genetic injuries complex and impossible for a cell to repair correctly --- quite unlike the routine damage from endogenous free radicals (Ward 1988, + Gofman 1990, Chapter 18, Part 2, + Ward 1991, + Baverstock 1991, + Ward 1995, + Gofman 1997).

(2) • Ionizing radiation is a mutagen which undeniably can cause every known kind of mutation, at any DNA location along any chromosome. The body does not always eliminate cells having harmful mutations. If it did, there would be no cancer or inherited afflictions.

(3) • Ionizing radiation is a mutagen known to induce genomic instability (references provided in earlier sections).

(4) • Ionizing radiation is a human carcinogen at every dose-level, not just at high doses; there is no threshold dose. A single photon or a single high-speed particle can cause unrepairable genetic damage. (See Gofman 1990, Chapters 18-21, + UNSCEAR 1993, Annex F, especially p.636 para.84, p.680 para.323, + NRPB 1995, especially pp.59-61, p.68, p.75, + Pierce 1996, p.9, + Gofman 1996, Chapter 45, + Riches 1997, p.519, + Hei 1997).

(5) • Ionizing radiation is a mutagen observed to induce virtually every kind of human cancer (Gofman 1969, p.4, + BEIR 1980, Section 5, + UNSCEAR 1988, p.460 para.394).

And the Comments:

(1) • In view of all the five facts above, it would be inappropriate to doubt the menace of low-dose ionizing radiation.

(2) • And in view of all the five facts, it is strange --- in studies which attempt to explain a difference in cancer-rates between two groups --- that the question is so seldom asked: How do the radiation histories differ between the groups? In view of the five facts above, it should be the FIRST question.

(3) • And in view of the five facts, it is sad that so many members of the medical profession give only lip-service to the need to reduce the unnecessarily high exposures to radiation administered by their own profession (UNSCEAR 1993, Annex C, + Gofman 1996, Chapter 48). Today, the two largest sources of voluntary radiation exposure are (i) pre-cancer medical procedures, including CT scans and fluoroscopy (NCRP 1987, p.59, + NCRP 1989, p.69) and (ii) cigarette-smoking --- which delivers appreciable alpha-particle radiation to the lungs (Martell 1974, 1975, 1983, + NCRP 1984, + BEIR 1990, p.19). As for involuntary exposures accumulated from nuclear pollution, they have been poorly ascertained --- to put it in a kindly fashion.

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"Asleep at the Wheel": The Special Menace of Inherited Afflictions from Ionizing Radiation. Fall 1998.

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Part 1 • "Asleep at the Wheel" due to a "Famous Failure"

1a • The topic which consumes Parts 5,6,7 of this article is the famous failure to detect (at a statistically significant level) any extra frequency of inherited afflictions, in the Japanese children of the Atomic Bomb Survivors.

1b • The main importance of the "famous failure" has been its power to render much of the environmental and medical communities "asleep at the wheel," with respect to the menace of inherited afflictions caused by ionizing radiation. Some environmentalists even talk about "giving nuclear power a second chance." And some people in medicine are so relaxed, about low-dose radiation, that their customers have to fight in order to obtain shielding of their ovaries and testes from xray beams.

1c • We suspect that hardly one-percent of environmentalists and medical professionals know (a) that when the A-Bomb Genetics Program was initiated, it was already acknowledged that, in all probability, it would be inherently incapable of producing statistically significant results (see Para.5b), and (b) that very few inherited effects were even explored in that Program (see Part 6). One purpose of this article is to document statements (a) and (b).

1d • The other purpose of this article is to set forth a scientifically credible warning that ionizing radiation is probably the single most menacing mutagen to which people everywhere are exposed --- and by itself is probably the mutagen which accounts for one-quarter or more of humanity's inherited afflictions (Para.2b and Para.12f). This warning is tied to three types of relevant human evidence (Parts 9,10,11).

Part 2 • A Dramatic Difference between Two Concepts

2a • The renowned British biologist, J.B.S. Haldane, suggested in 1948 that perpetual exposure to natural background radiation might account for most of humanity's accumulated burden of inherited afflictions (Haldane 1955, p.115). The great bulk of such afflictions are in the class called "Irregularly Inherited Disorders" (Part 3).

2b • A reality-check, on evidence accumulated since 1955, suggests that the share due to natural background radiation is very probably 25% or more --- maybe as high as 50%. So, it is time to consider the following scientifically credible proposition: "Natural background radiation is the mutagen which accounts for 25% or more of those cases of Irregularly Inherited Afflictions which occur because of inherited predisposition." For brevity in this article, we can refer to the proposition as "The Radiation Concept" (The Radiation Concept of Irregularly Inherited Afflictions).

2c • "The Radiation Concept" differs dramatically from a notion which became the operative concept during the "Atoms for Peace" program --- namely, that it would be inconsequential if nuclear pollution were to double the dose from natural background radiation. This operative notion is embedded in such numbers as a "permissible annual radiation dose" of 0.1 rad (100 milli-rads), and it is the premise of current discussions which refer to 0.1 rad per year as a dose too small to bother about at all (for instance, see Billen 1990 and Health Physics 1996). We and others call this "The De Minimis Concept."

2d • "The Radiation Concept" can neither be validated nor invalidated by the A-Bomb Genetics Program --- as we will explain --- but three OTHER types of evidence make it a very credible warning, scientifically (Part 9).

Part 3 • Which Afflictions Are Irregularly Inherited?

3a • Inherited afflictions and inherited mutations are not the same thing, of course. Mutations are a cause, afflictions are a result. Many different kinds of mutations may result in the same affliction.

3b • Inherited mutations can be loosely divided by their consequences: (1) Those which confer a certainty of some affliction (for instance, a malformed heart, a mental handicap, or a disease like hemophilia), (2) those which confer an elevated chance of negative consequences --- a predisposition, vulnerability, susceptibility, (3) those which are biologically inconsequential, and (4) those which are beneficial. With respect to group (4), the BEIR Committee of the National Research Council has stated the "general wisdom" in this field: "It must be emphasized again that virtually all mutations have harmful effects" (BEIR 1990, p.69).

3c • Group (2), above, is the key to a vast group of afflictions --- from mild to devastating --- called "Irregularly Inherited Disorders" (also called, "Disorders of Complex Etiology").

3d • What are some of the Irregularly Inherited Afflictions? They range from dyslexia to Alzheimer's Disease. By 1990, the BEIR Committee included the following afflictions as an illustrative selection of Irregularly Inherited Disorders (BEIR 1990, p.70, p.89):

3e • Heart disease, cancer, diabetes mellitus, schizophrenic psychoses, affective psychoses (uni-polar and bi-polar), multiple sclerosis, epilepsy, glaucoma, asthma, psoriasis, rheumatoid arthritis, Grave's disease, gout, allergic rhinitis, idiopathic procto-colitis, gallstones, and mineral deposits in the kidneys. There are many, many more. The Irregularly Inherited Disorders are so common that every person is thought to have at least one (BEIR 1990, p.70). Logic insists that inherited predisposing mutations create problems in every major system: immune, endocrine, reproductive, nervous, respiratory, digestive, urinary ...

3f • No one yet knows (a) what share of cases of the Irregularly Inherited Afflictions occurs because of predisposing inherited mutations and (b) what share of cases of the same afflictions would happen "anyway." Estimates of (a) have been 50% or lower, in reports sponsored by the government (history in BEIR 1990 + NRC 1991). We predict that nearly all cases require some predisposing mutations (Gofman 1994, Chapter 7, Part 2). However, "The Radiation Concept" is independent of that prediction. Whatever the share turns out to be, "The Radiation Concept" (Para.2b) says that 25% or more of such cases are the result of humanity's perpetual exposure to natural background radiation.

3g • So, when we speak of Irregularly Inherited Afflictions, we mean all the cases which occur because of an inherited predisposition and not cases which would have occurred "anyway" under the same circumstances.

Part 4 • The Build-Up of Mutations during 1,000+ Years

4a • By definition, an inherited mutation is present in every cell of an offspring's body --- including the lymphocytes circulating in the blood. Some inherited mutations are so harmful that the recipient always dies before ever having any children. Because such mutations can not be passed along to the next generation, they never accumulate in the population. By contrast, most inherited mutations never cause EARLY death, and so they can be passed along to the next generation. These are the mutations which ACCUMULATE in a population. People inherit so many mutations that it is an enormous task (now in its early stages) to figure out which inherited mutations produce harmful consequences and which ones are biologically inconsequential (Para.3b).

4b • If an offspring inherits a particular mutation, and the same mutation is NOT found in the lymphocytes of one of the parents, it means that the mutation occurred newly in a germ cell of a parent who did NOT inherit it from his or her ancestors. (Germ cells are the precursors of "eggs" and sperm.) Such a mutation in the offspring is called a "de novo" mutation. By contrast, if the same mutation is found in the lymphocytes of one of the parents, the offspring's mutation is called a "parental mutation" --- meaning that one parent has it in EVERY cell. Many, many earlier generations may have had it in every cell, too.

4c • Suppose that Paul has inherited three parental mutations called A,B,C, plus one de novo mutation called D. Suppose that his wife Mary has inherited three parental mutations E,F,G, plus one de novo mutation called H. Their daughter Alice may inherit A,B,D,H as parental mutations plus J as a de novo mutation, while her brother Edward may inherit C,E,F,G as parental mutations plus K as a de novo mutation. In this "scenario," de novo mutations keep adding to the inventory. And indeed, de novo mutations are the only possible source of humanity's accumulated inventory of inherited parental mutations.

4d • The "mutation rate" in a population refers to the rate of DE NOVO mutations per generation, and NOT to the population's very much higher incidence rate of parental mutations, already accumulated during 50 or 100 previous generations. The ratio of "de novo to parental" mutations is low, and this unfavorable "signal to noise ratio" has been an obstacle to conclusive epidemiologic research in this field.

Part 5 • Inherent Limits of the A-Bomb Genetics Program

5a • One of the most important statements, in the world's professional literature on inherited afflictions, was published by the National Academy Press in 1991 (Neel 1991). The statement occurs in the "Orientation" section (at p.2) of the 518-page book entitled The Children of Atomic Bomb Survivors: A Genetic Study, edited by James V. Neel and William J. Schull --- two of the principal investigators in that study:

5b • "In 1946, knowledge both of the doses of radiation sustained by survivors [of the atomic bombings] and the sensitivity of the mammalian genome to radiation was far inferior to the present situation. Nevertheless, as the preliminary data on post-atomic bomb Hiroshima and Nagasaki emerged, it became very likely, given the number of survivors in the two cities and their probable gonadal doses, as well as the indicators one would be forced to pursue in any study, that even a very major effort would not yield a statistically significant difference between the children of survivors receiving increased radiation at the time of the bombings (ATB) and the children of suitable controls."

5c • In other words, when the study was initiated, it was expected in advance that such a study would be inherently incapable of detecting the radiation-induction of inherited afflictions at any statistically significant level. The famous negative "findings" were built-in before the study began. And yet the negative findings were described in 1990 as follows --- in the highly influential journal Science:

5d • "The [A-Bomb Study] researchers have found no evidence of any genetic effects at all in the children who were conceived after the blast --- no genetic diseases, cancer, or congenital abnormalities. And they have scoured the data with a fine-toothed comb, even scanning protein sequences for any telltale variation that would indicate a genetic mutation" (Roberts 1990).

5e • Readers of the Roberts description could easily say "Case closed." But the researchers who did the work have quite a different view. Seven leading analysts in the A-Bomb Genetics Program wrote in 1990 (Neel 1990, p.1061):

5f • "We take it as a given that the exposure [to the atomic bombs] resulted in mutations in some survivors of the atomic bombings, inasmuch as, without exception, under controlled laboratory conditions, ionizing radiation has produced mutations in every properly studied plant and animal species." And (Neel 1990, p.1063): "Again we reiterate the point that, unless humans differ from every other properly studied animal, as well as from plants, mutations must have been produced by this exposure." See also Para.7a.

5g • These statements are emphatic warnings --- widely unknown or ignored --- that of course ionizing radiation (regardless of its source) contributes to inherited human afflictions.

Part 6 • Only 8 Inherited Effects Covered by Bomb Study

6a • If one appreciates the vast range of afflictions, to which inherited mutations contribute, then one can better appreciate the limitations of the A-Bomb Genetics Program with respect to radiation-induced inherited afflictions in offspring of A-Bomb Survivors. Only the following eight "indicators" were studied, in an effort to detect a statistically higher rate of de novo mutation in offspring having at least one parent exposed to bomb radiation, compared with offspring having neither parent exposed to bomb radiation (details in Neel 1990). As predicted (Para.5b), for none of the eight indicators was a statistically significant difference found (Neel 1990, p.1053).

1 - Untoward pregnancy outcome (an infant stillborn and/or exhibiting major congenital malformation and/or dying within the first 2 weeks of life expectancy.

2 - Death (except from cancer) before an average age of 28.8 Years (age in Neel 1991, p.403); age 39 was the oldest.

3 - Occurrence of malignancy before age 20 (age at p.1057, Neel 1990).

4 - Frequency of de novo chromosomal translocations and inversions: Blood samples were taken from offspring at an average age of 23-24 years (Awa 1987, p.346). Searches for balanced translocations (reciprocal and Robertsonian) and pericentric inversions were done without any molecular techniques, such as "FISH."

5 - Frequency of sex-chromosome aneuploidy (wrong number of sex chromosomes).

6 - Frequency of de novo mutation in 30 selected protein-coding genes (Neel 1988 + Neel 1990, p.1059-1060): Out of an estimated 50,000 to 100,000 genes in the genome, 30 were selected for study, indirectly. The protein products of 30 genes were studied electrophoretically, for alteration of electric charge, and a subset of nine enzymes was examined for a partial loss of activity (Neel 1988, pp.664-66).

7 - Sex-ratio among children of exposed mothers.

8 - Height, weight, circumference of head, chest.

Part 7 • "Fragile" Foundation Acknowledged by Neel & Colleagues

7a • What do Neel and co-workers conclude from their eight specific indicators? They acknowledge (Neel 1990, p.1063) that "Each of the eight estimators of a genetic effect of the bombs which we have been able to generate is associated with a relatively large error term, and individually these estimators are fragile reeds on which to lean in building a case."

7b • Nonetheless, Neel and co-workers combine five of their eight indicators (#1, 2, 3, 5, 6, from above), and calculate an estimate of the dose of bomb-radiation which would double the mutation rate for these five indicators. Their estimate (Neel 1990, p.1064 text): About 200 rems (approx. 200 rads). Since the error-term on each of the five indicators is larger than its slope (Neel 1990, Table 5), their estimate of 200 rems is consistent with very different values. Neel and co-workers decline, appropriately, to suggest any specific confidence limits (Neel 1990, p.1064).

Part 8 • The Health-Menace of a False Perception

8a • After responsible people become familiar with the BASIS of the estimated 200-rem doubling dose, they will recognize how unreliable and virtually irrelevant it is. This is not the fault of Neel and colleagues. From the outset, their study was expected to be inherently unable to produce any meaningful evaluation of the impact of ionizing radiation on inherited afflictions (Para.5b). What is such a menace to human health is the PERCEPTION that the results are meaningful when they are NOT.

8b • Neel and co-workers partly acknowledge the irrelevancy of their 5-indicator estimate, when they state (Neel 1990, p.1063; emphasis is in the original): "Ideally, the genetic doubling dose is calculated as that amount of radiation which increases the TOTAL impact of spontaneous [de novo] mutation by 100%."

8c • That statement is correct. And we add that the Irregularly Inherited Disorders represent the overwhelming share of the potential impact. When the A-Bomb Study addressed cancer before age 20 (very rare), it essentially addressed the issue of inherited predisposition to cancer NOT AT ALL. As for the multitude of other Irregularly Inherited Afflictions (Para.3e), the A-Bomb Genetics Program has addressed only the very rare disorders which were FATAL before an average age of 28.8 years of age. The overwhelming share, of the potential impact from exposure to ionizing radiation, is simply not addressed by that Program.

Part 9 • Why "The Radiation Concept" Is So Credible

9a • "The Radiation Concept" was defined in Paragraph 2b. It assigns a very large role to natural background radiation --- an assignment based on three types of human evidence.

9b • First is the fact that today's incidence rate of Irregularly Inherited Afflictions (Para.3g) is the result of many centuries of build-up, because the responsible mutations rarely kill their carriers before child-bearing age (Para.4a). Therefore, the chemical "revolution" after World War Two can not explain very much of humanity's current incidence of such inherited afflictions. A very large share of the current incidence has to be explained by mutagens which have "always been with us." Natural background radiation certainly qualifies on that requirement.

9c • Second is the emerging evidence --- thanks to recently developed laboratory techniques in "molecular" cytogenetics --- that structural chromosomal mutations are extremely important causes of inherited diseases and "birth defects" (as we predicted in Gofman 1970 and 1981). We have described some of the evidence and references elsewhere (Gofman 1992, 1994). Such chromosomal mutations are often called "I/D/R events" in the biomedical literature.

9d • How important are they? In 1989, Mohrenweiser and 2 co-workers stated (Mohrenweiser 1989, p.242): "[Recent] molecular studies of human genetic diseases indicate that insertion/deletion/re-arrangement [I/D/R] events are the molecular basis for many genetic alterations ... The latter group of variants may be of greater health significance than base substitutions as most of the mutations in the I/D/R class, if they involve

functional loci, should result in the loss of a functional gene product" --- the same point made in Gofman 1981 (p.787). Elsewhere, Neel and 7 co-workers acknowledge: "... a surprising frequency of spontaneous mutations are being found to be deletions" (Neel 1988, p.666). Hemophilia-A is an example. Youssoufian reported in 1987 that more deletions than point mutations have been identified as causing hemophilia-A (Youssoufian 1987, p.3772).

9e • Third is the evidence --- some of it available for decades (e.g., Kucerova 1972, Evans 1978) --- that ionizing radiation is a "champion clastogen." Clastogen means "chromosome breaker." Breakage of BOTH opposing strands of DNA, in the double helix, is the key requirement for production of all varieties of structural chromosomal mutations --- including dicentric translocations, insertions, and deletions. There are many mutagens beside ionizing radiation which can cause SINGLE strand breaks, but ionizing radiation can also deliver the biologically unnatural amounts of energy which readily break BOTH strands (discussion of the uniquely violent properties of ionizing radiation, in Gofman 1997, Part 4). The double-strand breaks are far more difficult for a cell to repair correctly than single-strand breaks.

9f • Not only is ionizing radiation a particularly potent chromosome breaker, but also chromosomal mutations are more likely --- per mutation --- to have biological consequences than non-chromosomal mutations. For instance, one of the most common chromosomal mutations (the deletion) actually removes segments of the genetic code, whereas a single base-change does not. Even the smallest deletion can scramble the genetic code along major segments of DNA.

9g • It is scientifically very credible to predict that chromosomal mutations cause at least half of humanity's current incidence of Irregularly Inherited Afflictions (with the other half caused by non-chromosomal mutations such as base-changes, etc.) AND that ionizing radiation causes at least half of the de novo chromosomal mutations (Part 11).

Part 10 • Can Natural Radiation Explain the Mutation Rate?

10a • We have proposed "The Radiation Concept" (Para.2b) because there is ENOUGH dose from natural background radiation to cause 25% or more of the Irregularly Inherited Afflictions (details in Part 11).

10b • At sea-level, natural background radiation exposes everyone to about 0.1 rad per year of absorbed radiation dose (the dose is is slightly higher at higher altitudes). This means that, ever since the beginning of humanity, the germ cells in our ancestors have accumulated a radiation dose of about 0.1 rad per year. At what age did people have children in the past? We can not ignore past practices (Para.9b). If we say that ages 15-20 (or 17.5 years on the average) have been common, then the average accumulated gonadal dose would be about 1.75 rads for each parent.

10c • So, the question becomes: Could an average gonadal dose of only 1.75 rads suffice to account for half of the de novo mutation rate for chromosomal mutations? By accounting for half of all chromosomal mutations, natural background radiation would account for one-fourth of all the afflictions --- if half of the afflictions are due to non-chromsosomal mutations (Para.9g).

10d • This question can be explored by study of chromosomal mutations in human blood. Such studies are highly relevant, because every chromosomal mutation inflicted by ionizing radiation on lymphocytes can also be inflicted by radiation on the chromosomes of human germ cells. Blood-studies have been done for decades. Although the methods reveal only the easily visible mutations, the non-detected chromosomal mutations occur in proportion to the detected ones, since all types begin with chromosome breakage.

10e • The dicentric translocation is the chromosomal mutation on which blood-studies generally rely most heavily. With the use of common methods, about 1 dicentric is detected in 1,000 cells from an adult blood-donor. This frequency reflects the fact that the dicentric mutation occurred after conception --- because the same dicentric would have to appear in EVERY cell if it were inherited. There is no question that blood-studies are counting DE NOVO dicentrics.

10f • What we really would like to count, with respect to "The Radiation Concept," is the frequency of de novo dicentrics typically found in the blood of people at age 17.5 years, when their accumulated gonadal dose from natural background radiation is about 1.75 rads. Then, we would irradiate samples of their blood with an extra 1.75 rads. If we found that the experimental dose of 1.75 EXTRA rads doubled the pre-experimental count of de novo dicentrics, we would have to conclude that natural background radiation caused ALL of the pre-experimental dicentrics in the blood.

10g • Why? If 1.75 extra rads can ADD as many de novo dicentrics as were already present BEFORE the extra 1.75 rads --- in other words, if 1.75 rads can DOUBLE the frequency of dicentrics --- this would be evidence that 1.75 rads from natural background radiation are sufficient to cause ALL of the pre-experimental de novo dicentrics. There would be no "room" for a contribution, to the pre-experimental count of dicentrics, by any other clastogen EXCEPT the inescapable natural background radiation.

10h • Moreover, because natural background radiation has access to the gonads, we could reasonably infer that natural background radiation caused all of the de novo chromosomal mutations in the germ cells, too.

10i • Suppose such studies establish that an extra dose of 3.5 rads is required in order to double the pre-experimental number of de novo dicentrics at age 17.5 years? Then we would conclude that natural radiation causes about HALF of the de novo chromosomal mutations which accumulate during the child-bearing years (Para.10c).

Part 11 • The Specific Evidence from Low-Dose Radiation

11a • We quote from the BEIR-5 Report (BEIR 1990, p.385): "In areas of high natural background radiation, an increased frequency of chromosome aberrations has been noted repeatedly."

11b • In 1983, Tonomura and 2 co-workers at the Tokyo Medical and Dental University reported their blood-study of 96 adults (49 females; 47 males) who had neither previously received any exposure to ionizing radiation from their jobs nor any significant exposure from medical procedures, as well as of 23 newborn infants whose mothers had NOT received medical radiation during pregnancy. The age-distribution of the blood-donors and the number of cells examined were (Tonomura 1983, Tables 28-1 and 28-2):

Age 20: 12,495 cells from 13 donors.
Age 30: 20,322 cells from 20 donors.
Age 40: 21,560 cells from 22 donors.
Age 50: 18,546 cells from 21 donors.
Age 60: 19,544 cells from 20 donors.
Newborn: 15,325 cells from 23 donors.

11c • Tonomura et al report (p.605) that "the incidence of dicentrics showed a linear increase with age." The frequency detected in newborns was zero. The frequency at age 20 --- when about 2.0 rads of gonadal dose have accumulated from natural background radiation --- was 0.0007 (9 de novo dicentrics in 12,495 cells). The frequency at age 40 (when an additional 2.0 rads of gonadal dose from natural background radiation have accumulated) was 0.0012 (25 dicentrics in 21,560 cells). Because the additional 2 rads added 70% to the rate of 0.0007 already present at age 20, it is credible that less than 2 rads could account for 50% or more of the dicentrics observed at age 17.5.

11d • "The Radiation Concept" and the Tonomura data are therefore in harmony (see Para.10i). It would be very enlightening to have some larger studies of the Tonomura type, but we are unaware of any. We note that in 1979, Evans also reported that de novo chromosomal mutations increase with age. Citing "unpublished evidence" and one 1968 Russian study, Evans writes (1979, p.532): "We have evidence from studies on a variety of populations for an increase in the spontaneous frequency of [chromosomal] aberrations --- in the absence of known radiation exposure [other than natural background] --- with increasing age."

11e • In 1992, results were published from one of the largest and most reliable blood-studies (Lloyd 1992). Blood samples were drawn from 20 donors of various ages, with an average age of 30.1 years (Lloyd 1992, Table 8). Two of the 20 donors were smokers. Each blood sample was divided into four portions: One portion (the control) received no extra radiation. The second portion received an extra radiation dose of 0.482 rad (4.82 mGy). The third portion received an extra dose of 2.85 rads (28.5 mGy). The fourth received an extra dose of 28 rads (280 mGy). The blood was irradiated with xrays of defined quality (169 keV ISO wide series) produced by an xray machine operated at 250 kVp with a half-value layer of 4.3 mm Cu (Lloyd 1992, p.336).

11f • Except for blood samples receiving 28 rads, 3,000 cells were "scored" at each dose-level from each of the 20 donors (for example, 60,000 cells were scored for the control group). Even though this was a much bigger study than Tonomura's, counts varied considerably from one donor to another, both before and after the extra irradiation (Lloyd Table 8) --- which illustrates the reason not to rely heavily on small studies.

11g • Because of "The Radiation Concept," our interest is in comparing the counts of de novo chromosomal mutations in the Control Group (which must have accumulated a dose from natural background radiation of about 3.0 rads by age 30) with the counts from the blood which received an EXTRA 3.0 rads (actually, 2.85 rads). The counts below, from the 20

donors combined, come from Lloyd 1992, Table 8. Dic=dicentrics. CR=centric rings. AF=acentric fragments.

Control:	49 Dic.	1 CR	134 AF
Extra 2.85 rad:	88 Dic.	12 CR	211 AF

11h • The extra 2.85 rads added 80% to the control's frequency of de novo dicentrics and added about 60% to the fragments. (We can ignore the centric rings, because a measurement of 1 is very unstable.) If we assume, reasonably, that the counts of dicentrics and fragments in the control samples would have been lower, if the average age had been 17.5 years instead of 30.1 years, then it would be very reasonable indeed to believe that (a) 2.85 rads is enough approximately to double such control values, and (b) that 1.75 rads of gonadal dose, received by age 17.5 years from natural background radiation, is enough to cause half of all the de novo chromosomal mutations.

Part 12 • Is the Evidence "Screaming" at Humanity?

12a • "The Radiation Concept" is in harmony with the Tonomura data and the Lloyd data on low-dose radiation. And that is because "The Radiation Concept" is not a mere speculation drawn from thin air. It is a scientifically credible concept BASED on relevant real-world evidence of the types described in Part 9.

12b • Ionizing radiation from any source (natural or man-made) is well-established as a particularly potent cause of chromosomal mutations and other complex genetic mutations. This is just not in dispute. And there are solid biological reasons for the unique mutagenic potency of ionizing radiation (discussion and references in Gofman 1997).

12c • A population dose of 0.1 EXTRA rad per year, due to human activities, would be the equivalent of doubling the annual gonadal dose from natural background radiation. We have shown above that such an annual increment, if received generation after generation, could ultimately add 25% to the incidence of the Irregularly Inherited Afflictions --- a consequence of breath-taking size. Indeed, adding that extra dose for just ONE generation would have a very large aggregate impact on future generations, because no one can issue "a recall" on the mutations, which are transmitted from that ONE generation to future generations (quantitative analysis in Gofman 1994, Chapter 7.)

12d • Moreover, if the extra dose comes from nuclear pollution, it is impossible to limit such dose to a single generation, because many of the radioactive species persist in the biosphere for centuries and millennia. For example, half of the carbon-14 created in nuclear power plants today will still be around 5,700 years from now. And half of the radium, already "liberated" by mining nuclear fuel, will still be around 1,600 years from now.

12e • The very low doubling-dose for radiation-induced chromosomal mutations, and confirmation of the importance of such mutations in inherited disorders, combine almost to scream at humanity: "Do not permit increases in nuclear pollution. At enormous expense, you can recapture only a small part of what you let loose. Irrevocable nuclear pollution inevitably increases humanity's rate of inherited afflictions."

12f • Responsible people will also consider the possibility that chromosomal mutations are the cause of MORE than half of humanity's inherited afflictions (Para.9g). Such a prospect is not rendered "improbable" by current knowledge. Moreover, the measurements discussed in Part 11 have error-bands, which means that natural background radiation could turn out to explain almost ALL the mutation rate for chromosomal mutations. In other words, today's evidence does not rule out the possibility that very low-dose ionizing radiation, from natural background, explains 50% or more of the inherited afflictions.

12g • The bottom line is: Even "The Radiation Concept" presented in this article (Para.2b) may rather severely underestimate the impact of low-dose ionizing radiation on inherited afflictions. It is far from prudent, for anyone in environmental or medical circles to be "asleep at the wheel."

# # # # #

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BERKELEY VOICE

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■ Letters to the Editor

Unsafe in any dose

Editor:

By way of introduction, I should say that I earned my Ph.D. at UC Berkeley in 1942 in nuclear/physical chemistry. I am co-holder with Glenn Seaborg and Raymond Stoughton of the patent for the slow and fast neutron fissionability of uranium-233, with its application to production of nuclear power or nuclear weapons. For the Manhattan Project, I led the group which irradiated a ton of uranyl nitrate by placing it around the Berkeley cyclotron, and then reduced that ton to a half cc of liquid containing 1.2 milligrams of plutonium, urgently requested by J. Robert Oppenheimer for some measurements at Los Alamos.

I am also a physician, and after the war, I led the group at the Donner Lab on campus which discovered the diverse lipoproteins involved in heart disease. In 1963, I was invited by the Atomic Energy Commission to establish its Biomedical Research Division at the Lawrence Livermore National Laboratory, and I did. Since retirement, I have written five books about the health effects of ionizing radiation.

In short, I am no enemy of physical and biomedical research, nor am I an opponent of using radioisotopes in research. I have used many myself. But the privilege of doing interesting and beneficial research with the help of radioisotopes and other dangerous substances must be very tightly linked to the duty to take the utmost care to protect public health from those substances. Even small releases into the environment contribute to the nation's total pollution. If the totality of nuclear pollution matters biologically—and it does—then citizens must oppose each small contribution to that totality.

Unfortunately, the track record of the Dept. of Energy's National Laboratories often reflects a disgusting disregard for public health. Thus, the citizens of Berkeley, Oakland, and the whole Bay Area need to behave with a high level of suspicion about the past and proposed handling of radioactive substances and "mixed waste" at Lawrence Berkeley National Laboratory.

Citizens of California would be crazy not to insist, even belatedly, on credible proof that the radioactive and "mixed" inventory at LBNL will remain contained — not only during routine operations, but also through earthquakes, mud slides, and especially fire such as the terrible conflagration which might have consumed the lab just a few years ago. Can a good hot fire and its wind lift and then drop the radioactive and chemical poisons as "fallout"? I am astonished to be told that this question seems not to have been answered in a straightforward, persuasive manner yet.

Credible assurance cannot be obtained from anyone with a conflict of interest — like the lab itself or DOE. It would be ridiculous for the lab to tell the public and its state and local officials, "Just trust us," and it would be the purest arrogance to tell the public "it's none of your business." The public always has a huge stake in the proper handling of hazardous wastes, both radioactive and nonradioactive. People who operate facilities with the potential to pollute need the humility and goodwill to recognize that the public has every right to impose preemptive measures for self-defense against such poisons before they escape.

This is especially unarguable when the potential pollutant is radioactive, since it is clear that there is no threshold dose-level (no safe dose, no risk-free dose) of ionizing radiation. Thus, nuclear pollution, in the aggregate, causes premeditated random murder.

It is high time that potential and current pollution from the lab should receive very close public scrutiny. The first step is to postpone any expansion of the total on-site inventory (either pure or mixed), until citizen-watchdogs are funded by the state, or by the cities of Berkeley and Oakland, to hire some independent, credible evaluation of the routine and worst-case health hazards.

I was a personal friend and colleague of Ernest O. Lawrence, and I feel that I honor his memory and his devotion to health and to public service when I say: I am in favor of research proceeding at the LBNL—provided that the lab meets the demands of the public for protection, not vice versa. With enough good will, the needs of the lab and the public can both be met, but the needs of the public come first. Let us never forget that the lab's justification for existence is service to the public.

John W. Gofman, M.D.

No One Escapes Harm:
The Essential Story of In-Utero Irradiation

By John W. Gofman, M.D., Ph.D., November 1992

The title of this CNR paper, "No One Escapes Harm," was a speculation a few years ago. Today, there is some real-world human evidence to support it. The nature of this evidence, and some of its important implications with respect to accidental and deliberate nuclear pollution and to other sources of radiation exposure, are the subjects of this "story." The details are in Chapter 6 of CNR's next book (CNR 1993, Radiation Consequences from Chernobyl and Comparable Exposures).

1 • The Early Story about Severe Mental Retardation

There are some human data on "birth defects" following in-utero irradiation received during radiation-therapy of pregnant women for uterine cancer, and there are some human data following the use of high-dose radiation to induce abortions. These types of data are at doses too high to be relevant to members of the general population.

By contrast, the Atomic-Bomb Survivor Study includes a sample of children who were irradiated in-utero by the bombings, at various gestational ages and at various dose-levels ranging from about 4 rads to over 150 rads. Thus, almost all analysts rely on the A-Bomb Study for evidence about "birth defects" induced by in-utero irradiation of humans. The A-Bomb Study is controlled by the Radiation Effects Research Foundation (RERF), which is jointly sponsored by the U.S. Department of Energy and the Japanese Ministry of Health. RERF is the successor to the ABCC (Atomic Bomb Casualty Commission).

In the summer and autumn of 1950, the ABCC undertook a search for radiation-induced abnormalities in Hiroshima children exposed to bomb radiation during the first 20 weeks of gestation. The investigator, George Plummer, reported as follows (1952, Pediatrics Vol.10: p.687, 692):

"... 205 such children were discovered and studied in the summer and autumn of 1950 ... Eleven were exposed within 1200 meters of the bomb hypocenter ... Seven of these 11 children exposed within 1200 meters had microcephaly [small head circumference] with mental retardation. This diagnosis was not made on any of the 194 children exposed at greater distances." Since 1950, the radiation community has done additional studies of mental retardation involving in-utero survivors of both Hiroshima and Nagasaki.

The Operative Definition of "Severe Mental Retardation"

All the RERF reports use the same criteria to identify severe mental retardation: "Judgments of severe mental retardation were based on clinical impressions and not on an IQ score, if such existed. A child was deemed to be severely mentally retarded if he or she was 'unable to perform simple calculations, to make simple conversation, to care for himself or herself, or if he or she was completely unmanageable or had been institutionalized'" (Otake 1987 in RERF Technical Report TR-16-87, p.4).

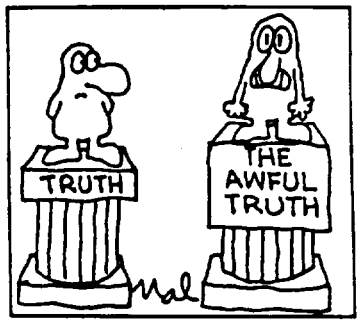
The 30 Unluckiest Children

The study-sample used by RERF in 1987 consists of a total of 1598 individuals: 513 were exposed to in-utero radiation by the bombs, and 1085 are non-exposed controls. In this study-sample, there are a total of 30 cases of severe mental retardation: 21 in the exposed groups and 9 in the non-exposed controls. The rate of severe retardation in the exposed is (21 cases / 513 children) = 0.041 , while the rate in the non-exposed controls = (9 cases / 1085 children) = 0.008 --- 5-fold lower.

Readers may have noticed that the rate of 0.041 (or 4.1 percent) in the exposed group means that 95.9 % of the exposed study-sample did ESCAPE severe mental retardation. How is this consistent with our title? The "story" is just beginning.

The Effect of Gestational Period

RERF analysts have shown, and our independent analysis agrees, that the hazard varies with gestational age at time of irradiation. This was learned by dividing the study-sample into four groups: Survivors who were irradiated 0-7 weeks after fertilization, 8-15 weeks, 16-25 weeks, and 26+ weeks. The four zero-dose groups were conceived at comparable times relative to the bombings, but they were not irradiated. A sample of the raw data is shown in the box . ——>



Courtesy of Malcolm Hancock.

The data indicate that, if 100 rads are received in-utero during the 8-15 week period, almost 50 % of all liveborn children will be SEVERELY mentally retarded (see the criteria above). If the same dose is received during the 16-25 week gestational period, about 14 % (one out of every seven) of all liveborn children will be SEVERELY mentally retarded. The percent of each sample which is severely retarded rises as dose rises, in both of the vulnerable periods. The positive dose-response is strong evidence in favor of radiation as CAUSAL, so causation is not in dispute.

Within the data, there is no observable effect in the 0-7 week and 26+ week periods, but "no effect observed" is not the same as "no effect occurred." Analysts should be very cautious about drawing important conclusions from small numbers, which are subject to random fluctuations. How small are the numbers here? When the 30 severely retarded cases (exposed plus non-exposed) are subdivided by gestational age at irradiation, just ONE case falls into the 0-7 week period. (It occurred in the non-exposed group.)

2 • A Call for MORE of the "Story"

For over thirty years, the total "story" about mental retardation from in-utero irradiation rested on the severely retarded cases. It was possible to imagine that, aside from a few tragic cases, no one else suffered —— even at high doses.

In Gofman 1981 (Radiation and Human Health, p.735), we analyzed the data on the severely retarded cases, and we commented "... it would be sad indeed if our concern were only for those who were so seriously retarded [that they were unable] 'to perform simple calculations, to carry on a simple conversation, to care for himself' or [they had a record of] complete unmanageability or institutionalization at any time. If we do not concern ourselves with radiation until these effects are present, there will likely be no human beings left who can care for themselves."

Where Was the Rest of the Story?

"Obviously, we should really be concerned about grossly smaller effects than those looked for in the Hiroshima and Nagasaki infants exposed in-utero ... It seems as though some more sophisticated study of mental development could have been made that would have given meaningful information about lesser degrees of mental retardation" (Gofman 1981, p.735).

8-15 WEEK PERIOD

Avg.Fetal Dose	Percent of Sample with Severe Mental Handicap
0 rad	(2 / 257) = 0.78 %
4 rads	(3 / 69) = 4.35 %
23 rads	(4 / 50) = 8.00 %
72 rads	(4 / 13) = 30.77 %
146 rads	(6 / 8) = 75.00 %

Numerators are the severely retarded cases; denominators are the total sample. Data are from Otake 1987, Table 2a. We show the unaltered, complete sample.

8-15 WEEK PERIOD

Avg.Fetal Dose	Number of Children and Mean School Score
0 rad	170 with score = 2.80
4 rads	60 with score = 2.79
24 rads	26 with score = 2.4
73 rads	5 with score = 1.6
129 rads	2 with score = 1.1

Data are from Otake 1988, Table 3, plus readings off Otake's Figure 2. We show the unaltered, complete sample for first-grade school-scores (scale 1-5; best=5).

We predicted in the same chapter (p.708) that the severity of radiation-induced mental handicap and other birth defects would vary "from exceedingly mild effects to exceedingly severe effects, the degree being in some way related to the amount of radiation." We explained the difference between radiation-induced cancer which is a "stochastic effect" and radiation-induced loss of mental function, which we expected to be a "non-stochastic effect."

Non-Stochastic Effects — No One Escapes Harm

"Certain effects fall into the category of 'all or none' effects, in which a given amount of radiation confers a probability, or chance, of developing the effect. These are known as stochastic effects of ionizing radiation. The severity of the effect is not at issue; rather the probability that the effect will occur at all is what we may relate to the radiation dose. Two outstanding examples of stochastic effects of radiation are cancer and leukemia ... The radiation increases the probability of developing the cancer, but does not influence the severity of its clinical manifestations" (Gofman 1981, p.708).

Non-stochastic in-utero effects are effects whose severity in a single fetus rises with dose. When radiation acts non-stochastically on the central nervous system of fetuses in-utero, every fetus is injured according to the particular dose. None completely escapes injury. However, equal in-utero doses do not result in equal mental function in liveborn children because radiation is acting upon a future function whose natural, pre-radiation levels vary in any general population from fetus to fetus.

3 • More of the "Story" Is Released

Does the degree of radiation-induced mental handicap in an individual who was irradiated in-utero depend on the amount of the individual's radiation dose? The question can not be addressed by the thirty cases of severe mental retardation because the data cover only ONE degree of mental handicap.

In 1986 and 1988, RERF released data which were collected decades earlier. These "exhumed" data cover "IQ" tests of intelligence at ages 10-11 years, and records of school performance in grades 1-4, in samples of in-utero irradiated A-bomb survivors (Schull 1986 = RERF TR-7-86, and Otake 1988 = RERF TR-2-88). The radiation effect is non-stochastic. The exhumed evidence leads Schull et al to conclude (Schull 1990 in Neurotoxicology and Teratology Vol.12: p.257):

"These data suggest a continuum of effects on the developing brain of exposure to ionizing radiation; indeed, the downwards shift seen in the distribution of IQ scores with increasing exposure predicts reasonably well the increase in severe mental retardation actually observed. This suggests, in turn, that the impact of exposure to ionizing radiation will be related to where in the normal continuum of cortical function an individual would have resided if unexposed."

Elsewhere, the RERF analysts report that both effects (reduced school scores and reduced IQ scores) seem to be proportional to fetal radiation dose --- the linear dose-response, with no suggestion of a threshold. Also, they report no detectable effects in the 0-7 week and 26+ week periods of gestation.

An Independent Analysis Performed

Do we concur that the data support their conclusions? Both sets of data are independently analyzed in CNR 1993, Chapter 6. We do agree. One sample of the data is provided on the front page (right side of the box) so that readers can see how the newer data differ from the data for severe mental retardation. Instead of showing how the frequency of a SINGLE level of mental function (severe retardation) changes with fetal radiation dose, the school-performance data show how the average level of mental function VARIES with fetal radiation dose. Hiroshima school scores combine achievement-data for language, social studies, arithmetic, science, music, drawing plus handicrafts, and gymnastics.

The exhumed data are the human data which happen to exist in this world on degrees of brain damage from in-utero irradiation. No one asserts that there is a one-to-one relationship between school performance and either structural or biochemical evaluation of brain function. No such assertion is made for IQ scores either. However, we share with RERF the opinion that each set of scores is ONE meaningful way to assess functional damage in the CNS (central nervous system).

Severely Retarded Cases: One Extreme of a Continuum

The school-score data include some of the 30 severely retarded cases. Thirteen attempted the first grade; only one made it into the fourth grade. Otake et al perform extensive statistical testing on the effect of excluding these cases from school-score analysis (Otake 1988, Table 7a), and these analysts find that a radiation effect is present with and without these cases. This supports the presumption that the severe cases of mental retardation are an integral part of the non-stochastic effect of in-utero irradiation upon mental function, and should be INCLUDED in the analyses. The inclusion does not appear to be in dispute.

4 • Warning about the First Week of Pregnancy

Reports that the A-bomb study-sample shows no radiation-induced mental handicap among embryos irradiated during the first seven weeks of development may lead some women and some physicians to become more careless about irradiation during the first week of pregnancy.

Findings from the A-Bomb Study would be an exceedingly poor reason to become casual. In the study, there were a total of 85 bomb-exposed survivors who were between 0-7 weeks of their development at the time of the bombing. If their conception occurred with equal frequency in each week, then the entire study consists of only (85 / 7), or 12 children exposed during the first week of development. On the basis of such a small sample, it would be reckless indeed to become careless about avoidable exposures and thus to gamble with the future of any family.

When radiation exposure occurs during the second or third day after fertilization, there are only about 2 to 16 cells present in the developing embryo. Additional cell-divisions occur during days 4-6, when the cells of the developing embryo (now called a blastocyst) are arranged in a single layer which forms a hollow ball. If, during the first week, radiation induces a chromosome aberration in one of the cells, what will happen?

The evidence stares at us, from the mosaic cases of birth defects in the Clinical Atlas of Human Chromosomes (Grouchy+Turleau 1984), that embryos at these early stages do NOT always discard a cell with a chromosomal aberration. A mosaic case is a child with most cells chromosomally normal but a fraction chromosomally abnormal. The known mosaics prove that a single aberrant cell, probably injured before an embryo has even 100 total cells, can develop into a very large clone of cells with the same chromosomal defect. These known mosaics also prove that the health consequences can be devastating --- and they almost always include mental retardation (CNR 1993, Chapter 5).

An Emphatic Warning

CNR emphatically warns against unnecessary radiation exposure at ANY stage of pregnancy. Quite aside from the menace of reduced mental function, there is a radiation-induced stochastic risk of both childhood cancer (including leukemia) and adult cancer --- details in CNR 1990, Radiation-Induced Cancer. Moreover, there are good reasons to think that in-utero irradiation can permanently injure organs ADDITIONAL to the brain. These reasons are thoroughly presented in CNR 1993.

5 • "The Essential Story of In-Utero Irradiation"

The evidence from the school scores and the IQ scores indicates that, during the combined 8-25 week period of gestation, (a) the mental function of each fetus is injured in proportion to radiation dose (the linear dose-response), (b) severe retardation induced by radiation is part of a continuum of injury, and (c) there is no threshold-dose which must be reached before radiation starts inflicting permanent CNS injury.

Injury is a CERTAINTY rather than a RISK during the 8-25 week period. No one who is thus irradiated in-utero completely escapes some loss of mental function. These are reasonable conclusions from the only existing human evidence, but of course, they might someday be modified by additional human evidence.

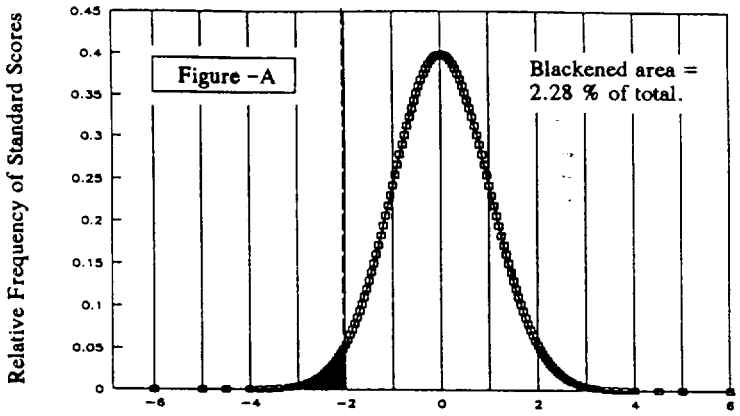
How Many People Are Mentally Retarded?

We are going to assume that mental function in a general population has a normal distribution or bell-shaped curve, like Figure-A. Levels of mental function are shown in Standard Scores along the horizontal axis, and the height of the curve indicates the relative frequency. The crest of the curve represents the most frequent or typical level of mental function, at Std.Score = 0. The curve is exceedingly low at Std.Score 4+, and also exceedingly low at Std.Score -4, because only a very small percent of a general population has either such brilliant or such poor mental function.

In any curve like Figure-A, the Std.Scores of 50 % of the population lie to the LEFT of the crest ("below average"), scores of 15.87 % lie at or below the Std.Score -1, and scores of 2.28 % lie at or below Std.Score -2.

Either school scores or IQ scores can be converted to Standard Scores (as shown in CNR 1993, Chapter 6).

It is self-evident that mental function is a continuum of levels, and that any score dividing "mental retardation" from "normal" is an arbitrary choice. Like Schull et al (1990, p.255), we use a Std.Score of -2 as the dividing line. Individuals with Std.Scores of -2 or lower "qualify" as mentally retarded. And so Figure-A shows a heavy vertical line at -2. By definition, then, 2.28 % of a general population is mentally retarded, and a smaller percent is SEVERELY mentally retarded.



Mental Function in Standard Score Units.
Heavy vertical line = onset of retardation.

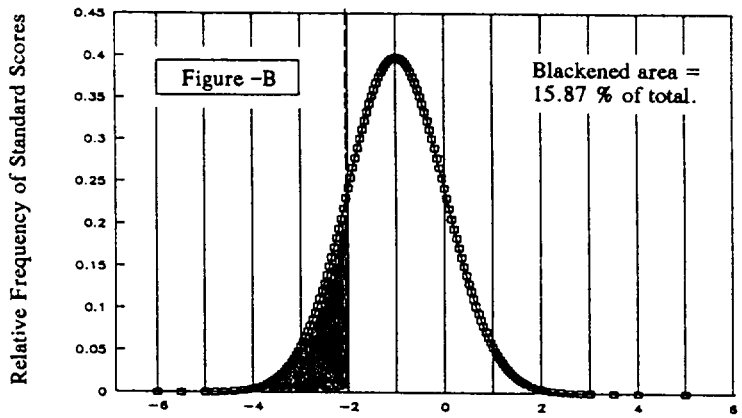
Pushing the Entire Curve to the Left by In-Utero Irradiation

The data shown in the box for school scores illustrates the finding that the average mental function in the non-irradiated group was better than the average in any of the irradiated groups, and that average performance deteriorated as radiation dose increased.

Let us consider one irradiated group at a time: The 24-rad group. Without in-utero irradiation, the average score would have been 2.80, like the non-exposed group. The average score is calculated from ALL the scores, including the ones which are way below average and way above average (near the extremes of the bell-shaped curve), and all the scores in between.

Exposure to 24 rads in-utero lowered ALL the potential scores. Thus, the single average score found in the study is 2.4 instead of 2.80. And in the same way, ALL the potential scores in the 73-rad group were reduced by the in-utero exposure, so that the single average score found in the study is 1.6 instead of 2.80. And an even greater shift to a lower average is found in the 129-rad group.

In-utero irradiation is pushing the entire curve of mental function in an irradiated group to the left (compare Figure-A with Figure-B). But the absolute level of mental performance which we regard as "retarded" is independent of radiation. So the heavy vertical line which denotes the onset of mental retardation does NOT move to the left when the whole curve shifts leftward. If radiation moves the curve to the left by -1 Std. Score, as shown in Figure-B, the fraction of the irradiated group which lies at or below the heavy vertical line becomes 15.87 % instead of 2.28 %.



Mental Function in Standard Score Units.
Heavy vertical line = onset of retardation.

The Dimming of Intelligence

Everyone is more familiar with IQ scores than Standard Scores, so we will describe the essential story of in-utero irradiation in terms of IQ scores. A score of 100 is considered average. In the absence of evidence to the contrary, it is reasonable to assume that the reduction of intelligence is the same per rad of in-utero irradiation at all underlying (pre-injury) levels of potential intelligence.

If someone is destined, biologically, to have an IQ of 130 on a particular test, and then is shifted due to in-utero radiation by 15 points to an absolute IQ score of 115, then someone else who is destined to have an IQ of 100 will be shifted also by this same 15 points to an absolute IQ score of 85 ... and 85 will be shifted to 70 ... and 70 to 55.

In-utero irradiation during the vulnerable period causes the brilliant to become less brilliant, the average to become "below average," and the retarded to become more retarded. And by pushing more people over the heavy vertical line into the realms of mental retardation and severe retardation, such exposure automatically increases the PERCENT of a population-sample which is retarded and severely retarded.

6 • Brain-Injury versus Elevated Cancer-Risk

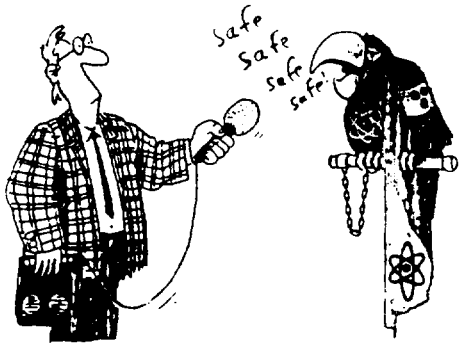
There are some interesting differences between the issues of brain-injury and cancer-risk. With respect to cancer, in-utero irradiation confers an elevated risk of an often fatal disease, which may not occur until late in life. With respect to brain-injury, in-utero irradiation during the 8-25 week period confers a certainty of reduced mental function, an effect which is lifelong. We have shown elsewhere (CNR 1990) that there is no threshold-dose or safe-dose of radiation with respect to cancer. The risk is approximately proportional to the size of the dose, right down to zero-dose. What about brain-injury?

Some Astonishing Suggestions in Medical Journals and Reports

Some of the RERF analysts (echoed almost verbatim by the BEIR Committee) are suggesting far and wide that high threshold-doses — in the regions of 10 to 70 rads — may exist for radiation-induction of severe mental retardation. For example, see Otake et al 1987, p.2; and Schull et al 1990, p.255, 257; and Yamazaki and Schull in J.Amer.Med.Assn., August 1, 1990, p.605, 608; and BEIR 1990, pp.357-58.

Nevermind that, in the very same articles and reports, they present the newer evidence against any threshold-dose. Nevermind that they themselves appear to accept the premise that SEVERE mental retardation is just the extreme end of the continuum of mental function tested by school and IQ scores. Nonetheless, they make elaborate efforts with alternate statistical models to find thresholds within the tiny group of 30 severely retarded cases.

Artist unknown.



They especially focus attention on the retroactively altered input in which average doses, number of participants, grouping of participants, and percent with severe retardation have all been changed after the results were known. They even experiment with dropping selected cases from the total of 30 (details in CNR 1993). What ever happened to the rules of objective research?

A Serious Issue for Humanity

Our mind boggles at the very idea of scientists searching so creatively for thresholds in the meagre supply of cases (19 cases in the 8–15 week period, 6 cases in the 16–25 week period).

The strongest claims about a threshold involve the 16–25 week period. For instance, Schull et al (1990, p.255, 257) say that "A threshold does seem to exist; no increase in cases is seen at doses of less than 0.5 Gy [50 rads] ... There is still disagreement, however, whether a threshold does truly exist." Yamazaki and Schull (1990, p.608) tell the vast international readership of JAMA that the evidence suggests a threshold in the range of 21 to 70 rads. They characterize the evidence as "the seemingly clear evidence of a threshold at this later stage of development."

We are just amazed that anyone would actually discuss a possible threshold in a sample whose dose-response is based on a total of SIX CASES (with only 3 cases above 10 rads). The inadequate size of the sample is not emphasized in these two peer-reviewed papers, however.

It is our opinion that on a serious issue for humanity — and this is a serious one indeed — the suggestion of a threshold based upon such thin evidence should simply be dismissed. This would be our opinion even without the positive evidence AGAINST any threshold which is provided by the data on school and IQ scores.

What about a Fetal Dose of a Half Rad?

The absence of any threshold-dose for brain-injury has different implications than its absence for cancer. For instance, an in-utero dose of a half rad would be of concern with respect to cancer-induction. The available evidence suggests 0.5 rad in-utero can increase the risk of childhood cancer or leukemia by about 35 % (CNR 1993, Chapter 4). By contrast, the evidence from IQ scores suggests a reduction of about one-quarter point per fetal rad, or one-eighth point for 0.5 rad during the 8-25 week period (not applicable to the first week; see Part 4).

So with respect to brain-injury, a half-rad during the 8-25 week period is not the issue. The issue is claims that no injury may occur unless the fetus receives 10, 20, 50, or 70 rads. We shall see the real-world relevance of such doses in Part 7.

7 • Some Real-World Implications of the Newer Data

People often assume that doses from nuclear pollution will be low. The Chernobyl accident has already shown that such an assumption is mistaken. Some 24,000 residents of Pripyat received average doses estimated at 40 rads each (DOE 1987). In addition, about 600,000 soldiers and other "clean-up" workers may have received average doses like 25 rads or more. These are not low doses. And if the winds and rains had been different during that accident, over 2 million people in the city of Kiev might be dealing with average doses like 10 to 25 rads, too. (For comparison, we remind readers that the background dose from natural radiation is about 0.1 rad whole-body dose per year at sea level, when the lung-dose from radon is omitted.)

Make no mistake. The doses from nuclear accidents come from radio-nuclides. Although most nuclides — with some famous exceptions — decay in a few hours, a few days, or a few months, they are nuclear POLLUTANTS during their short and menacing existence.

Suddenly the speculations and quasi-claims about thresholds for severe retardation, at fetal doses like 10 to 70 rads, take on real-world meaning in terms of the future of nuclear power. We repeat, however: The evidence does not support threshold-suggestions.

One section of the radiation community goes beyond proposing threshold-doses. The proponents of "hormesis" suggest that ionizing radiation improves the general health. The leading hormetic is Thomas Luckey, who proposes in his 1991 book (p.236): "The theme of future research and practice in radiation safety should be supplementation of background radiation for health." Luckey worries about "radiation deficiency syndrome," and suggests that "optimum exposures" appear to be about 10 rads per year (p.229, 233).

Hormesis is a routine topic in such radiation journals as Health Physics. A notable example was the hormetic suggestion from J.A. Izatt of the Scottish Universities Research and Reactor Centre that doses up to 50 rads may protect people against cancer (Izatt 1991; Gofman 1991).

Mental Handicap from Nuclear Pollution (or from Hormetic Doses)

Again we will use the approximation that 2.28 % of a general population is mentally retarded (Part 5). This means that every mother has a 2.28 % chance (about 1 in 50) that she will give birth to a mentally retarded child. Our work in CNR 1993 makes it possible for anyone to obtain a "ballpark" estimate of how the percent (and thus a mother's individual risk) rises with fetal irradiation during the 8-25 week period.

Some examples follow. They use doses which are already in the tabulations of CNR 1993. The work derives from the exhumed data on school and IQ scores.

Average Fetal Dose	New Percent / Old Percent	Percent Increase in Rate of Mental Retardation
4 rads	(2.63 / 2.28) = 1.15	15 % increase
10 rads	(3.13 / 2.28) = 1.37	37 % increase (at the optimum "hormetic" dose)
15.4 rads	(3.77 / 2.28) = 1.65	65 % increase
23.0 rads	(4.75 / 2.28) = 2.08	2.08-fold increase
30.8 rads	(6.00 / 2.28) = 2.63	2.63-fold increase
46.2 rads	(9.12 / 2.28) = 4.00	4-fold increase
61.5 rads	(13.36 / 2.28) = 5.86	5.86-fold increase
72.0 rads	(16.85 / 2.28) = 7.39	7.39-fold increase

The tabulation speaks chillingly for itself. Surely there is a moral issue as well as a scientific issue here. Even the lowest entry — a 15 % increase in the number of babies born retarded among the exposed mothers — is not acceptable. Yet the tabulation covers only the increase in the frequency of full-blown mental retardation. Full-blown mental retardation is certainly not the only issue.

The really HUGE aggregate injury arises because evidence and logic combine to indicate that EVERYONE who receives extra in-utero radiation during the 8-25 week period loses some mental function, in proportion to the extra dose. Those who are NOT pushed over the arbitrary dividing line into full-blown mental retardation are injured too. At each dose-level, those who were destined to be mentally retarded anyway become more retarded, those who were destined for average function become below-average, and those who were destined for brilliant mental function become less brilliant.

In national and international policies toward ionizing radiation, we are dealing with a toxic agent which will lower the mental function of every developing infant who gets in its way.

# # # # #

AUTHOR: JWG is chairman of CNR; professor emeritus of Molecular and Cell Biology at the University of California, Berkeley; founder in 1963 of the Bio-Medical Research Division of the Livermore National Laboratory; author of four scholarly books on health effects from ionizing radiation (1981, 1985, 1990, and 1993 in progress).

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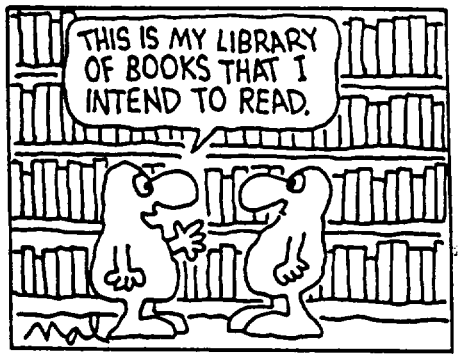
Answers to Frequently-Asked-Questions about "Radiation." Fall 1996.

John W. Gofman, M.D., Ph.D.
Egan O'Connor, Executive Director of CNR



Malcolm "Mal" Hancock

• Introduction: What Kind of Radiation Are We Talking About?

• During our 25 years of experience at the Committee for Nuclear Responsibility (CNR), we have received certain questions again and again. Question #1 (next column) is the most frequent, by far.

• The type of radiation which this Committee addresses is IONIZING radiation. This type includes xrays, gamma rays, beta particles, alpha particles, and lots of other high-energy particles (neutrons, positrons, etc.). Ultra-violet radiation is generally treated as a separate class.

• Xrays and gamma rays, which are a type of electro-magnetic radiation, are far more energetic per photon than visible light, and immensely more energetic per photon than microwaves and radiowaves. Nonetheless, xrays and gamma rays do their biological damage via PARTICLES, especially electrons. The rays can (and do) make some electrons in our cells start traveling like high-speed rockets through the home-cell and neighboring cells. These "unnatural" electrons are just like beta particles, except for origin. Beta particles are ejected as high-speed electrons from inside the nucleus of an unstable atom, whereas high-speed electrons are orbiting outside a nucleus when they are "kicked" into travel by a photon. Very high-energy photons (>1.02 MEV) can CREATE high-speed electrons and positrons (a conversion of energy into mass).

• Regardless of their origin, as high-speed particles slow down, they transfer unnaturally large amounts of energy at irregular intervals to various cells. These transfers of too much energy are unlike the smaller energy-transfers in routine body-chemistry, and the bigger transfers can cause complex, NON-repairable damage to a cell's library of genetic instructions --- the chromsomes and DNA. Some types of permanent injury kill the cell, but other types do not.

• If the radiation-injured cell does NOT die, a damaged chromosome or damaged piece of DNA can result in benign and malignant tumors. If the injured chromosome or DNA is in the germ-line (in a "sex cell"), the result can be afflictions suffered by descendants of the irradiated person.

• Separate from ionizing radiation is the investigation of biological impacts from electrical fields, magnetic fields, microwaves, radiowaves, "wireless" personal communications, and radar. These are very important topics in which CNR has no expertise. A citizen-group concerned with these radiations is the EMR Alliance, 410 West 53rd Street, Suite 402, New York City 10019. Tel: 212-554-4073. $35 per year.

• An independent, professional publication (bi-monthly) on non-ionizing radiations is MICROWAVE NEWS, Post Office Box 1799, Grand Central Station, New York City 10163. $285 per year. If your library-system does not yet subscribe to MWN, the librarian should ask MWN for a free sample copy of this excellent publication. It is hard to see how citizens can participate in decisions about non-ionizing radiation if librarians fail to provide this essential source of current information on the newest scientific studies, meetings, etc. On the Internet: <http://www.microwavenews.com>

• - LIST OF QUESTIONS

1 • What amount of radiation is safe?
2 • Among the proven causes of human cancer, how important is radiation?
3 • Can one case of cancer have more than one cause?
4 • When you estimate that 75% of recent and current breast-cancer in the USA is due to earlier exposure to medical irradiation, do you mean that all other agents combined are responsible for only 25% of the cases?
5 • What makes your estimate 75%, when some other estimates are as low as 1% to 10% ?
6 • How can radiation both be a cause of cancer and also be used to TREAT cancer?
7 • Should I have radiation therapy to treat my cancer?
8 • Will regular mammograms protect me from breast cancer, or will they give me breast cancer?
9 • Just how big IS the chance that mammography will give a woman breast cancer?
10 • Aren't some people more sensitive to radiation than the average person?
11 • Which is worse, external radiation or internal radiation?
12 • How much extra radiation do we receive from flying?
13 • Why do some sources say our average dose from natural background is 100 milli-rems per year, and other sources say the dose is 250 milli-rems or more? Who's right?
14 • Rads, rems, grays, sieverts, effective dose equivalents, roentgens --- how can we cope with such terms?
15 • How much extra radiation dose do I get from a smoke detector?
16 • What is a "curie" of radiation?
17 • Which is more dangerous --- a radioactive substance with a short half-life or a long half-life?

1 • What amount of radiation is safe?

• Safe means free from danger or risk. Safer means more nearly free from risk than something else. Safest means the most nearly free from risk than other things under discussion. Even the safest car is NOT SAFE (risk-free). And even the smallest exposure to ionizing radiation is not safe (risk-free), with respect to cancer and inherited afflictions. In other words, there is no "threshold" dose-level below which all cancer-risk from radiation disappears.

• The AMOUNT of the danger or risk depends on the AMOUNT of radiation exposure. The only risk-free (safe) dose is zero-dose, with respect to unrepairable injury of chromosomes and DNA. We proved this in CNR's 1990 book,

by any reasonable standard of scientific proof (Gofman 1990). In 1993, the United Nations Scientific Committee on Effects of Atomic Radiation supported the same conclusion (UNSCEAR 1993). And in 1995, Britain's National Radiological Protection Board also concluded that the weight of the evidence "falls decisively in favor of" the no-threshold conclusion for benign and malignant tumors (NRPB 1995).

• When an individual receives a small extra dose of radiation, the person receives a small extra risk of cancer --- say, 1 chance in 1,000. The person has 999 chances out of 1,000 of escaping. But if 25,000,000 people like that individual each receive the same, small extra dose of radiation, EACH person receives 1 chance in 1,000. The consequence is a rate of 25,000 extra cancers in that group. Point: A small personal risk can mean a large actual rate for a group --- a fact which produces important ethical and health issues.

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2 • Among the proven causes of human cancer, how important is radiation?

• We think that ionizing radiation is very probably the single most important human carcinogen of the 20th century. In 1997, CNR will publish a study which is consistent with that hypothesis.

• Other proven human carcinogens include certain viruses and chemical substances (including asbestos and tobacco smoke). Specific chemicals sometimes cause only specific types of cancer. By contrast, we predicted in 1969 that "All forms of cancer, in all probability, can be increased by radiation." This warning met with resistance from the radiation community, and we were called "controversial" (and worse). But by 1980, the radiation committee of the National Academy of Sciences acknowledged that "Cancer may be induced by radiation in nearly all the tissues of the human body" (BEIR 1980, Section 5).

• An extremely important question remains unsettled, however. Do the various carcinogens work synergistically (as co-factors, multiplying the potency of each other), or do they work additively (as independent agents having a fixed potency in every situation and in every nation)? We predict that they usually work as synergists. If correct, then reducing exposure to ionizing radiation --- which would be easy to do --- would also reduce the impact of many OTHER carcinogens.

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3 • Can one case of cancer have more than one cause?

• Most experts currently accept (a) the single-cell origin of a cancer and (b) the requirement for multiple genetic abnormalities in the same cell. It follows that a single case of cancer very probably has more than one cause, even if carcinogens act additively instead of synergistically.

• Suppose that a type of cancer requires the accumulation of 5 independent genetic injuries in the same cell. If only 4 occur, no cancer can occur. But each of the 5 injuries required (in this supposition) to produce ONE case of cancer, could be caused in the same cell by a DIFFERENT carcinogen. Some such injuries are surely inherited.

---

4 • When you estimate that 75% of recent and current breast-cancer in the USA is due to earlier exposure to medical irradiation, do you mean that all other agents combined are responsible for only 25% of the cases?

• No, we don't. Our 75% incorporates a very big role for non-radiation agents, because it explicitly incorporates the assumption of synergy between them and radiation, with the other agents causing each unit of radiation to be much more potent in causing breast cancer in the USA than in Japan (Gofman 1995/96, Chapters 40 + 47).

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5 • Why is your estimate 75%, when some other estimates are as low as 1% to 10% ?

• Anyone who assumes that causes of breast-cancer act independently (additively) can divide our estimate by 6. Everyone must choose assumptions, because evidence is still too meagre to settle the issue (as stated in Question 2). The "additive" assumption converts 75% to 12.5% (Gofman 1995/96, p.313).

• In addition, analysts who still treat medical xrays identically with atomic-bomb radiation cut our estimate in half. So they convert 12.5% to 6.25%. Such analysts ignore the evidence that xrays are at least 2 times more potent than A-bomb radiation per dose-unit (Gofman 1995/96, pp.337-338).

• The estimate of 1% incorporates irrelevant dose-estimates which are over 10 times lower than the relevant dose-estimates (Gofman 1995/96, pp.314-315).

---

6 • How can radiation both be a cause of cancer and also be used to TREAT cancer?

• The "current wisdom" is that cancer begins with a single cell having abnormal genetic instructions. Over time, it (or one of its descendant cells) acquires additional injuries. Finally, a cell's abnormal instructions cause it to do abnormal things --- such as dividing too often, or forming a tumor, or migrating from its appropriate location to live and divide elsewhere in the body (metastasis). These cancerous activities are done by LIVING cells, whose abnormalities can be caused by radiation.

• When radiation is used to TREAT cancer, it is used in very high doses which do enough damage to KILL cells. Dead cells cannot behave like cancer. It is very difficult to give radiation only to CANCER cells, without giving both high and low doses of radiation to HEALTHY cells in the neighborhood. Methods in radiation therapy are improving with time.

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7 • Should I have radiation therapy to treat my cancer?

• We think INFORMED consent is an important principle in medicine (and in every voluntary transaction).

• We hear from too many women with breast cancer whose own physicians told them only about the benefits from radiation therapy --- but not about the side-effects which SOMETIMES occur on the irradiated side --- such as chronic swelling of the arm, chronic pain in the arm, paralysis of the arm (from radiation damage to its nerve), broken ribs (from radiation damage to bone), or radiation damage to the underlying lung or heart. Unavoidably, the non-cancerous breast also receives considerable radiation exposure.

• Patients who consider radiation therapy for abdominal cancers may also want to ASK for details about potential complications from radiation damage involving the bladder, intestines, ureters, kidneys, nerves, spine, etc.

• CNR has no expertise in treating any type of cancer. Our focus is on helping to PREVENT cancer.

8 • Will regular mammograms protect me from breast cancer, or will they give me breast cancer?

• Mammograms never PREVENT breast cancer. They may help to DISCOVER a cancer which already exists, and then the treatment which follows the discovery may help protect a woman from DYING of the cancer.

• Unlike earlier decades, the radiation dose from each mammographic exam today can be quite low, which means the average risk of GETTING cancer from the exam is not high (see Question 9). At accredited mammography centers in the USA, the maximum mean glandular dose from a 2-view exam is now 0.6 rad (600 milli-rads). Actual doses are often lower, like 0.2 rad per 2-view exam. Dose is mostly confined to the breasts.

9 • Just how big IS the chance that mammography will give a woman breast cancer?

• Below, we will give three examples from Gofman 1995/96. Estimates are based on the premise that the mean absorbed glandular dose is 0.2 rad from a 2-view exam.

• Suppose a woman age 50 has one 2-view mammographic exam. Our estimate is that the average woman would have 1 chance in 2,041 of getting breast cancer from that single exam. In other words, 1 woman out of every 2,041 such women would develop breast cancer because of the mammogram.

• Suppose a woman has 15 mammograms beginning at age 50. Then we estimate that the average woman would accumulate 1 chance in 136 of getting breast cancer because of the exams.

• Suppose a woman has annual mammograms beginning at age 40. By age 65, she has taken 25 exams. Then we estimate that the average woman would have accumulated approximately 1 chance in 81 of getting breast cancer because of the exams.

• Other analysts claim that the risk is much lower, for the first two reasons discussed in Question 5.

10 • Aren't some people more sensitive to radiation than the average person?

• Yes, almost certainly. But there is no way to identify them --- yet. For instance, several different genes provide every cell with the ability to REPAIR routine injuries to chromosomes and DNA. People who are born with a faulty "repair gene" in every cell, are going to be more vulnerable than the average person to cancer induced by radiation and by other carcinogens (mutagens).

• When analysts study the cancer-response to radiation in human groups, the sensitive individuals are probably contributing much of the response. Therefore, the unlucky sensitive women are going to have HIGHER risks from mammography than the average values in Question 9, and other women will have LOWER risks than indicated in Question 9.

11 • Which is worse, external radiation or internal radiation?

• To a cell, all high-speed electrons feel alike, except for their particular energy (Introduction). A cell does not know WHY such electrons are there. And a cell does not CARE whether they come because of an external source (like an x-ray machine or a radium dial) or because of a radioactive substance inside you (for example, cesium-137, strontium-90, iodine-131). But the cell cares a lot about the NUMBER of such electrons, because (at equal energy per electron) the damage is proportional to the number.

• Unlike xrays and gamma rays (photons), radioactive substances (radio-nuclides) have CHEMICAL properties, and the body uses them chemically. For instance, the body collects iodine in the thyroid gland. Therefore, thyroid cells experience MANY more high-speed electrons (and more damage) than do breast cells from internal RADIO-iodine.

12 • How much extra radiation do we receive from flying?

• Radiation exposure, from natural cosmic sources, increases with altitude, with peak dose at about 45,000 feet. Dose from cosmic radiation also varies with latitude; it is lowest near the equator and highest near the poles. Therefore, the extra radiation dose from flying depends on (a) the particular route, (b) the duration of the flight, and (c) the fraction of the trip spent below the flight's maximum altitude.

• A useful "ballpark" value for a nonstop commercial flight, from California to New York and back, is an extra dose to all your organs of about 0.003 rem (3 milli-rems). Such a trip adds about 3% to the average annual whole-body dose from all natural radiation combined --- which is about 100 milli-rems per year of whole-body exposure in the USA, on the average.

13 • Why do some sources say our average dose from natural background is 100 milli-rems per year, and other sources say the dose is 250 milli-rems or more? Who's right?

• There is no contradiction. There is just some carelessness in specifying what each number describes.

• 100 milli-rems per year refers to the average annual WHOLE-BODY exposure. Every organ is at risk, including the ovaries and testes. The figure of 100 milli-rems per year excludes exposure by natural radon and thoron because these radio-nuclides and their radioactive decay-products cause primarily lung-exposure, rather than primarily whole-body exposure.

• 250 milli-rems of annual EFFECTIVE DOSE EQUIVALENT is a number which combines the whole-body exposure with the partial-body exposure --- by applying a long series of assumptions about the relative importance of each organ, in terms of health consequences.

14 • Rads, rems, grays, sieverts, effective dose equivalents, roentgens --- how can we cope with such terms?

• The RAD is the most "solid" unit of biological dose, because it contains no ASSUMPTIONS. A rad is defined as a certain amount of energy deposited by high-speed particles per gram of biological tissue (Introduction). Rads and roentgens are almost equivalent. The GRAY is the name for 100 rads.

• The REM is a unit which incorporates some evidence and some assumptions about the relative harmfulness of various high-speed particles, even when they deliver the SAME amount of energy per gram of biological tissue. In general, the RAD

and the REM are equivalent only when discussing gamma rays (or certain xrays). The SIEVERT is the name for 100 rems.

• The EFFECTIVE DOSE EQUIVALENT, which is always expressed in rems or sieverts, incorporates many ADDITIONAL assumptions about biological consequences (details in Gofman 1995/96, pp.358-359). "Effective doses" and rad-doses are not directly comparable.

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15 • How much extra radiation dose do I get from a smoke detector?

• Very, very little. If you have a photo-electric smoke detector, there is no radioactive substance in it. If you have the much more common "ionization" type, there is a radio-nuclide in it --- usually 1 micro-curie of americium-241. A micro-curie is one-millionth of one curie (Question 16). Americium-241 emits alpha particles (Question 17), which are kept inside the case. It also emits some gamma radiation which can penetrate the case. We measured the gamma dose-rate from our own smoke detector, and 3 feet away from it, the extra dose-rate was 1/80 of a micro-rad per hour --- 1/80 of one millionth of a rad. To receive one extra milli-rad of gamma dose from our detector, we would have to sit 3 feet away from it for about 80,000 hours.

---

16 • What is a "curie" of radiation?

• A curie is the amount of a pure radio-nuclide which can decay into a different substance at the rate of 37 billion atoms per second. Decay means changes in the atomic NUCLEUS. The curie is not a measure of biological dose. The dose (in RADS) is a separate piece of information.

• Each pure radioactive species is characterized by what FRACTION of its remaining atoms are decaying during a unit of time (second, minute, year). The radioactive half-life is the time required for half of the atoms in any pure radioactive sample to decay into a different species.

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17 • Which is more dangerous --- a radioactive substance with a short half-life or a long half-life?

• Two opposite answers are possible! To understand why, one must consider the very simple --- but amazing --- LAW OF RADIOACTIVE DECAY, which is: The fraction of atoms (of a pure radio-nuclide) decaying per unit of time equals 0.693 divided by the radioactive half-life. If the half-life is expressed in years, then the fraction decaying is "per year." (Details in Gofman 1981, pp.33-36).

• The radioactive half-life of plutonium-239 is about 24,400 years, compared with about 88 years for plutonium-238. The way their atoms decay is comparable: Each atom ejects (out of its nucleus) a high-speed alpha particle having over 5 million electron-volts of energy. An alpha particle consists of 2 protons plus 2 neutrons; the particle carries a +2 electrical charge; it interacts so fiercely with tissue that it "spends" all of its kinetic energy within just a few cells.

• **Is it more dangerous to have 100,000 atoms of Pu-239 in your body, or 100,000 atoms of Pu-238?**

• The fraction of Pu-239 atoms decaying per year = 0.693 / 24,400 years = 0.000028402. So, during the first year, the number of atoms decaying = 100,000 atoms times 0.000028402 = 2.8 atoms. Since there are no fractional atoms, we'll say 3 atoms. The fraction of Pu-238 atoms decaying per year = 0.693 / 88 years = 0.007875. So, during the first year, the number of atoms decaying = 100,000 atoms times 0.007875 = 788 atoms --- lots more than 3.

• During the second year, the decayed atoms are no longer available to decay. So the number of Pu-239 atoms decaying = 99,997 available atoms x 0.000028402 = 2.84 atoms, or 3 again. The number of Pu-238 atoms decaying = 99,212 atoms x 0.007875 = 781 atoms --- still lots more than 3.

• Since the biological damage per year is proportional to the number of decaying atoms, the Pu-238 will remain much more dangerous, if you start with equal numbers of atoms.

• BY CONTRAST, the Pu-239 will do slightly more damage than the Pu-238, if you start with equal CURIES --- or partial curies (e.g., a nano-curie: "only" 37 decays per second).

• Many more atoms of Pu-239 than Pu-238 are required to produce an equal number of decays per second. Why? The fraction of Pu-238 atoms decaying per unit time is about 277 times larger than the fraction of Pu-239 atoms decaying per unit time. An example of equal decays from UNequal number of atoms: (1,000,000 Pu-238 atoms) x (0.007875) = 7,875 decays during first year. And: (277,000,000 Pu-239 atoms) x (0.000028402) = 7,867 decays during first year --- the same.

• Initially equal CURIES of Pu-239 and of Pu-238 cause equal decays (equal damage) during the first year. But during every subsequent year, the remaining Pu-238 atoms eject fewer alpha particles per year than the remaining Pu-239 atoms. That is because a smaller fraction REMAINS of the original Pu-238 atoms than the original Pu-239 atoms. The ratio of remaining atoms is no longer 277. This being the case, the two samples cannot continue to generate equal decays per year, as they did at the outset. Pu-239 generates more than Pu-238.

• In diagnostic NUCLEAR MEDICINE, radio-nuclides are measured in fractional curies. With initially equal curies of two nuclides having comparable biochemical behavior, shorter half-life means less radiation dose than longer half-life.

# # # # #

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BERKELEY, CALIFORNIA 94720

Maria Holt, Field Director
Citizen's Monitoring Network
Safe Power for Maine

Dear Maria Holt:

August 3, 1999

I emphatically associate myself with Safe Power for Maine, and Friends of the Coast, and any other group which opposes the 25 mrem/year extra irradiation level proposed for unrestricted site exposure (all pathways combined) from Maine Yankee after its decommissioning.

It is morally intolerable to propose such a high level when lower levels are feasible. An extra 25 mrem per year would be 1.7-fold higher than 15 extra mrem/year, and 2.5-fold higher than 10 extra mrem per year. An extra 25 mrem/yr over a 75-year lifespan amounts to an extra exposure of 1.875 rem, while the comparable lifetime dose from an extra 10 mrem/yr would be 0.750 rem.

Ionizing radiation is a uniquely potent mutagen, and radiation-induced mutations are cumulative. It is the mutagenic potency of ionizing radiation which makes it a carcinogen. Moreover, the number of radiation-induced cancers will be the same whether the extra dose is accumulated by one person or divided among "substitutes" who take that person's place in the radioactively contaminated region. For simplicity here, we will not even consider the various NON-cancer effects inducible by pre-conception and post-conception mutations.

The fundamental starting point, for discussing 25-mrem extra vs. 10 mrem extra as an annual standard, is the overwhelming evidence that there is no dose-rate or dose-level of ionizing radiation exposure which is safe (risk free). The evidence from my own work (Gofman 1990), from the United Nations (UNSCEAR 1993), and from the British National Radiation Protection Board (NRPB 1995) is summarized in Chapter 45 of my 1996 book (Gofman 1996) --- available on the Internet at www.ratical.org/radiation/CNR/ . On the evidence against any safe dose, the web also provides the Oct. 1998 draft report of the Natl. Council on Radiation Protection's Scientific Committee SC 1-6, Chaired by Dr. Arthur Upton, "Evaluation of the Linear No-Threshold Dose-Response Model," at www.ncrp.com/review.html .

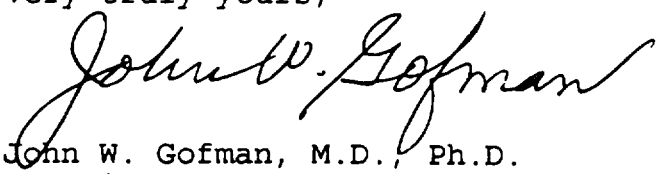
→

Back in 1990, the A-Bomb LifeSpan Study evidence resulted in our estimate (Gofman 1990, Table 16-C) that 27 radiation-induced fatal cancers per 10,000 persons of mixed ages are induced when each accumulates 1 extra rem of whole-body dose. Thus, per 10,000 such persons who accumulate 10 extra mrem per year for 75 years, there will be about (27 cancers/rem times 0.75 rem) or about 20 extra fatal cancers plus about 20 extra nonfatal cancers. Forty cases/10,000 is equivalent to giving cancer to about 1 person in every 250 such persons. The estimate of the National Research Council (BEIR Committee 1990, p.172, Table 4-2), including assumption of an unjustified Dose RATE Reduction Factor of 2, was about 7.5-fold lower than mine. Without the DREF of 2.0, Gofman and BEIR were only about 3.5-fold apart.

The number of cases/rem will never be knowable with exactitude. Let us keep our eye on the BALL:

It is clearly despicable for anyone to give cancer to another person who does not consent. Is this point even debatable? To set a 25 mrem extra/yr standard, instead of a 10 mrem extra/yr standard, would give 2.5-fold more people cancer than necessary. This being deliberate, how could it NOT be called premeditated random murder? Is Maine on the brink of losing its moral compass?

Very truly yours,



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- UNSCEAR 1993. Sources and Effects of Ionizing Radiation. 922 pages. ISBN 92-1-142200-0.

MARYKNOLL FATHERS AND BROTHERS

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Corporate Social Responsibility

May 30, 2000

REPORT ON UNOCAL'S MAY 22, 2000 SHAREHOLDERS' MEETING

Vote = 16.4% on 88.8% of voting shareholders, First presentation of the Executive Compensation Resolution.

Dear Folks,

Again I arrived in the Los Angeles area a few days prior to the scheduled May 22 Unocal shareholders' meeting to plan for the meeting specifics and to respond to scheduled media interviews.

On May 18, Carol Richards (Burma Forum-LA) and I were interviewed live by Mr. Jim Lafferty Esq. on Los Angeles station KPFK for a 30-minute program ("Corporate Abuse of Power"). We were able to explain our shareholder action against Unocal and to invite listeners to attend the Brea, California shareholders' meeting.

On May 19, I interviewed with Gary Gentile of the Associated Press providing background material for an anticipated story release on May 22. (See attachment)

On May 23, attended a group to discuss programmed activities concerned with both the internal meeting and the outside act-up activities.

- Internal Meeting: I briefed the new comers about shareholder meeting protocol and provided them with particular questions appropriate to be asked either during the presentation of our resolution or during the Q&A.

- External Meeting: We were briefed on the various group activities planned to coincide with inside activities. They included folks from: indigenous Burmese groups, Union members, student activists, Burma Forum members from various Burma Forum groups and interested folks willing to support Burmese efforts to seek withdrawal of Unocal from Burma.

- Unique to this year's actions was a planned tree climbing experience with a hoped for unfurling of a banner between the trees. It failed when a security guard managed to lasso the initial message cord shot between the two trees. Negotiations went on till slightly after the meeting to allow the tree climbers to descend without arrest. I was surprised at how professional this particular group was, how well they knew the law and how capable they are as negotiators.

- Numerous colorful banners were made and carried by the rest of the group with Burmese drummers attracting much attention of passing people.

- A symbolic pipeline with a face of Beach at its head and masked students dressed up as slaves working on the pipeline.

Legal Title: Catholic Foreign Mission Society of America, Inc.

- An effigy of Roger Beach and a Junta leader marched around participating in acts that attracted the attention of media and others in the area.

- Media presentation was a bit more forceful this year. A live two-hour radio program began at 9:30 AM and ended at 11:30 AM matching the termination of the shareholders' meeting. Many of us told the story of why we were present for the meeting explaining the history of the Military Junta's initial and on-going activities and Unocal's culpability in the matter. *The Los Angeles Times, Associated Press* and others of whom I am unaware represented the press. Television was present with 60 Minutes footage being taken in anticipation of a 60 Minutes program in the Fall centering on the (John Doe I,II,II, etc. Vs. Unocal et al) lawsuit.

- Radio Free Asia was also present for broadcasts to the people of Burma. These faithful people seem to be present wherever we go, be it the New York, Washington or Los Angeles demonstrations.

Security at Hartley Center was high as in previous years but inside security seemed to be reduced – perhaps they were tending to the tree climbers. The meeting hall contained more shareholders this year than last but still at reduced level from earlier years. Shareholders were a bit more aggressive against us. One man in his seventies insisted on kicking the back of my chair during the meeting while shouting slurs, don't know if he was a plant or just doing his own thing.

At the official opening of the meeting, first item, election of board members, I presented a statement (See attachment) asking for Roger Beach's comments on the absence of 55% of his board the previous meeting also noting that four members (40%) were missing for this meeting. Roger just gloated about how wonderful his board was and never answered the question.

Larry Dohrs (Burma Forum, Seattle) followed with a very strong argument concerning the NPR report that quoted a Pentagon spokesperson as "...flatly [telling] executives that when they keep insisting that slave labor is not used to support the project, they appear at best naïve and at worst a willing partner in the situation." Larry pushed to see if Roger Beach had shared this information with the board; Roger denied having seen such a report.

In presenting Item #5 (See attachment) our Executive Compensation resolution, Beach, myopic on Burma, didn't even address the litany of Unocal sins about the world. He spun everything around his memorized phrase, "There were no human rights violations on our project and that's a fact." He spins well and certainly the shareholders present don't ask him to explain any of the items we offer as criticisms. Follow-on questions pushed Beach, especially when a Burmese doctor spoke of his personal experiences with the boarder people running away from the pipeline area. Beach responded again with, "There were no human rights violations on our project and that's a fact."

At the Q&A, we raised additional issues, one of mine concerned the Fr. Timm report (See attachment). When I indicated Fr. Timm's troubled conscience on making the report, Beach defended it by saying they, "...the inspection team, could go anywhere they wanted and thus Unocal did not direct the inspection – it was a good evaluation," said Beach. Again he stated, "There were no human rights violations on our project and that's a fact."

Before and after the meeting I met with Mr. Gregory Huger, Director, Corporate Responsibility, Unocal. Greg is an experienced US AID director, now working for Unocal. He is new on the job but seems amiable for conversation. Turns out that he is the nephew of a Maryknoll Priest, a Maryknoll Sister and a St. Louis priest working in Maryknoll's cultural training in Cochabamba, Bolivia. Greg learned Spanish there.

He joined with our group in our assigned seating area during the meeting and so also Ms. Deborah Purcell, Manager Corporate Responsibility Communications. She met me at the entrance and guided me about providing all that we asked as far as getting people into the meeting. Greg is brand new to the Unocal operations, (±) six months.

Obviously, the two of them are very sharp people; in my conversations I had with them, they are no pushovers and seemingly not opened to hear any outside opinion concerning Unocal's presence to their human and environmental rights violations. I spoke to Greg about our own *Principles* and though they have copies of the book all over Unocal, I promised to send him a copy.

Upon departure from the meeting, I was interviewed by Ms. Mai Tran of the *Los Angeles Times*. (See attachment) and Dr. Kyi May Kaung of *Radio Free Asia*.

At a 2:00 PM Press Conference at the LA County Federation of Labor, the book. *Total Denial Continues,* was presented to the public. This is a follow-on book to *Total Denial* a first run book authored by EarthRights International. It's stronger than the first book, *Total Denial,* in pointing out the particulars connecting Unocal with pipeline human rights violations.

On May 25 I interviewed with Ms. Trisha L. Sorrells of 60 Minutes who is preparing the grounds for a possible September program concerning Unocal and the lawsuit. I have another appointment with her during the third week of June if not sooner.

My apologies to all for so much repetition of materials over these past two weeks. It is only when I returned home and got a chance to look over all the data, which seemed so fast moving at the time, that I was able to put it together in a cohesive presentation. The various press releases tell the story with a different flavor as well, so all are included.

You may note that the shareholder resolution aspect that is so much a part of the Interfaith Center on Corporate Responsibility (ICCR) is only a part of the great effort to move Unocal and other corporations towards respect for human and environmental values, especially in the country of Burma.

A great effort by a lot of folks and especially for those who laid themselves on the line for arrest, they deserve lots of praise. Those who I worked with most directly during these days were: Dr. Carol Richards, Ph.D., Ms. Heidi Quante and Mr. Kevin Rudigar of Burma Forum Los Angeles, Mr. Larry Dohrs, Burma Forum Seattle, Ms. Pam Wellner of Free Burma - No Petro Dollars for SLORC, Ms. Edith Mirante of Petro Oil and Ms. Betsy Apply, Esq. of EarthRights International. This by no means exhaust the list of those outside of ICCR that are so faithfully involved in the work of checking Corporate values.

Of note from Edith Mirante is this: "As I was going into the meeting I overheard Barry Lane (Unocal PR) say to another Unocal exec, 'If we have learned ANYTHING from all this, it is [that] when we go in somewhere, to have someone on site from the get-go to monitor that's going on.' Anyway I think it is significant that people within KNOW they did something wrong no matter how Beach denies it all..."

I received an unexpected apology from Ms. Brigitte Dewez, Corporate Secretary for the unnecessary brutishness of a shareholder who took great delight in making nasty comments about our presentation and enjoyed kicking the back of my chair during the meeting. That was thoughtful of her.

Enjoy the readings,

Joe

Joe La Mar

ATTACHMENTS:

1) ITEM #1 ELECTION OF BOARD MEMBERS
   a) Explain absent Board Members – Joe La Mar
   b) Advising Board Members – Larry Dohrs
2) ITEM #5, EXECUTIVE COMPENSATION
   a) Presentation – Joe La Mar
   b) Comment -- Dr. Tom Lee
3) QUESTION AND ANSWER PERIOD
   a) Question on forced labor -- Betsy Apple, Esq.
   b) Question of Fr. Timm Report – Joe La Mar
4) PRESS RELEASES
   a) May 19 – Heidi Quante
   b) May 20 – Joe La Mar
   c) May 22 – Heidi Quante
   d) May 22 – Joe La Mar
5) PRESS REPORTS
   a) May 21 – AP, Michael White
   b) May 23 – LA Times, Orange County Edition
   c) May 23 – LA Times

ITEM #1 ELECTION OF BOARD MEMBERS

FATHER JOE LA MAR COMMENTED ON ITEM #1 THE ELECTION OF MEMBERS ON THE BOARD CONCERNING THE ABSENCE OF BOARD MEMBERS DURING LAST YEARS SHAREHOLDERS' MEETING.

MR. BEACH, MEMBERS OF THE BOARD, FELLOW SHAREHOLDERS, I AM FATHER JOE LA MAR REPRESENTING THE MARYKNOLL FATHERS AND BROTHERS AND TEN OTHER RELIGIOUS ORGANIZATIONS OWNERS OF MORE THAN 360,000 SHARES.

I SPEAK AT THIS MOMENT BECAUSE I AM CONCERNED WITH THE LACK OF RESPONSIBILITY DEMONSTRATED BY OUR BOARD, FIVE MEMBERS OF WHICH WERE NOT PRESENT AT LAST YEARS MEETING, AND I NOTICE FOUR MEMBERS OF THE BOARD ARE MISSING TODAY AS WELL.

MR. BEACH INTRODUCED THOSE FEW MEMBERS PRESENT BUT OFFERED NOT A WORD OF EXPLANATION CONCERNING THE FIVE MISSING BOARD MEMBERS – FIFTY FIVE PERCENT (55%) OF THE BOARD

MOST IRREGULAR WERE THE ABSENCES OF

- MR. JOHN IMLE, THE VICE-CHAIRMAN OF THE CORPORATION AND;
- MR. RICE, NOMINATED FOR ELECTION TO THE BOARD, BUT WHO FAILED TO SHOW FOR HIS OWN ELECTION.

THE VERY SOUL OF UNOCAL IS LOST AND OUR DIRECTORS DEMONSTRATE THAT THEY DON'T

CARE.

THE RESPONSIBILITY FOR THE GOVERNANCE OF THIS COMPANY IS THEIRS, WHERE ARE THEY?

TO ABSENT ONESELF FROM SUCH A POSITION DUE TO PERSONNEL SICKNESS OR FAMILY PROBLEMS IS NOT QUESTIONED, ALTHOUGH AN EXPLANATION SHOULD TO BE FORTHCOMING.

TO ABSENT ONESELF FOR OTHER REASONS QUESTIONS THE COMMITTED RESPONSIBILITY OF THE BOARD MEMBER.

IN A PERSONAL LETTER TO EACH OF THE ABSENT BOARD MEMBERS ASKING THEM TO EXPLAIN THEIR ABSENCE, ONLY MR. CREIGHTON WAS GOOD ENOUGH TO RESPOND WITH A PROMISE TO BE PRESENT AS THIS MEETING.

MS. BRIGITTE DEWEZ ATTEMPTED TO ANSWER FOR ALL FIVE BOARD MEMBERS EXPLAINING THAT, "THEY [BOARD MEMBERS] ARE INFORMED OF STOCKHOLDER CONCERNS EXPRESSED TO THE COMPANY..."

I FOR ONE DON'T HAVE MUCH FAITH THAT SUCH IS THE CASE.

HOW WE OFFER OUR PRESENTATION --- HOW WE STATE IT --- HOW FORCEFULLY WE FEEL ABOUT THE ISSUES ARE NOT FAITHFULLY EXPLAINED, ESPECIALLY BY A BIASED THIRD PARTY VOICE.

WE SHAREHOLDERS' DESERVE AN APOLOGY AND A PROMISE TO RESPECT US AS OWNERS OF THE COMPANY SUBJECT TO ALL THE HONORS DESERVING OF OWNERSHIP.

MR. BEACH I ASK FOR YOUR COMMENTS ON THIS MATTER, THANK YOU.

MR. LARRY DOHRS COMMENTED EXTEMPORANEOUSLY ON ITEM #1 THE ELECTION OF MEMBERS ON THE BOARD. QUOTING FROM THE NATIONAL PUBLIC RADIO REPORT,

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> *"ACCORDING TO COMPANY SOURCES, UNOCAL HIRED A FORMER PENTAGON ANALYST TO INVESTIGATE WHETHER THE ARMY WAS ABUSING HUMAN RIGHTS ALONG THEIR PIPELINE, AND HE WARNED UNOCAL EXECUTIVES THAT MYANMAR'S MILITARY WAS COMMITTING EGREGIOUS HUMAN RIGHTS VIOLATIONS. ACCORDING TO COMPANY SOURCES, THE CONSULTANT FLATLY TOLD EXECUTIVES THAT WHEN THEY KEEP INSISTING THAT SLAVE LABOR IS NOT BEING USED TO SUPPORT THE PROJECT, THEY APPEAR AT BEST NAIVE AND AT WORST A WILLING PARTNER IN THE SITUATION."*

LARRY ASKED ROGER BEACH IF HE HAD INFORMED THE BOARD OF THE ANALYST'S COMMENT. HE SAID HE DID. WHEN FURTHER QUESTIONED, HE SAID THAT HE INFORMED THE BOARD OF THE NPR REPORT, HE HADN'T INFORMED THEM OF THE DIRECT REPORT COMING FROM THE PENTAGON ANALYST. WHEN QUESTIONED WHY, HE RESPONDED, "I HAD NEVER SEEN THE REPORT."

ITEM # 5 EXECUTIVE COMPENSATION

PRESENTATION OF ITEM #5 - RELATING TO EXECUTIVE COMPENSATION BY REV. JOSEPH P. LA MAR, M.M.

MR. BEACH, MEMBERS OF THE BOARD, FELLOW SHAREHOLDERS, I AM FATHER JOE LA MAR REPRESENTING THE MARYKNOLL FATHERS AND BROTHERS AND TEN OTHER RELIGIOUS ORGANIZATIONS OWNERS OF MORE THAN 360,000 SHARES.

AS MANY OF YOU ARE AWARE, I HAVE BEEN INVOLVED IN SHAREHOLDER ACTIVISM WITH OUR COMPANY SINCE 1994.

MY ORIGINAL GOAL WAS TO SEEK UNOCAL'S WITHDRAWAL FROM BURMA BECAUSE OF ITS INVOLVED RELATIONSHIPS WITH AN ILLEGAL GOVERNMENT THAT VIOLATED THE HUMAN RIGHTS OF THE PEOPLE OF BURMA.

HAD WE WITHDRAWN FROM BURMA AS DID MORE THAN THIRTY OTHER CORPORATIONS, I PROBABLY WOULDN'T BE HERE TODAY.

BUT I AM HERE AND MUCH THE WISER ABOUT OUR COMPANY. CERTAINLY THE SITUATION IN BURMA REQUIRES AT A MINIMUM OUR IMMEDIATE WITHDRAWAL. HOWEVER, IN COMPARING OUR *GLOBAL PRINCIPLES* AGAINST OUR WORLDWIDE OPERATIONS IT IS OBVIOUS, THAT THE *PRINCIPLES* ARE CONSTANTLY VIOLATED. MY CONCLUSION IS THAT UNOCAL BY NOT SUPPORTING ITS *PRINCIPLES*; IT HAS LOST ITS SOUL!

IN SUPPORT OF MY CONCLUSION, A FEW INSTANCES COME TO MIND:

1) ONE, 18 OF 21 PREGNANCIES RESULTED IN STILL BIRTHS AFTER A UNOCAL SOUR GAS PLANT BEGAN ITS OPERATIONS IN THE NEAR PRESENCE OF THE RESERVATION OF THE LUBICON TRIBE IN CANADA.

2) TWO, STATING THAT, "SOME OF OUR PAST CALIFORNIA OPERATIONS HAVE CAUSED ENVIRONMENTAL PROBLEMS," UNDERSTATES OUR COMPANY'S LONG TERM COURT FIGHTS TO AVOID APOLOGIES AND CLEAN UP. A GOOD NEIGHBOR WOULD HAVE APOLOGIZED AND CLEANED UP THE MESS WITHOUT A COURT ORDER!

3) THREE, PARTNERING WITH AN ILLEGAL MILITARY JUNTA IN BURMA, WHERE REPORTS OF HUMAN RIGHTS ABUSES BY THE MOST RESPECTED OF HUMAN RIGHTS AGENCIES ARE LEGEND, HAVE BETRAYED OUR COMPANY AND BESMIRCHED OUR NAME: AND WHAT ARE SOME OF THEM?
   i) AN EXTENSIVE AND PERHAPS A LANDMARK LAWSUIT.
   ii) EXTENSIVE NEGATIVE MEDIA AGAINST UNOCAL.
   iii) UNOCAL'S LOBBYING FOR A GOVERNMENT NOTORIOUS FOR HUMAN RIGHTS VIOLATIONS IN BURMA AND THE SALE OF DRUGS IN OUR STREETS.

4) FOUR, FAILING TO LEARN FROM THE BURMA EXPERIENCE, WE ENTERED INTO OPERATIONAL RELATIONSHIPS WITH AFGHANISTAN, ONCE AGAIN DEMONSTRATING OUR INSENSITIVITY FOR HUMAN RIGHTS CONCERNS.

5) FIVE, PEOPLE OF INDIA PROTESTING AGAINST A UNOCAL PORT PROJECT IN INDIA WERE

BEATEN UP BY LOCAL POLICE RESULTING IN THE PHYSICAL SUFFERING OF MANY AND THE DEATH OF RETIRED COLONEL SAVE.

6) SIX, UNOCAL/MOLYCORP'S DETERMINATION TO STORE RADIOACTIVE WASTE NEAR A PENNSYLVANIA COMMUNITY IN DIRECT OPPOSITION TO THE WISHES OF THE COMMUNITY.

7) SEVEN, AND SADLY, IN A RECENT *REUTERS* NEWS REPORT, UNOCAL IS LISTED ALONG WITH A NUMBER OF COMPANIES THAT "HAD PLANTS IN GERMANY OR OCCUPIED COUNTRIES [DURING W.W. II] THAT USED FORCED OR SLAVE LABOURERS." [NEW YORK, APRIL 26]

IT SURE APPEARS TO ME THAT WE HAVE LOST OUR SOUL. AND "FOR WHAT DOES IT PROFIT A MAN IF HE GAIN THE WHOLE WORLD BUT LOSE HIS SOUL?"

MY FELLOW SHAREHOLDERS, OUR COMPANY HAS PLACED IN OUR HANDS A REPORT TITLED, *CORPORATE RESPONSIBILITY AT UNOCAL, Sep. 1999.* HOPEFULLY, IT INDICATES THEIR DESIRE TO BE A RESPONSIBLE CORPORATION.

PLEASE READ IT IF YOU HAVEN'T.

- OUR *STATEMENT OF PRINCIPLES* HAS BEEN REPLACED BY A SET OF *GUIDING PRINCIPLES.*
- UNOCAL HAS EMBRACED THE *SA 8000 CODE* AND SIGNED ON TO THE REVISED *SULLIVAN PRINCIPLES.*
- UNOCAL HAS ALSO CREATED A *CORPORATE RESPONSIBILITY STEERING TEAM.*
  WE APPLAUD THESE CHANGES AND TAKE CREDIT FOR PUSHING UNOCAL INTO EMBRACING SUCH A CREATIVE INITIATIVE.

HOWEVER, THE MAJOR WEAKNESS OF THIS REPORT NOTED ON PAGE 8, 1ST PARAGRAPH, *"WE WILL CONDUCT AN ANNUAL SELF-EVALUATION OF OUR PROGRESS."*

SELF-EVALUATION IS OBSCURITY. JUST RECALL THE LITANY ABOVE AND KNOW THAT ALL OCCURRED UNDER *SELF-EVALUATION.* THE MISSING ELEMENT THAT WOULD INSURE A TRANSPARENT AND CREDIBLE REPORT IS *INDEPENDENT MONITORING.*

HUMAN RIGHTS IS A BUSINESS ISSUE. IN AN APRIL 5TH AMNESTY INTERNATIONAL REPORT, *"HUMAN RIGHTS --- IS IT ANY OF YOUR BUSINESS?" (NEW YORK TIMES, BUSINESS SECTION),* THE REPORT CONCLUDES THAT IF COMPANIES DO NOT ADDRESS HUMAN RIGHTS ISSUES, THEY FACE A NEW KIND OF CORPORATE RISK WITH OPERATIONS, REPUTATION, RETENTION OF QUALITY EMPLOYEES AND SHAREHOLDERS.

AND INDEED, A SURVEY OF FORTUNE 500 COMPANIES NOTED THAT 36% OF THE RESPONDENTS "HAVE DECIDED NOT TO PROCEED WITH A PROPOSED INVESTMENT PROJECT BECAUSE OF CONCERNS OVER HUMAN RIGHTS ISSUES" AND 19% "HAVE DISINVESTED FROM A PARTICULAR COUNTRY BECAUSE OF CONCERNS" ABOUT HUMAN RIGHTS.

WE BELIEVE THAT IN ORDER TO RECOVER OUR SOUL, AN ABSOLUTE REQUIREMENT IS TO SERIOUSLY CONNECT EXECUTIVE COMPENSATION WITH A VERIFIABLE ACTIVE COMMITMENT TO OBEY THE *GUIDING PRINCIPLES.* THIS CAN ONLY BE ACCOMPLISHED THROUGH INDEPENDENT MONITORING.

ROGER, YOU STATE THAT, "IT IS ONE THING TO SET HIGH STANDARDS OF BUSINESS CONDUCT, WE MUST ALSO LIVE BY THEM." WELL, WHY DON'T WE?

ROGER, IT IS NOT A QUESTION OF A DIFFERENCE OF OPINION BETWEEN US; IT IS A MATTER OF ETHICS, OF MORALITY. OUR COMPANY RUNS NAKED BEFORE THE PUBLIC WITHOUT A SOUL. IT IS TIME TO CHANGE.

MY FELLOW SHAREHOLDERS, WE ASK THAT YOU SUPPORT THIS RESOLUTION BY VOTING YES ON ITEM #5.

THANK YOU.

COMMENT ON ITEM #5 - RELATING TO EXECUTIVE COMPENSATION BY DOCTOR TOM LEE

MR. BEACH IT SEEMS TO ME THAT YOU SPEND AN ENORMOUS AMOUNT OF TIME TALKING ABOUT ONE HALF OF ONE PERCENT OF THE CONSORTIUM'S SPENDING ON HEALTH CARE, PIG AND FISH FARMS AND SCHOOLING ALL GOODS IN THEMSELVES WHILE SAYING NOTHING OF THE HUMAN RIGHTS VIOLATIONS ORIGINATING FROM THE REMAINING 1.2 BILLION DOLLAR EXPENDITURE IN THE CONSTRUCTION OF THE PIPELINE.

- WE ARE VERY MUCH AWARE THAT PONTIOUS PILATE'S WASHING OF HIS HANDS AFTER CONDEMNING CHRIST TO HIS PASSION AND DEATH DID NOT RELIEVE HIM OF HIS GUILT NOR HIS RESPONSIBILITY;
- WHY DO YOU WASH YOUR HANDS WITH THE ONE HALF OF ONE PERCENT ARGUMENT AFTER CONDEMNING EITHER DIRECTLY OR THOUGH SILENCE THE PASSION AND DEATH INFLICTING UPON THE KAREN AND MON IN BURMA?

WHILE I WROTE ALL OF THE ABOVE, TOM LEE, A BURMESE DOCTOR WHO CARED FOR THE BURMESE REFUGEES IN THAILAND WHO MIGRATED FROM THE PIPELINE AREA REPLACED THE TWO BULLET POINTS WITH SOME OF HIS LIVED EXPERIENCES. STRONGLY CHALLENGING BEACH'S ANSWERS, ALL BEACH REPEATED WAS, "THERE WERE NO HUMAN RIGHTS VIOLATIONS ON OUR PROJECT AND THAT'S A FACT."

QUESTION AND ANSWER PERIOD

COMMENT BY BETSY APPLE, ESQ. WOMEN'S RIGHTS PROJECT DIRECTOR, EARTHRIGHTS INTERNATIONAL, THE ORGANIZATION PROVIDING THE MAJOR PORTION OF THE DATA BEING USED AGAINST UNOCAL IN THE ANTICIPATED TRIAL.

I DON'T HAVE HER PRINTED OUT COMMENT. SHE CHALLENGED ROGER ON FORCED LABOR ON THE PIPELINE. ROGER RESPONDED WITH THE FACT THAT LABOR WAS PAID FOR AND THEREFORE LEGAL. BETSY THEN PROCEEDED TO INFORM ROGER THAT PAID WAGES HAS NOTHING TO DO WITH FORCED LABOR. INTERNATIONAL STANDARDS STATE THAT FORCED LABOR IS THAT LABOR IN WHICH ONE HAS NO CHOICE BUT TO COMPLY – PAYMENT HAS NOTHING TO DO WITH FORCED

LABOR. THAT SEEMED TO SLOW DOWN ROGER AND OTHERS. BUT AGAIN ROGER WENT INTO HIS, "THERE WERE NO HUMAN RIGHTS VIOLATIONS ON OUR PROJECT AND THAT'S A FACT."

COMMENT BY FATHER LA MAR CONCERNING THE "FATHER TIMM" REPORT.

MR. BEACH YOU SEEM TO RELY HEAVILY ON THE FATHER TIMM REPORT TO BLESS UNOCAL'S HUMANITARIAN PRESENCE IN THE PIPELINE AREA OF BURMA.

- SINCE HUMAN RIGHTS EXPERTS HAVE TRASHED THE TIMM REPORT FOR ITS NUMEROUS PROCEDURAL VIOLATIONS WHICH HAVE COMPROMISED THE VERACITY OF THE REPORT.
- AND INDEED, IN A WRITTEN RESPONSE TO MY REQUEST FOR PRAYERFUL SUPPORT PRIOR TO ENTERING THE 1998 SHAREHOLDER MEETING, FATHER TIMM WROTE, I SHALL INDEED PRAY TO THE HOLY SPIRIT THAT JUSTICE IS DONE, SINCE I WANT TO GET MY INNER PEACE BACK.

ROGER, WHY DO YOU CONTINUE TO PRESENT THIS FAULTED REPORT ON YOUR WEB PAGE AND/OR SEND IT OUT TO INVESTIGATIVE AGENCIES AS A WHITEWASH FOR YOUR ACTIONS IN THE PIPELINE AREA?

ROGER BEACH DENIED THAT IT WAS A FAULTED REPORT STATING THAT THE INSPECTION TEAM WAS FREE TO GO ANYWHERE THEY WANTED TO GO.

> LATER INFORMATION INDICATES THAT THERE WAS A FIGHT BY OTHERS ON THE TRIP [UNMENTIONED IN THE ORIGINAL REPORT] WHO FOUGHT TO GO TO UNANNOUNCED LOCATIONS. THE FIRST DAYS TOUR COULDN'T BE CHANGED BUT THEY WERE ALLOWED TO GIVE A DAYS NOTICE ON ANY OTHER LOCATION TO VISIT. WHEN THEY VISITED THOSE NAMED LOCATIONS THE FOLLOWING DAY, THINGS WERE NOT AS ROSY AS THEY WERE THE PREVIOUS DAY. I WAS UNAWARE OF THIS UNTIL MAY 29, 2000.

PRESS RELEASES

For Immediate Release
May 19, 2000

Media Contacts: Heidi Quante: 323-653-4571
On May 22, Pam Wellner, cell: 415-730-0105

Angry Demonstrators to Mass at Unocal Annual Meeting

Company Connection to Burma Human Rights Abuses Continues

May 19, 2000 - Brea -- On Monday, May 22 at 9:00 am at Unocal's Hartley Center, 376 S. Valencia, Brea, CA, a diverse coalition of labor, religious, Burmese, human rights and shareholder activists will protest at Unocal's annual shareholder meeting. A unique and boisterous display will highlight Unocal's ties to human rights and environmental abuses in connection with their natural gas pipeline in Burma.

Unocal's partners in the gas pipeline project include the Burmese junta and France's TotalFina. Burmese democracy leader and Nobel Peace Laureate Aung San Suu Kyi this week blasted the joint venture, "Total knew what it was doing when it invested massively in Burma while others withdrew from the market for ethical reasons. The company must accept the consequences. The country will not always

be governed by dictators."

Shareholders have introduced a resolution that would link executive compensation with the company's ethical and social performance, including their involvement in Burma. Unocal and its top executives, CEO Roger Beach and former President John Imle, are being sued in Federal Court by Burmese citizens who allege that they suffered torture, slave labor and other abuses at the hands of the Burmese military providing security for the gas project.

Recently declassified US State Department documents, reveal Joel Robinson, a Unocal employee admitting, "Š the companies have hired the Burmese military to provide security for the project." Internationally condemned, the Burmese military is known for its widespread human rights abuses such as forced labor, torture, extortion and murder. "Unocal and Total choose to ignore and cover up human rights abuses. Their callousness towards this most horrendous situation is the shame of the company, its executives and board members," said Pamela Wellner of Free Burma: No Petro-Dollars campaign. "The world will neither look away nor forget."

A newly released report, by EarthRights International, "Total Denial Continues", chronicles the continued abuses by SPDC troops in the pipeline region and Unocal's knowledge of such acts. In the report, a villager describes the forced portering of supplies for the troops guarding the pipeline project construction, "The loads we had to carry were very heavy, and the soldiers were always shouting at us. One of the villagers stepped on a mine, lost his leg, and died. Along the way, there was shouting, swearing, and some people were crying. People could not carry anymore, but they had to because of the SLORC soldiers. . . . [W]e were like slaves."

Unocal's Burma pipeline is not their first experience with slave labor. According to Mel Weiss, a prominent class-action attorney suing US companies on behalf of Nazi-era slaves, Unocal used slave labor in Nazi Germany, for the manufacturing of technical and medical oil during the entirety of W.W.II.

The Brea demonstration is endorsed by the LA County Federation of Labor, AFL-CIO and the Southern California Fair Trade Network, as well as the Paper Allied Industrial Chemical and Energy Workers - PACE, local 8-675. Available on-site for interviews are shareholder Father Joe La Mar of the Maryknoll Fathers and Brothers, Naw Mu Si, woman of the Karen ethnic group who documented abuses in the pipeline region and, David Campbell, Trade Union representative.

FOR IMMEDIATE RELEASE
May 20, 2000

CONTACT:
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MARYKNOLL CHALLENGES UNOCAL TO OBEY ITS *GUIDING PRINCIPALS BY* CONNECTING EXECUTIVE PAY WITH PROVEN ADHERENCE TO ITS CODE.

MARYKNOLL, N.Y. - Maryknoll Fathers and Brothers will present a shareholders' resolution at Unocal Corporation's annual meeting on May 22 at Brea, California seeking to connect executive salaries with adherence to their public code of conduct *(Guiding Principles).* Father Joseph P. La Mar, M.M., Assistant Treasurer and head of the Office of Corporate Social Responsibility will represent Maryknoll and ten additional religious organizations having a combined ownership of over 360,000

shares in Unocal common stock.

Initial shareholder challenges to Unocal were concerned about their operations and connections with an illegal military junta that shot its way to power in Burma in 1990. The U.S. government, the United Nations and the International Labor Organization have found the military government of Burma responsible for a myriad of egregious human right violations. These abuses include forced labor, suppression of a democratically elected government, suppression of individual political rights, torture, rape and discrimination against ethnic minorities.

A worldwide examination of Unocal's operations raises questions about their allegiance to a code of conduct, named *Guiding Principles.* An historic overview of their human and environmental rights violations, with the Lubicon Indians in Canada, environmental damages in California and Pennsylvania, partnering with and lobbying for a government notorious for human rights violations, drug production and sales, attempted operations in Afghanistan -- well known for human rights violations against women and recently, a report that Unocal, "had plants in Germany or occupied countries during W.W.II where forced or slave labourers were used," indicates a failure in adhering to their *Principles.*

A major court action against Unocal for alleged participation in these violations is nearing closure. This lawsuit has the potential for restricting any responsible U.S. Corporation from entering communities or countries where human rights violations are widespread.

Father La Mar stated, "It appears that Unocal has lost its soul. It has obviously failed to live up to its *Guiding Principles* and justifies its exploratory activities with the oft repeated argument of Constructive Engagement." "In Burma, Constructive engagement could be understood as trickle down economy whereby economic well being of the rich and powerful would eventually trickle down to the peasant presently used in forced or slave labor to insure that the rich have the money to begin the cycle." (Fr. La Mar)

Maryknoll Fathers and Brothers, the Catholic Foreign Mission Society of America, a member of the Interfaith Center on Corporate Responsibility, an organization of 287 religious organizations of Protestant, Catholic and Jewish persuasion challenge U.S. Corporations to live within and respect the social community who work in their plants, buys their products, grows from its presence, nurtures the environment and offers profit to its shareholders.

Maryknoll challenges corporate abusers based on documents authored by Vatican Council II and The National Council of Catholic Bishops, which assert that an informed conscience cannot accept the incongruity of individual corporations having the freedom to do business with violators of human rights.

Maryknoll, the U.S.-based Catholic missionary movement, has been representing U.S. Catholics in overseas mission since 1911, and currently serves in 30 countries worldwide. For more information on Maryknoll, consult the World Wide Web at www.maryknoll.org

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For Immediate Release
May 22, 2000

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Photos and Video Available

PROTESTERS HAVE UNOCAL UP A TREE AT ANNUAL MEETING

May 22, Brea, CA - Tree-sitting demonstrators, giant puppets, Burmese drummers, environmental, labor and pro-democracy activists converged today at the annual shareholders meeting of the Unocal Corp., furious at the company's partnership with Burma's military dictators, as well as its poor environmental record.

A heavy security presence failed to stop two Free Burma advocates Colette Mercier and Mehmet McMillian from scaling 60' pine trees in front of company headquarters. Unocal security hauled down a guide rope to prevent the unfurling of a banner reading "Burma Slaves/Shame of Unocal." The climbers occupied the site for hours, encouraged by shouting demonstrators.

Giant figures of Unocal CEO Roger Beach and a Burmese General looked on as protesters re-enacted the May 27, 1990 elections in which Burmese voters overwhelmingly rejected military rule, giving more than 80% of the seats to the party of Nobel Peace Laureate Aung San Suu Kyi. The Burmese military quashed the results of the election, and have imprisoned, tortured and harassed the winning candidates.

CEO Beach was unrepentant when shareholders condemned Unocal's Burma investment for financing the reign of terror of the junta. Thousands of soldiers have been shifted to the area of the Unocal natural gas pipeline, and human rights abuses there have been widely documented, as they have throughout the country. "The Myanmar government has the right to protect their assets, and they did not commit a single human rights abuse," said Beach. LA physician Dr. Tom Lee countered that comment with his eyewitness description of the Burmese army protecting Unocal's assets with rape, burned villages and landmines.

"Since this is a joint venture between Unocal and the junta, Beach is condoning the use of forced labor, forced relocation and massacre, all routine practices of the security forces in the area," said Edith Mirante, author of "Burmese Looking Glass." "To suggest that the Burmese Army, notorious worldwide for raping and plundering, could pour thousands of soldiers into the area to protect Unocal's investment without committing 'a single human rights abuse' is both ludicrous and contemptible."

Beach's claim also contrasted with a mea culpa offered last week by the Chief Executive of Britain's Premier, Ltd., operators of a parallel pipeline in Burma. Premier's CEO Charles Jamieson said, "It is not just human rights but environmental [abuses], too " Other major oil companies, including ARCO, Texaco and Amoco have already withdrawn from Burma.

Shareholder activists received more than 16% of the vote on a proposal to tie executive compensation to the company's ethical and social performance. "This is more than double the vote we got on last year's resolution," says Larry Dohrs of the Free Burma Coalition. "It shows that concern among shareholders over Unocal's horrible reputation is rising rapidly."

EarthRights International, co-filers of a Federal lawsuit against Unocal, also today released a report titled "Total Denial Continues" that provides proof of Unocal's awareness of forced labor and other crimes on its pipeline project. See <www.earthrights.org>.

FOR IMMEDIATE RELEASE
May 22, 2000

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UNOCAL SHAREHOLDERS DOUBLED LAST YEARS VOTE AGAINST THE COMPANY ON A RESOLUTION SEEKING TO CONNECT EXECUTIVE PAY WITH ADHERENCE TO ITS GUIDING PRINCIPLES.

MARYKNOLL, N.Y. – Father Joseph P. La Mar, M.M., Assistant Treasurer and head of Maryknoll's Office of Corporate Social responsibility was elated with the 16.4% vote received at

Unocal's shareholder meeting on a resolution seeking to connect executive salaries with adherence to their public code of conduct *(Guiding Principles)*. The higher vote, more than double last year's vote, indicates a dramatic increase in shareholder dissatisfaction with the companies attitude towards human and environmental rights.

Father La Mar presented the resolution on behalf of the Maryknoll Fathers and Brothers, The Adrian Dominican Sisters, the National Council of Churches of Christ in the USA, the Priests of the Sacred Heart, the Sisters of Charity of the Incarnate Word, the Sisters of Charity of St. Elizabeth, the Sisters of Charity New York Mount St. Vincent-On-Hudson, the Sisters of Mercy of the Americas, the Sisters of St. Joseph of Carondelet, the United Methodist Church General Board of Pensions and Health Benefits and As You Sow Foundation. These eleven organizations have a combined ownership of over 360,000 shares in Unocal common stock.

Initial shareholder challenges to Unocal were concerned about their operations and connections with an illegal military junta that shot its way to power in Burma in 1990. The U.S. government, the United Nations and the International Labor Organization have found the military government of Burma responsible for a myriad of egregious human right violations. These abuses include forced labor, suppression of a democratically elected government, suppression of individual political rights, torture, rape and discrimination against ethnic minorities.

A worldwide examination of Unocal's operations raises questions about their allegiance to a code of conduct, named *Guiding Principles*. An historic overview of their human and environmental rights violations, with the Lubicon Indians in Canada, environmental damages in California and Pennsylvania, partnering with and lobbying for a government notorious for human rights violations, drug production and sales, attempted operations in Afghanistan -- well known for human rights violations against women and recently, a report that Unocal, "had plants in Germany or occupied countries during W.W.II where forced or slave labourers were used," indicates a failure in adhering to their *Principles*.

A major court action against Unocal for alleged participation in these violations is nearing closure. This lawsuit has the potential for restricting any responsible U.S. Corporation from entering communities or countries where human rights violations are widespread.

Father La Mar stated, "It appears that Unocal has lost its soul. It has obviously failed to live up to its *Guiding Principles* and justifies its exploratory activities with the oft repeated argument of Constructive Engagement." "In Burma, Constructive engagement could be understood as trickle down economy whereby economic well being of the rich and powerful would eventually trickle down to the peasant presently used in forced or slave labor to insure that the rich have the money to begin the cycle." (Fr. La Mar)

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PRESS REPORTS

May 21, 2000 (AP)
Shareholder resolution seeks to link executive pay to social, ethical issues
MICHAEL WHITE, AP Business Writer

(05-21) 13:58 PDT LOS ANGELES (AP) -- Activists protesting Unocal Corp.'s involvement in a Burma natural gas pipeline Monday will present shareholders with a resolution seeking to link executive compensation to the company's record on human rights and other ethical issues.

The move comes as the company holds an annual stockholders meeting that promises to be one of Unocal's most optimistic in recent years.

The company is benefiting from high crude oil prices, and last week won key ruling in a patent infringement lawsuit that could reap the company hundreds of millions of dollars over the next few years.

The meeting also will be the target of protesters angered by Unocal's involvement in the Yadana pipeline, a $1.2 billion conduit that carries gas from wells off Burma's coast to customers in neighboring Thailand.

Unocal owns 28 percent of the project, which was completed in 1998. Paris-based Total Fina Elf operates the pipeline and is the largest partner with a 31 percent share.

At every shareholders' meeting since 1994, activists have introduced resolutions seeking Unocal's withdrawal from the project at shareholder meetings since 1995, and each has been soundly defeated. Supporters hope this one will carry more weight because it focuses not on Burma specifically, but general issues of corporate ethics.

"The idea is for a reform movement within Unocal, both on an ethical basis and the whole way that management does business," said Edith Mirante of Free Burma.

The resolution is supported by 11 religious groups, including Maryknoll Fathers and Brothers, which together hold 360,000 Unocal shares, said the Rev. Joseph Lamar, a Maryknoll priest who will introduce the resolution.

Unocal's critics contend that members of Burmese minority groups have been subjected to relocation and forced labor because of the pipeline. Some have been killed by Burmese military forces, they contend.

Barry Lane, a spokesman for Unocal, said the company has investigated the allegations, and has been unable to find any evidence of relocations or murder. Total officials discovered several years ago that the military was using unpaid porters in its operations to support the pipeline, but the practice has since stopped.

"We would not tolerate the use (of) forced labor anywhere around the pipeline project," Lane said. "So basically the military discontinued its practice."

"This debate's been going on for more than a decade," Lane said. "Fundamentally the debate is over whether engagement or isolation is the way to achieve social and political change. Based on our experience in Asia, we think engagement is the proper way, the effective way of favoring a more open society. There are others who disagree with us."

Lamar acknowledged that his resolution has no chance of getting the 51 percent vote needed for approval. Such resolutions rarely influence shareholders, analysts said.

The measure would create a panel to determine whether Unocal executives were abiding by the company's guidelines for social responsibility.

The panel likely would have problems establishing benchmarks for assessing whether an executive's pay should be cut, said Judith Fischer, publisher of the newsletter Executive Compensation Reports.

"It's a pretty subjective thing. I don't imagine it would have much appeal," she said. "Social concerns aren't among the most popular shareholder resolutions."

Brea Unocal Meeting Is Protested
By MAI TRAN, Times Staff Writer
Tuesday, May 23, 2000
Orange County Edition
Section: Metro
Page: B-3

A rowdy crowd wearing masks and black clothes to represent death banged wooden drums early Monday outside a Brea-based oil conglomerate, shouting "Unocal out of Burma!" while security officers stood guard and passing drivers honked.

The 75 Burmese human rights and labor activists were demanding that the company stop operating a pipeline in Burma, now known as Myanmar.

But at a Unocal shareholder meeting inside, investors batted down a resolution to link the compensation and bonus packages of Unocal's executives to the company's ethical and social performance.

At issue is Unocal's investment of $1.2 billion in a 150-mile pipeline completed in 1998 that carries gas from offshore wells to customers in Thailand.

Protesters accused the corporation of working with Myanmar troops, who allegedly relocated residents to build the project. Activists say the military rounded up villagers and forced them to work for three weeks at a time, digging ditches, constructing helicopter pads and building roads. Some were beaten, tortured or murdered, activists said.

"We're here to let Unocal and its shareholders know that their blood profit has affected a lot of people and their lives," said Pye Nyein, 38, of Van Nuys. "Unocal continues to profit off murder and rape and slavery, and we're not going to stand for it."

Unocal spokesman Barry Lane said the corporation is an investor with only 28% interest in the project, and had no control over its construction or operation.

He denied that villagers were chased out of their homes, and said no slave labor was used. Instead, he said, the project has led to better living conditions, bringing doctors, schools, roads, water and sanitation systems to the 40,000 people living in the area. The corporation's 30-year contract included

2,500 construction jobs, and now 75 people are in training to operate and monitor the pipeline.

Despite shareholders' rejection of the initiative that the demonstrators backed, activists were pleased that 16% supported their position, up from 8% the previous year.

"We are raising awareness," Nyein said. "and the numbers show that there are people who are realizing there are human rights violations."

Los Angles Times

Tuesday, May 23, 2000

Unocal Shareholders Meeting Draws Protesters

Protesters hoisting puppet effigies and making passionate pleas failed to persuade stockholders of Unocal Corp. to tie executive pay to the company's human rights record. About 75 protesters gathered outside the company's satellite office in Brea, banging on empty oil drums and holding signs urging, "Unocal out of Burma" – a reference to the company's participation, in the Yadana pipeline, a $1.2 billion conduit that carries gas from wells off the coast of Myanmar-formerly known as Burma-to customers in Thailand. Inside at the company's annual shareholders meeting, activists accused the company of ignoring reports that the Myanmar government forcibly relocated residents and used slave labor in conjunction with the pipeline's construction. The charges were strongly denied by Unocal Chief Executive Roger Beach. "There were no human rights violations on our project and that's a fact," Beach said 'A resolution that sought to tie executive compensation to an annual, independent review of the company's compliance with social responsibility, guidelines failed, garnering 16.4% of shareholder votes. The resolution was supported by 11 religious groups, which together hold 360,000 Unocal shares. Shares of El Segundo-based Unocal fell 38 cents to close at $37.50 on the New York Stock Exchange. *(Associated Press)* •

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Anatomy of a Bankruptcy

Crying wolf?

Thursday, January 21, 1999

It was certainly not the only reason for AHERF's stunning collapse.

But like all health systems in the late 1990s, the Allegheny Health, Education and Research Foundation suffered from curbs in the growth of federal Medicare reimbursements and cuts in the Medicaid payments that Pennsylvania funds in partnership with the federal government.

At the same time, more and more people with private insurance were being shifted into some form of managed care plan. Those plans not only seek discounts on hospital fees, they also try to curb hospital admissions, lengths of stay and costly specialty treatment. Coupled with technology that makes many more medical treatments available on an outpatient basis, managed care disciplines helped empty a lot of hospital beds.

Together, the government and private attempts to rein in health care spending have put hospitals in an entirely different economic environment than they once had.

With all that said, it's almost impossible to quantify the actual dollar impact of changes in Medicare and Medicaid for the hospital industry, much less any single institution.

Under the federal Balanced Budget Act of 1997, Congress did not make actual cuts in Medicare spending. It reduced the rates of increase in spending that had previously been projected.

Hospital industry representatives have said the constraints are already hurting them, but some analysts are skeptical. The trade magazine Modern Healthcare reported in its January 11 edition that the nation's hospitals, in aggregate, posted a record profit for the fiscal year ended in June 1997, the latest for which figures are available, and that aggregate profit margins hit 6.6 percent, the second-highest level ever. The magazine attributed part of the robust showing to Medicare business, on which the overall margin was 16 percent.

Sorting out the effect of changes in Medicaid _ part of an overhaul of

Pennsylvania's welfare programs that took effect in July 1997 _ is more complicated.

Although the debate over the impact goes on, even analysts in the Pennsylvania Department of Public Welfare estimated as recently as August that welfare reform made 95,000 former recipients ineligible for Medicaid, meaning that hospitals probably saw more non-paying patients show up at their doors.

In addition, the state began shifting Medicaid's remaining beneficiaries into private managed care plans.

The Hospital and Health Systems Association of Pennsylvania has estimated that the changes cost Philadelphia hospitals some $75 million in revenues in the first 11 months after they were initiated.

According to a state House Appropriations Committee staff analysis, the medical assistance cuts resulted in a 2.7 percent reduction in patient revenues for AHERF's Delaware Valley hospitals and a 1.25 percent reduction for the foundation's Western Pennsylvania hospitals.

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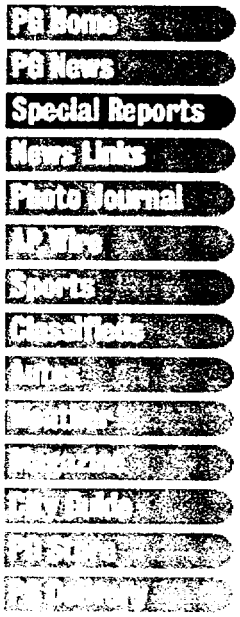

Anatomy of a Bankruptcy

Share the risk, share the pain

Thursday, January 21, 1999

The concept was a novel one to Western Pennsylvania hospitals nearly two years ago when AHERF entered a "risk-sharing" contract with HealthAmerica, the region's second-largest managed care insurer.

Insurers, of course, have always been in the business of taking financial risk. Not so for hospitals. Under the new agreement, however, AHERF's hospitals, in effect, took on some of the insurer's function.

Hospitals engaged in "risk-sharing" give up the traditional promise of fees for every service they provide and every treatment they perform. Instead, they accept a fixed price, usually a percentage of the premiums a health plan charges its members, for all of the treatments and services that those members will need.

By doing so, the hospitals expose themselves to the same risk the insurer takes: that the health care may cost more money than they receive.

There is, of course, an upside, or hospitals would never sign these pacts. Just as insurers may take in more premium dollars than they expend on claims, the hospitals may get more money from the insurers than they have to spend on treatments and services. That is especially true if they have lean overhead and treat patients in the most cost-effective ways.

That was not the case for AHERF. The foundation has acknowledged that the risk-sharing contracts it signed here, with HealthAmerica, and in Philadelphia, with U.S. Healthcare and Independence Blue Cross, incurred steep losses.

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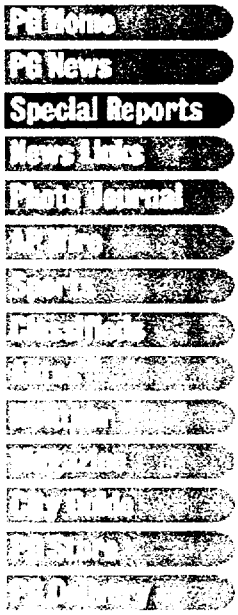


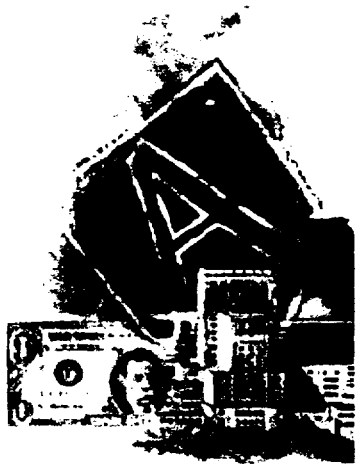
Anatomy of a Bankruptcy

Part 5: Burning down the house

Friday, January 22, 1999
By Steve Massey, Post-Gazette Staff Writer

As the new dean at the Allegheny health system's School of Nursing in Philadelphia, Gloria Donnelly wanted to do something special.

Lured from LaSalle University in 1996 by more money and the challenge of working for a large, seemingly solid institution, she embraced an idea to celebrate the 150th anniversary of Allegheny's Hahnemann medical school not with a big bash, but by raising money for a local program that helps care for inner-city youth.



What better way to send a message about what Hahnemann and Allegheny were all about, Donnelly thought. The top Allegheny brass were enthusiastic about it, too.

So Donnelly and her staff pledged money to the program — Donnelly alone gave $4,000 through a payroll deduction plan.

There was only one problem. When Donnelly checked a year later, she found the money was never spent on the inner-city project.

To this day, Donnelly's not sure where it went.

She's not alone.

From comparatively small sums like Donnelly's to ones in the tens of millions at the Allegheny Health, Education and Research Foundation's own hospitals, money seems to be missing. Substantial amounts of

money.

While federal and state investigators are still probing its financial affairs, the parent organization has admitted to withdrawing at least $50 million from endowments and other donor-restricted accounts at its scattered affiliates during the last year before entering bankruptcy.

The actual sums are likely to be far higher, if Forbes Health System and Allegheny Valley Hospital are any indication. The pair say the parent foundation raided $65.2 million from funds they had set aside to finance building acquisitions and renovations before joining the Allegheny system in 1997.

And, they maintain, the raid was orchestrated by AHERF Chief Executive Officer Sherif Abdelhak and his finance lieutenant, David McConnell, at a time the parent company was desperately looking for cash. Abdelhak and McConnell, who were ousted last spring, have repeatedly declined all requests for interviews.

Forbes and Allegheny Valley had joined the Allegheny system largely because they already had a working relationship with Allegheny General. The three were part of a network of community hospitals that the parent company formed to contract with managed-care insurers for business.

By merging, the two hoped the Allegheny network could consolidate accounting and other administrative functions, thus reducing costs and boosting profit margins to better compete with the fast-growing UPMC Health System.

Unfortunately, the combination also allowed the parent foundation to get its hands into the pockets of Forbes and Allegheny Valley. Both had taken steps to protect themselves. Before agreeing to the merger, they insisted on a pledge that their restricted funds would be left alone. And it is just these funds, Forbes and Allegheny Valley say, that the parent foundation raided.

Similarly, but on a smaller scale, the heads of several foundations and hospital research projects in Philadelphia have complained that millions of dollars appear to be missing from their endowments. And the Allegheny General Nursing Alumni Association says its bank accounts have been depleted of almost $500,000.

It's clear that Allegheny needed the money — years of operating in the fast lane while the caution flag was out, had finally caught up with it — and it didn't really view its actions as all that different from what it had done in the past.

Over the years, Abdelhak would familiarize himself with the fine print governing endowments and other donated funds to determine how the

money was to be used and whether there was a way to use it for other purposes if necessary. The foundation also took money out of idle or little-used accounts, with the view that the borrowings represented loans that would be paid back.

A centralized cash-management system made it all the easier to shift the money around. Indeed, Allegheny was notorious for transferring funds among scattered affiliates, making it almost impossible for even veteran accountants, much less board members who'd meet just a few times a year, to keep track of it all.

"Stuff was moved back and forth so fast that we never saw the dollars missing," says a longtime director who sat on both Allegheny General's and its parent foundation's boards. "We had a cash problem for three or four years and didn't really know it."

It's not hard to understand why it was so hard to track the money.

There were dozens of Allegheny hospitals and affiliates and scores of accounts. Many subsidiaries and even the parent habitually filed tax and financial reports late. AHERF didn't file its 1997 taxes until mid-May of 1998, 11 months after the end of the fiscal year. A report to bondholders, disclosing loan violations at its Philadelphia affiliates, wasn't ready for 210 days, 120 days after it was due. And only in the past year did the Allegheny system compile a consolidated financial report for all its subsidiaries. Before, only reports on each individual subsidiary were available.

Even then, understanding the financial reports was a task. Allegheny administrators were masters at masking troubles, relying on creative bookkeeping, relaxed disclosure rules for nonprofit hospitals and misleading public statements to keep inquiries in check.

Allegheny General is a good example.

In fiscal 1996, it quit breaking out operating results in its annual financial statement, which was allowed by accounting laws. But the switch from what it had previously done hid operating losses — what it lost on day-to-day operations before factoring in interest and other investment income.

In 1996, operating losses totaled more than $20 million, and actually were closer to $40 million if one-time gains are excluded. The year before, operating losses topped $13 million, but Allegheny General

didn't disclose that fact until 1997 — in a footnote in an obscure report to bondholders disclosing that 1995's results had been restated. And the footnote didn't even say the restatement resulted in an operating loss. Readers were left to do the math themselves.

Analysts at Moody's Investors Service, the bond-rating agency, have expressed exasperation at Allegheny's financial statements, saying the reports were among the most confusing and complicated they had ever seen. And they were stunned to uncover $117 million in loans to the Philadelphia operations classified as investments in 1997's financial statements. The quality of the 1997 statements is so poor that even the parent foundation has since renounced them, saying they overstated assets by $123 million.

The accounting gimmickry didn't catch everyone by surprise.

Since 1991, when Joseph Donnelly, a former corporate controller at Allegheny General's parent company, resigned, Allegheny General and its related affiliates have experienced a handful of finance-department defections by high-level individuals concerned that caution was being thrown to the wind.

In many ways, the organization was simply reflecting the personality of its top financial officer, David McConnell. A race-car driver and owner of a kit-car company, McConnell took pride in pushing the envelope. He'd find out what was legally allowable and stay within those parameters. But he didn't have any problem bumping up against the limits and would order subordinates to do whatever it took to make the numbers work.

A former Mellon Bank loan officer, who wouldn't sign off on a loan McConnell and Abdelhak wanted for a new garage at Philadephia's St. Christopher's Hospital for Children, recalls a nasty meeting with the pair in 1992. McConnell was almost belligerent, the loan officer says, and Abdelhak was just as bad. At the end of the meeting, Abdelhak threatened to pull Allegheny's business from Mellon if it didn't get the loan. The loan officer didn't back down, and the threat proved idle. Allegheny continued to do business with Mellon, which handled much of the health system's investments and had representatives on Allegheny's board.

The gung-ho, cutthroat accounting approach was a sharp departure from the 1980s, when Allegheny General was conservative, almost stingy, with its books. Then, for example, it would low-ball estimates of accounts receivable — primarily money owed it from insurers — arguing that it was prudent to be cautious because insurers were cracking down on reimbursements. The reality was the estimates were still low, but it allowed AGH to build reserves as more money came in than estimated.

Snapshot of AHERF
Spring 1998

Employees: 29,500
Revenue: $2.05 billion
Assets: $2.6 billion
Debt: $1.18 billion
Inpatient admissions: 128,388

* Based on Allegheny Health Education and Research Foundation and tax documents

Allegheny General used to be careful in other ways, too. It would designate funds for future construction and building improvements that weren't likely or even scheduled to occur. And it took pride in providing lenders with accurate and reliable information about its financial position and projections.

But that began to change after the move into Philadelphia in 1988. The pressure to portray the company in the best possible light increased as the need to issue bonds and obtain bank loans increased.

One-time cash infusions and income boosts, which make the future look brighter at a costs of adding to future obligations, became a way of life.

Separate sale-leaseback transactions for Allegheny General's North Side office buildings and parking lots in 1996 — in which the hospital agreed to sell the facilities to investors and then lease them back under long-term agreements — grossed $61 million and generated gains in excess of $23 million, but also obligated AGH to more than $100 million in future lease payments.

In September 1997, just before it lopped 1,200 workers off its Philadelphia payroll, the parent foundation entered into a financing agreement with GE Capital Public Finance, a lightly regulated lender of last resort, for up to $30 million for the lease and purchase of equipment. Leasing required less up-front outlays.

And in the merger with Forbes Health System and Allegheny Valley Hospital, the Allegheny health system took advantage of Medicare accounting law provision that lets hospitals recover a portion of merger-related costs from the government. The move, which required it to write down the value of Forbes and Allegheny Valley's real estate holdings, resulted in a one-time addition to income of $7 million.

But all the one-time maneuvering to raise more cash and boost income was not enough. By late 1997, the combination of declining government

reimbursements, increasing managed-care pressures, a bungled Philadelphia expansion and poorly managed ventures into insurance and doctors' practices had resulted in losses of nearly $1 million a day.

Going to the bond markets, where Allegheny and its acquired affiliates had raised more than $1 billion over the previous decade, was no longer an option. Credit ratings on its Philadelphia operations were at junk-bond levels, and the North Side flagship was headed that way, too. Banks also were balking. The more they poked and probed, the more they uncovered a disaster waiting to happen.

Frank Cahouet, the retiring Mellon Bank chairman who would become chairman of Allegheny General in January 1998, was concerned enough about the health of the hometown institution and its Philadelphia operations that he began seeking ways to preserve the North Side flagship if the rest of the empire crumbled.

There was one possible option.

Vanguard Health Systems, a new Nashville-based hospital operations company founded by a former top executive at for-profit giant Tenet Healthcare and backed with Morgan Stanley & Co. money, was sniffing around. It approached Allegheny in late 1997 about buying a large chunk of its Philadelphia holdings, a move that would free Allegheny of struggling institutions and help it out of the hole it had dug for itself.

It wasn't going be easy to let go. While there was speculation Abdelhak had pursued Graduate with a goal of turning around and selling the Philadelphia holdings to for-profit giant Columbia-HCA, that was never the case, insiders say.

Columbia was shopping around, but Abdelhak still believed in his vision of an empire. And Columbia would soon fall off anyway, caught up in a federal fraud investigation.

But now was different. Nothing Allegheny did seemed to stem the flow of red ink, and everything seemed to be hitting at once.

Doctors and nurses were complaining about short supplies. Vendors were complaining about not getting paid. Lenders were complaining that Allegheny's Philadelphia operations had fallen out of compliance with loan covenants. And unions were balking at suggestions of pay cuts.

There was no more margin for error, no place to turn — except Vanguard. Negotiations intensified, and by March, the pair had cut a deal. Vanguard would buy six of Allegheny's nine Philadelphia hospitals for at least $300 million. The two still had some issues to hammer out, namely a price, but they had some time — directors were told the deal would need to close within 120 days to be viable.

Abdelhak seemed to think it could work. At least that's what he was saying publicly. In March, he maintained that the cuts made the previous fall had brought the Philadelphia hospitals to break-even, and that the Pittsburgh flagship had not been harmed by Philadelphia's troubles.

The public statements, of course, contrasted sharply with the reality of the situation. Behind the scenes, the board could see the deterioration and would act to protect its interests, doubling officers' and directors' liability insurance from $50 million to $100 million in March, and doubling it again in June, to $200 million. Meetings of its executive committee increased to every two weeks, from four a year. In April, the possibility of bankruptcy was even discussed.

Yet in other ways, it was business at usual at Allegheny.

Pay cuts that Abdelhak had vowed management would take often turned out to be nothing more than the elimination of bonuses. Base pay remained the same and in a few cases even increased.

Quarterly meetings of the insurance subsidiary to review malpractice cases continued to be held in pleasing foreign locales. And in March, the board's compensation committee approved a new benefit that effectively let Allegheny's six top executives cash in $8 million in deferred benefits not due them until they resigned or retired — with some of the withdrawals occurring just a day before the bankruptcy filing.

It was a revelation that later outraged hundreds of lower-level Allegheny managers stuck trying to get their benefits from bankruptcy court, as well as nurses and other staffers who'd been forced to work longer hours with little or no pay increase the past few years. It came to symbolize the sense of entitlement that had gripped senior management.

It also tainted Anthony Sanzo, the former Allegheny General CEO who succeeded Abdelhak and who now is trying to hang on to control of the surviving Western Pennsylvania hospitals with the aid of Cahouet. Sanzo was among the top six officers to benefit from the deferred benefits deal.

Two members of the compensation committee, former Dollar Bank Chairman Francis Nimick and former Mellon Chairman J. David Barnes, say they don't recall approving the payout.

Even though the issue had been before the committee for months, William P. Snyder III, who stepped down as Allegheny chairman last fall and who served on the compensation committee, apparently didn't remember either. When the benefit was revealed after bankruptcy, he expressed shock in a statement issued by the parent foundation.

Other members of the compensation committee were former

Westinghouse Chairman Douglas Danforth, who adopted new pay policies at Westinghouse that substantially raised compensation for top officers including himself, and Graemer Hilton, former president of Allegheny International, which went bankrupt, renamed itself Sunbeam and moved out of town.

All members of the compensation committee had a long affiliation with the Allegheny system, and insiders say the committee increasingly acted on its own the past few years, without the knowledge of other board members.

None of it would have mattered much if the Vanguard deal had closed. But by mid-March, a consortium of lenders led by Mellon, was becoming antsy. The Allegheny system wasn't generating enough cash to remain in compliance with the terms of its $100 million line of credit, and at least two of the banks, Toronto Dominion and the Akron, Ohio, affiliate of Columbus-based Bank One, wanted their money back. Each was committed for $24 million, while Mellon's exposure was $28 million.

Weeks of negotiations followed, but when First Chicago, which also had pledged $24 million, decided it wanted out, Mellon was on the hook and demanded repayment. Instead of seeking full restitution by the end of June or preferably September, as Allegheny had wanted, Mellon wanted it now, on April 22. Abdelhak didn't even have time to get board approval. He just let the $89 million owed to the banks go — in violation of board policy requiring him to run all substantial transfers by it first.

Where he came up with all the the money is unclear. But $65.2 million came out of the Forbes-Allegheny Valley accounts that were supposed to be off-limits.

It was Abdelhak's last significant act, one that outraged several directors when they found out.

Cahouet insists he had no knowledge of his bank's action, even though it ate up cash at a time Allegheny could least afford it. Not that it necessarily would have prevented the bankruptcy. Vanguard was growing more circumspect, as its team of inspectors kept finding surprises, and not the good kind.

By late June, Vanguard had nixed the original deal. The pair kept talking, but its decision sealed Allegheny's fate. With money running low and its one potential savior getting cold feet, Allegheny had run out of options.

On July 21, it filed for Chapter 11 bankruptcy, becoming the largest nonprofit health care system failure in history.

Allegheny had achieved national recognition, but hardly the kind that Abdelhak — and Snyder — had envisioned.

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Anatomy of a Bankruptcy

20 largest creditors in Allegheny bankruptcy*

Friday, January 22, 1999

Name	Nature of claim	Amount
1. MBIA Insurance Corp.	insured series of 1996 bonds	$306.15 million
2. Graduate Health System	bondholders, as a group	$160.56 million
3. PNC Bank	note and letter-of-credit for 1996 bonds	$98 million
4. Aetna/U.S. Healthcare	shared-risk contract, premiums	$23.64 million
5. HealthAmerica	shared-risk contract	$16 million
6. Allegiance Healthcare Corp.	medical supplies	$13.4 million
7. Independence Blue Cross	shared-risk contract, premiums	$8.68 million
8. Ernst & Young LLP	consulting services	$6.9 million
9. Amerisource Corp.	pharmaceutical supplies	$3.57 million
10. Shared Medical Systems Corp.	software/consulting	$3.49 million
11. Medtronic Inc.	medical supplies	$2.64 million
12. Guidant	pharmaceutical supplies	$2.29 million
13. IBM Corp.	equipment lease	$2.23 million
14. Siemens Medical Systems Inc.	equipment lease	$1.98 million
15. Deloitte & Touche LLP	consulting services	$1.45 million
16. Qualmed	management services contract	$1.34 million
17. Peco Energy	utilities	$1.22 million
18. Aramark Healthcare Support Service	management services	$1.21 million
19. Health Data Sciences Corp.	patient billing systems	$1.19 million
20. The Hartford	premiums	$1.17 million

*Estimated claims as of July 21, 1998, filing. Total estimated claims have

since grown from $1.3 billion to more than $1.5 billion.

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Anatomy of a Bankruptcy

Part 6: Last dance

Sunday, January 24, 1999
By Mackenzie Carpenter, Post-Gazette Staff Writer

On a crisp fall night two years ago, a glittering party was held at the Priory Inn on the North Side. There was music and dancing and much merriment, all for a good cause: to raise money for Allegheny General Hospital's medical research programs.

It was AGH's annual "Auxiliary Ball'' and Sherif Abdelhak, its president, was there, accompanied by his wife Marlynn. They made a handsome if somewhat unlikely pair as they spun around the dance floor: Marlynn, with her sunny Midwestern good looks, towering over her courtly husband. While never much of a social animal, Abdelhak always seemed to relish these events, seizing the microphone to announce some new project or promotion to delight the crowd.

On this night, however, another side of Abdelhak would emerge. After Mary Warde, the ball's chairwoman and wife of Dr. Donal Warde, found herself having difficulty speaking over some giddy members of the audience, Abdelhak, resplendent in black tie, strode toward the podium.

Then, he leaned into the microphone and in a rough voice said: "SHUT UP."

Some people were shocked. But close associates regarded it as a typical flash of temperament from the man who, in the past 10 years, had transformed Allegheny General from a prosperous but staid hospital into the Allegheny Health, Education and Research Foundation, the largest

health system in the state, and one with national ambitions.

Elegant and well-spoken, sometimes touchingly emotional, the Egyptian-born Abdelhak could become brutal and uncouth if he sensed things were slipping out of control. And in 1996, things were slipping out of control at Allegheny — though few other people knew it. It's not even clear if Abdelhak himself realized that this festive charity ball, honoring the hospital's legion of volunteers, would be one of the last he would preside over as Allegheny's chief.

How much of a role did this man's volatile personality play in the fall of one of Pittsburgh's most beloved institutions? Was Sherif Abdelhak a brilliant visionary who became a victim of a health care market gone haywire and a board of trustees not willing to stick out a rough patch? Or was he a man with delusions of grandeur, who simply didn't know when to stop spending money, even when there was none left to spend, a man who could never admit to making a wrong decision and wouldn't know how to ask for help if he did?

Since June, when he was fired just as AHERF was plunging into bankruptcy, Abdelhak, 52, has firmly removed himself from Pittsburgh's public life. He repeatedly refused requests to be interviewed for this story.

Mystery has always been a big part of Abdelhak's persona, either from genuine reticence or calculation, say many of the dozens of people interviewed for this profile. A few considered themselves to be close associates, even close friends, of Abdelhak's at one time or another.

But none of them could answer this question:

"Who is this man, and how could he have done such a thing?"

Far from home

Of Abdelhak's early life in Egypt, not much is known, except what he chose to tell his associates: that his family, once wealthy, fell on hard times during the country's 14-year transition into socialism under Gamal Abdel Nasser; that his father was the director of Alexandria's railroad system and was divorced from his mother, with whom Abdelhak lived as a teen-ager in Cairo. Life was difficult and uncertain; Abdelhak saw friends and relatives led away in the middle of the night under Nasser's autocratic rule, never to be seen again.

In 1968, Abdelhak graduated from the

American University of Cairo — a school favored by the sons and daughters of the country's elite — with a degree in economics and political science. He excelled in sports. Small, wiry, and extremely competitive, he raced horses, and would later say he had been a soccer star in Egypt — no small achievement in a soccer-obsessed country.

After college, Abdelhak seemed — only temporarily — without direction; there was a 15-month stint as a purchasing trainee at the Gulf of Suez Petroleum Co., followed by 14 months as vice president and general manager of the Salt & Pepper Catering Co. in Cairo.

And then he was gone from Egypt, never to return. Two years after graduation, Abdelhak took off for the United States — with his new wife, Mervat, also an AUC graduate. He had definitely married up in the world. His wife was from a family of some wealth and social status — but she was a Coptic Christian.

"It was so romantic," says one old family friend. "He risked everything to marry her. A Muslim converting to Christianity — well, you risk death doing that. Of course he had to leave." Did he? It's not clear that he faced any such penalty, but Abdelhak never fully explained the reasons for his departure, even to longtime associates. Did he fall in with the wrong political crowd? Did he leave to escape military service?

What Abdelhak has made clear, however, is that he cannot go home again.

Climbing the ladder

In 1971, Abdelhak set out from home for the Texas oilfields in search of work, but he stopped in Pittsburgh for a brief visit with some of his wife's relatives. He saw a classified advertisement for a job at AGH's food service department, applied.

The rise and fall of Sherif Abdelhak

Within 15 years of arriving in Pittsburgh from his native Egypt, Sherif Abdelhak was president of one of Pittsburgh's most prestigious hospitals. Within a decade of that, the one hospital had grown to more than a dozen, with the parent foundation bankrupt.

1946
Sherif Abdelhak is born in Cairo, Egypt.

1968
Receives his B.A. in economics and political science from American University in Cairo.

1968-1970
Employed as a purchasing trainee at the Gulf of Suez Petroleum Co., followed by a stint as vice-president and general manager of the Salt & Pepper Catering Co., Cairo.

1971
Arrives in the United States with his wife Mervat. Abdelhak stops in Pittsburgh on his way to Texas, answers an ad and is hired by Allegheny General Hospital as a purchasing and control coordinator in the hospital's dietetics division. Quickly becomes known as "the fixer."

1973
Less than two years after his arrival at AGH, is made purchasing agent for the entire hospital

1975
Made assistant director of nursing for administration. Some see him as management spy, others as someone who would go out of his way to help colleagues.

1976
After attending classes on

and was hired as a purchasing and control coordinator in the hospital's dietetics division, buying food, silverware, dishwashing soap — whatever it took to provide meals for the institution's patients, staff and visitors.

Thus began his climb from rags to riches, a story that has evolved into legend at AGH. "I had 10 promotions in 11 years and never asked for one," he proudly told an interviewer in 1988. It was typical overstatement from a man whose drive to succeed became quickly apparent.

"I remember the first time I saw him he was working with these big containers of lettuce, standing to see if they were big enough to go through the door," recalls one former colleague. "He didn't really register, but then, I started seeing him pop up in the oddest places. He was just everywhere, it seemed."

In 1973, less than two years after his arrival at AGH, Abdelhak had been made purchasing agent for the entire hospital. For someone with ambition, it was a perfect opportunity: Abdelhak became the man doctors and nurses went to see when they needed that scarce hypodermic unit or EKG monitor.

"He was a fixer," recalls a former hospital administrator. " 'My pleasure,' he would always say when you asked him for assistance. And he would get you whatever you needed. He became very popular that way."

After two years in that role, he was made Assistant Director of Nursing for Administration in 1975. Ostensibly, his job was to serve as a business manager, but other former nursing supervisors saw him more as a foot soldier in the ongoing battle between management and nurses — on management's side.

weekends, receives a master's degree in business administration from the University of Pittsburgh.

1978
Promoted to assistant vice president for AGH.

1979
Made associate vice president for AGH.

1982
After five-month stint as the hospital's chief operating officer, Abdelhak is told by the hospital's new president, John Westerman, to get more "seasoning" elsewhere. In December, is named president and chief executive officer at Canonsburg General Hospital, 16 miles south of Pittsburgh. Under his tenure, the hospital grows into a health "system" and attracts notice for some innovative ideas; but Canonsburg's takeover of West Allegheny Hospital, at Abdelhak's insistence, proves to be a financial misstep.

1986
Brought back to AGH as its president and chief executive officer. One of first acts is to purchase West Allegheny facility, which has been a financial drain on Canonsburg.

1988
Allegheny General strikes an agreement to take control of the Medical College of Pennsylvania. Abdelhak announces he is separated from wife, Mervat. His relationship with Marlynn Singleton, the hospital's director of public relations, becomes public knowledge soon afterwards.

1993
After a cheerfully upbeat speech, Abdelhak surprises an audience at Hahnemann

He'd spy on us. He'd pretend to be my friend, then he'd go and tell the managers everything I'd said. I found out the hard way I couldn't trust him," says one former nursing supervisor who asked not to be named.

Others recall a man who was the first to volunteer to do the dirty job, or stay late, or go out of his way to help colleagues in a bind.

As a new assistant director of nursing in the late 1970s, Norma Gentile recalls having difficulty drawing up staffers' vacation and work schedules. "I couldn't get any supervisors to help me calculate [the] formulas. I went to Sherif [by then promoted to associate nursing supervisor] and he did. That was the kind of person he was."

Not only did he work long hours, he also went to school. In 1976 Abdelhak received his MBA from the Katz School of Business at the University of Pittsburgh, attending classes on weekends.

University Hospital, which has just been purchased by Allegheny, by saying, "Don't cross me, or you will live to regret it."

1994
Hahnemann and MCP are merged to form one medical school. Abdelhak clashes with new employees, saying "If you are loyal to me, I carry you on my back."

1997
Undergoes abdominal surgery in the fall and returns "a changed man," according to associates. Apparently he has had time to look at the numbers and realize that Allegheny is in dire straits.

1998
After a tense spring Abdelhak is told, on Memorial Day weekend, that he is fired.

Even with that punishing schedule, his ascent continued; by decade's end Abdelhak was a hospital vice president. But almost as suddenly, his career stalled when the hospital's president, Lad Grapski, was forced out over a scandal involving his part- ownership in an on-site pharmacy; Grapski was replaced by John Westerman, a smooth-talking academic from Minnesota who politely told Abdelhak, by then the acting chief operating officer, that he should go elsewhere for more seasoning.

It must have been devastating to be so casually dismissed after such a spectacular rise.

At a company retreat in December 1982, Abdelhak told colleagues he was leaving to take a post as CEO at Canonsburg General Hospital, some 16 miles south of Pittsburgh.

And, colleagues recall, he had tears in his eyes.

In the wilderness

In the Western Pennsylvania health care pantheon, Canonsburg wasn't exactly a major player. But Abdelhak quickly saw its potential. The market in northern Washington County was growing, and Canonsburg was building a new facility. The hospital's director had left after a

falling-out with the board of trustees. The board was looking for someone who would shake things up, or, in the words of a doctor who worked there then, "give Washington Hospital fits."

Abdelhak's three-year tenure got mixed reviews. At the height of the recession in the early 1980s, he came up with a plan to provide free health care for laid-off workers. Another Abdelhak brainstorm, which attracted national news coverage, was the hospital's "satisfaction guaranteed" program, in which patients would be given refunds for the cost of meals and other amenities not to their liking (excluding, of course, medical care).

And already, Abdelhak's penchant for acquisition was beginning to show He baffled board members when he talked of buying Fort Pitt Bridge Works, an 85-year-old steel fabricating facility that had shut down in late 1981 after a string of losses. Fort Pitt employees and local officials were still trying to interest new buyers, and Abdelhak thought it had potential as an investment for the hospital.

The board nixed that one, but, undeterred, Abdelhak came up with a different plan: taking control of West Allegheny Hospital, an osteopathic facility in Oakdale. The hospital was nearly $5 million in debt, but Abdelhak thought it was undervalued and that he could turn it around. With two hospitals, then, he would fulfill the board's mandate to make Canonsburg a competitor in a growing market.

"Vertical integration" was the new buzzword in hospital circles, with big hospitals buying smaller ones, combining operations to achieve economies of scale, so that money could be then directed towards more medical research and education — and more prestige.

But for West Allegheny, it wasn't meant to be.

With its 90 beds and negligible patient population (in 1986 it averaged 14 patients), it continued to bleed red ink.

"Abdelhak's ego was such that he figured he could turn around what everyone else thought was a disaster," said a former Canonsburg executive. "You'd be in a meeting and you'd sort of say, 'How are we going to do this?' the answer would be always something like, 'Don't worry,' or 'You don't understand.' "

But in a quirky twist of fate, Canonsburg's West Allegheny troubles would soon be solved.

Back home at AGH

One night in 1986, Mildred Fincke's telephone rang.

"Millie," a deep voice said, "I want you to come home."

Fincke, then vice president of patient services at the Medical Center in Beaver, was puzzled.

"I'm sorry, but I am home," she told the caller. "Who is this?"

"Why, don't you recognize my voice, Millie? This is Sherif. I want you to be my vice president of nursing at Allegheny General Hospital."

Abdelhak could perhaps be forgiven the lapse into sentiment, for he had just achieved his life's dream: the presidency of AGH. Westerman just hadn't moved quickly enough to make the hospital into the grand medical research and teaching facility the board had envisioned.

Surprisingly, his biggest backer was not board Chairman William Penn Snyder III, who had become something of a mentor, but the medical staff, who remembered how well Abdelhak had managed the move to AGH's new hospital building. He was a nuts-and-bolts kind of guy, they told the board, a much-needed insider, a doer, not a thinker — and, most importantly, someone who listened and cared about what the medical staff thought.

At his first meeting with top officials in April, 1986, an emotional Abdelhak described how "thrilled" he was to be back home. He would stay until the end of his career, he vowed.

Right away, Abdelhak appeared to be making all the right business moves at AGH. He announced new productivity measures that required departments to document the cost of care for every adjusted discharge, ordering that it not exceed the general inflation rate for all goods and services in the same year. And if employees met "quality targets" — absolute accuracy on tissue samples, for example — they received bonuses from a fund consisting of money saved from cutting costs.

Abdelhak also exhorted his marketing people to find the "hot" — read lucrative — new areas in health care. Luckily for his former associates at Canonsburg, Abdelhak saw dollar signs in none other than West Allegheny Hospital. He bought the money-losing facility in late 1986 and turned it into a neuropsychiatric center — which seemed a smart business move at the time, since mental health services were still being paid for under the old-fee-for-service system. That soon changed. The Allegheny Neuropsychiatric Institute, however, never did turn a profit and was dismantled in the mid-1990s; the building was eventually sold and is now a sub-acute care facility owned by Vencor, a non-profit chain.

Today, the West Allegheny episode seems oddly predictive of Abdelhak's later financial troubles — some fast footwork to cover up a questionable business decision. But it hardly slowed Abdelhak down. Within a

year-and-a-half of his return, Allegheny Health Services Inc., AGH's parent company, would grow from 700-beds to 2,100 beds; the workforce from 4,000 to 10,000, and its operating budget from $200 million to $500 million. And on Dec. 17, 1987, Allegheny finally became the proud owner of a medical school — the struggling Medical College of Pennsylvania in Philadelphia.

No expense was spared. Abdelhak went after the best people, hiring surgeons and researchers from Harvard, Emory, University of Pennsylvania and other prestigious institutions; at one point, he even tried to woo pioneer AIDS researcher Robert Gallo and his 125-person staff from the National Institutes of Health. Gallo declined the offer.

Locally, he hired people like Millie Fincke, who had started her career at AGH in 1947 and went on to become a pioneer in the field of emergency trauma nursing. "Whatever it takes," he told Fincke, when she asked for money to revitalize the hospital's troubled nursing program.

Abdelhak was practically unstoppable. One former colleague recalls his appearance in the late 1980s before the local Health Systems Agency, which has since been abolished but was once used to approve or disapprove hospitals' expansion plans.

"Sherif stood there, in front of all these heavyweight agency types and told them — he didn't ask, he told them — that Allegheny was going to embark on some ambitious transplant program and then held his hand in the air, with his thumb and index finger together, and said it would add zero dollars in costs to the system and they just nodded, in awe of this guy. No one challenged him."

Lavish living, divorce, scandal

Once he gained a foothold in Philadelphia, one of Sherif's first acts was to order the purchase of a private jet so he and other executives could commute back and forth. After some research, a subordinate told him it was too expensive, way above the cost of flying commercially. How about a cheaper turboprop?

Abdelhak cut him off. Turboprops are too noisy and uncomfortable, he said. The subordinate then expressed concern about the public relations ramifications of a not-for-profit buying a "corporate" jet.

"I can still remember the look on his face when I said that,'' said the subordinate who asked not to be identified by name. "He just exploded. He told me I was arrogant, that I couldn't talk to him that way. He said I didn't know what I was talking about and threw me out of his office."

Abdelhak got his jet. Its door could barely accommodate a stretcher, but he ordered that the hospital's "Life Flight" emblem be attached to the

aircraft, so he could tell the board that the purchase was for air ambulance operations, and only for corporate use between emergencies.

The emblem was never affixed to the jet and the board never questioned whether the purchase was cost effective.

It was just one more perk in Abdelhak's newly luxurious lifestyle. He had always loved horses. Shortly after becoming CEO, he became the owner of five prize Egyptian Arabians, with an estimated average worth of $200,000 each. It would be a short-lived hobby. After the 1986 tax laws changed, horse-breeding, like other passive investments were eliminated as tax shelters. Abdelhak sold his Arabians and turned to less-speculative thoroughbred racing.

To some, his expensive tastes seem, in retrospect, symbolic of all of Allegheny's troubles, a clear warning sign of things to come.

His appetites appeared to extend beyond horses; in 1988, an apparently chaotic personal life spilled out into the open. At the end of a company retreat for the medical staff Abdelhak stood up and walked toward the stage, muttering something about "shocking" people.

"He stood there and announced to us that he was separating from his wife, that things hadn't worked out between them, and that he was on his own. And then he said that from time to time we might be seeing him with two different women, because he needed escorts to attend certain meetings," recalls one who was present.

Then Abdelhak sat down to stunned silence.

One of the women he was talking about was in the room, but few people knew it. She was Marlynn Singleton, the hospital's blonde, effervescent director of public relations, a former KDKA-TV weekend anchor and Miss Ohio/USA. But within a few months, it was abundantly clear that she was involved with him — and pregnant.

It also became clear that Mervat Abdelhak wouldn't give up her husband without a fight. She was an accomplished woman, with a doctorate in information science, and was a top ranking official at the University of Pittsburgh's department of health records and administration. She also had another son and didn't want a divorce.

Despite the public scandal, support for Abdelhak from Allegheny's board of trustees never appeared to falter. In 1989, they created a company, . Jellico Inc., that would own his $938,000 Sewickley house and he would make lease payments on it. The reason, according to Nancy Wynstra, Allegheny's former senior counsel, and others, was to keep him in Pittsburgh after Abdelhak said he'd received job offers in New York and elsewhere. Mervat Abdelhak, however, charged in court that Jellico, Inc.

was a ploy by Abdelhak and the board to protect his assets from her divorce lawyers. Wynstra says there was no collusion by the board.

After the divorce was finalized, records were sealed. Mervat Abdelhak declined to talk to the Post-Gazette about her ex-husband for this article, citing a legal non-disclosure agreement as well as concern for sons.

Rich and famous

As Abdelhak consolidated his position at Allegheny in the 1990s, his taste for grandeur and power intensifie; in the process, he alienated former allies and new associates.

Employees buzzed about the frequent trips to Europe and the Cayman Islands where AHERF's offshore insurance company was located, about the houses in Sewickley and Florida, about the racehorses that Abdelhak owned.

Doctors at AGH, who had been big supporters, complained when he took control of two physican run organizations — an imaging corporation and a surgical center — even though, according to the doctors, there was no evidence of financial mismanagement.

"He said it was to prevent self-referrals, but he just wanted the money. And he wanted doctors to be without any levers. Personal control became the issue for him." said a doctor who asked not to be identified by name.

In 1990, he insisted that Marlynn Singleton be admitted to the Medical College of Pennsylvania — even though she had not taken standardized medical exams or submitted a complete application. That too caused a controversy, and, according to Margaret Levy, then dean of students, Singleton's presence there almost led to the school's lack of accreditation.

Singleton ultimately remained in school at the insistence of Levy, who said she was doing well in classes. Singleton received her M.D. in 1995.

And in 1993, he had staffers shaking their heads after what was supposed to be a welcome speech at the newly acquired Hahnemann University Hospital medical school in Philadelphia.

"He gave a very good presentation," recalls one who was present. "He talked a lot about Allegheny and what its goals were, the values of the system and so on, and by the end of the meeting, everyone was feeling pretty good.

"But then, out of the blue, he pointed his finger at the audience and said, 'Let me end by saying one thing. Don't cross me, or you will live to

regret it.' "

Was it just an unguarded moment, or a real sign of stress from the enormous task of combining operations in Philadelphia and Pittsburgh into one vast health care system?

As Allegheny's roots deepened in the eastern part of the state, Abdelhak had begun to deal with new groups of employees who had no emotional ties or loyalty to the institution he had worked for most of his life. That lack of connection, associates say, frustrated and irritated him.

At a meeting in the mid-1990s at a Philadelphia restaurant with physicians whose practices had just been purchased by Allegheny, Abdelhak dismissed questions asking for specifics.

"All he said was, 'If you are loyal to me, I carry you on my back,' " recalls Dr. Joseph Brezin, who chaired the department of medicine at Allegheny University Hospital, Hahnemann.

Doctors snickered at that answer, but the notion that debt defines all relationships was central to Abdelhak's thinking. He never understood why, for example, after paying doctors so much for their practices they continued to send their patients to other hospitals. Hadn't he given them ample reason to be loyal to him?

In many quarters, he had.

Besides money, Abdelhak's reverence for the average working man or woman at AGH was almost mystical. Allegheny wasn't just in charge of thousands of employees, it was "blessed" with them. His eloquence could be thrilling.

"I just remember feeling so attracted by his sensitivity to what patients were experiencing in a very complex health system," recalls Gloria Donnelly, who was wooed away from LaSalle University by Abdelhak in 1996 to become the dean of nursing at the Allegheny University of the Health Sciences.

"He said something that I thought was remarkably insightful, about how complicated it is these days for patients to get in and out of the hospital," Donnelly recalled. "He talked about how we sap a patient's strength and the family's strength by inundating them with all sorts of unnecessary personnel. And then he turned to me and said, as dean of nursing, you need to look at its function and how critical it is to patient care, and you need to reclaim what is yours."

But as the Philadelphia connection became more complex, there was less and less time for that kind of personal interaction. "I'd run past him on the airport tarmac, and he'd say, 'Millie, I miss you,' and I'd say I'd miss

him too. But there was never time to talk," recalls Fincke.

Certainly, by the end of 1996, some storm clouds were gathering. That year, the division overseeing the institution's medical practices had lost $40 million.

All the things Abdelhak had promised Donnelly — $1 million for pilot research programs — came to naught. But she soon started receiving memos, all hammering at the same theme.

"It was always, work harder, work smarter, be more productive...We were getting nothing back but blame," she says.

Brezin says he knew Allegheny's days in Philadelphia were numbered at that 1996 meeting with the physicians, when he pressed Abdelhak for more details,

"I asked him, What is your plan to manage these practices, and his answer said it all. He stood there and told me, 'You can't stop a freight train going 70 miles an hour.' "

Epilogue

When did Abdelhak realize he had overreached?

It's not clear he ever did. But many believe something must have dawned on him during recuperation from abdominal surgery in the fall of 1997.

"When he came back, he was a changed man," says one close associate. "I think during that period he had time to think, and really look at the numbers, and it was then he realized that it wasn't working."

Not long afterward, on October 13, 1997, the first major series of Philadelphia layoffs occurred. Abdelhak said it was "the worst day" of his life.

Still, he was far from admitting defeat. As 1997's bad financial news worsened in 1998, he continued to insist — at least publicly — that the system could weather the storm. And he increasingly blamed others for Allegheny's financial woes. Bad decisions by subordinates had been made while he was in his sickbed. Had he been there, he raged, he would have made the right moves.

All during the spring of 1998, there were weekly meetings to try to stem the flow of red ink. He told close associates that progress was being made; but in May, several members of Allegheny's medical staff told a panicky Snyder that they would contact the news media if Abdelhak wasn't removed.

On Sunday afternoon of Memorial Day weekend, Abdhelhak was called at home by Snyder, who lived nearby and asked that they meet. And then, Snyder fired him.

It was a total shock. "He was stunned. He had no inkling this was going to happen," says a close friend.

But even that wasn't the end — not yet. The very next day,May 25, Abdelhak appeared in his office. He seemed shell-shocked, but for the next two weeks he behaved as though he were still CEO, traveling to Philadelphia, meeting with Snyder and members of the board.

"It was a very strange time," recalls an associate. "I think he was trying to work something out. He must have believed that even if this was the signal, that, OK, you're not going to be able to remain here for the next five years, something could be arranged so there would be a graceful exit later in the year, with maybe a party to mark his departure."

But at the end of the day on June 5, Abdelhak walked out of his offices at Fifth Avenue Place Downtown, without fanfare. It would be for the last time as CEO.

Today, seven months later, Abdelhak is in seclusion, spending his time, friends say, brooding over what he perceives as a grave injustice done to him, unable to believe that he was being held responsible for AHERF's financial demise. Firing him was a mistake, he tells them; if he had just had more time...

Now, he has plenty of time. Abdelhak spends his days puttering in his new house in a less-expensive neighborhood of Sewickley, or running errands to the local Giant Eagle, or coaching his sons' soccer team, or fending off repeated phone calls from reporters who seek comment every time a new revelation surfaces about AHERF's troubles.

"I am a private person now, and I am trying to make a private life for myself," he says courteously to a reporter who telephones him.

Last fall, during a chance encounter at the Home Depot in North Fayette, with a shopping cart full of wooden boards, Abdelhak was asked if he was helping contractors renovate his new house.

Abdelhak shrugged. He was doing a few things.

"It helps to pass the time," he said, with a faint smile.

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Anatomy of a Bankruptcy

Steve Massey, 40, writes about airlines, economics and development-related issues for the Post-Gazette. He also writes the Sunday Biz Bytes column. Last year, Massey wrote the widely acclaimed six-day series Who Killed Westinghouse, which chronicled the disappearance of the giant corporation from Pittsburgh, where it had been an industrial institution for 111 years. Massey joined the Post-Gazette in 1990, covering banking and economics. He worked previously for The San Francisco Chronicle, the Louisville Courier-Journal and the St. Paul Pioneer Press.

A native of Morrilton, Ark., he is a 1981 graduate of the University of Kentucky, where he received a bachelor's degree in economics

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Assisting Massey in the reporting on this series were three other Post-Gazette reporters:

Pamela Gaynor, 45, a business writer at the Post-Gazette since 1985, has covered the health care industry for four years, writing extensively on both AHERF and its rival, UPMC, and on the complex changes in health care economics.

Christopher Snowbeck, 27, a medical writer at the Post-Gazette since 1997, covers health care technology, organ transplant policy and men's health. He has also written about boxing.

Mackenzie Carpenter, 44, is a member of the Post-Gazette's issues team. She has written prize-winning reports on liver transplant allocation processes, day care in the United States, and, most recently, a series entitled "Children of the Underground," dealing with mothers who hide their children in violation of custody orders. Before arriving at the PG in 1990, Carpenter was a producer and reporter for public television stations in Washington, D.C. She has also worked as a reporter for the Journal-Inquirer in Manchester, Conn., and United Press International. She was raised in Princeton, N.J., and Tokyo and received a bachelor's degree in English from Trinity College in 1976 and a master's degree in studies in law from Yale University in 1987.

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AHERF execs hit with, settle SEC fraud charges

Wednesday, May 03, 2000

By Pamela Gaynor, Post-Gazette Staff Writer

The Securities and Exchange Commission yesterday simultaneously brought and settled fraud charges against the former chief financial officer and two other former financial executives of Allegheny General Hospital's bankrupt parent foundation.

David W. McConnell, former chief financial officer of the Allegheny Health, Education and Research Foundation, was charged with "creating, reviewing and approving false financial statements ... thereby masking, from at least December 1996 through July 1998, AHERF's severely deteriorating financial condition."

PG Special Report:

AHERF: Anatomy of a bankruptcy

Without admitting wrongdoing, McConnell, 44, settled them for $40,000 and a pledge not to violate securities laws in the future.

That settlement and two others reached with Stephen H. Spargo, 42, and Albert Adamczak, 40, still require federal court approval, SEC spokesman Ron Long said.

Fraud charges against Spargo, former vice president of corporate support services for AHERF, were confined to activities in 1996. Charges against Adamczak, who replaced Spargo at AHERF, were confined to activities in 1997.

Without admitting wrongdoing, both accountants were banned from representing clients before the SEC for a period of three years.

Still pending are charges against Charles Morrison, who oversaw the finances of AHERF's Philadelphia operations and still serves as a liquidation officer in the parent foundation's bankruptcy under the supervision of a court-appointed trustee.

In U.S. District Court in Philadelphia, the SEC charged yesterday that

Morrison, along with McConnell, helped hide AHERF's financial problems with false financial statements.

AHERF collapsed into bankruptcy nearly two years ago after amassing $1.5 billion in debt from an aggressive expansion in Philadelphia.

The SEC investigation into the bankruptcy uncovered tens of millions of dollars shifted from one AHERF subsidiary to another, misuse of endowments and other alleged financial chicanery that hurt holders of bonds used to finance acquisitions.

Its probe is one of more than a score of government investigations and lawsuits to arise from AHERF's collapse.

The only criminal charges in the case thus far were brought earlier this year against the foundation's three top officers by the state attorney general.

Along with McConnell, those under criminal indictment are former Chief Executive Officer Sherif Abdelhak and former General Counsel Nancy Wynstra.

The SEC's spokesman yesterday defended the settlements, saying they represented "strong sanctions" within the context of a limited array of disciplinary actions available to the government agency.

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Anatomy of a Bankruptcy

Introduction: Hear no evil, see no evil

By Steve Massey, Post-Gazette Staff Writer

Only a decade ago, Allegheny General was the Fort Knox of the hospital business. Led by a board with some of the biggest names in corporate Pittsburgh, it exhibited an abiding respect for the bottom line. Its profit margin — the proportion of revenue beyond expenses — was just shy of 15 percent, the highest of any local hospital and a level many private companies would envy.

And it had a certain swagger. It advertised when other hospitals didn't. It bought a Sewickley Heights mansion for its top executive. It flew private jets, established a Cayman Islands insurance subsidiary and took its executives on business trips to Amsterdam, Paris and other foreign sites.

It sponsored lavish parties and management retreats, and paid among the highest salaries in the business. And it established a parent company, later renamed the Allegheny Health, Education and Research Foundation, to oversee the organization's increasingly complicated and scattered affairs.

It sure didn't act like a nonprofit, charitable institution. If anything, it made too much money, not too little. So much so that at one point it was forced to ante up millions to pacify local government officials who were challenging its tax-exempt status.

But even as Allegheny General sat atop one of the region's largest and fastest-growing industries, the seeds of its demise were being sown. In 1988, its parent bought a medical school in Philadelphia, beginning an ill-fated and poorly executed expansion that would muscle and siphon away hundreds of millions of dollars.

By the time AHERF filed for bankruptcy last summer, losses were so deep that creditors who were owed a total of $1.5 billion may be lucky to get back $200 million. And Allegheny General had been so weakened financially it openly says it'll need a partner to survive — if the U.S. Bankruptcy Court doesn't force a sale first.

How did it go so wrong?

A number of forces worked to conspire against the Allegheny empire: cuts in Medicare, Medicaid and government research; the growing clout of tight-fisted managed-care insurance plans; an expanding load of charity cases; and a cutthroat health care environment in the City of Brotherly Love.

But much of the trouble was of Allegheny's own making:

- Put off by exhaustive documents, discouraged from asking too many questions and caught up in the excitement spawned by its growth, board members failed to probe into the affairs of the organization;

- Top management used deceptive public statements and took advantage of lax regulatory oversight and ever-shifting accounting rules to mask the deteriorating financial health of the organization;

- And instead of consolidating operations and reining in costs as it grew, Allegheny executives went the other way, spending freely on pay, perks and facilities and creating an unwieldy bureaucracy that, by 1997, totaled 55 corporate entities, 10 separate boards, 132 directors and 117 senior managers — 77 of whom were making at least $200,000 a year.

Yet at the core of the collapse, former and current Allegheny doctors, directors and executives say, was a willingness to allow too much power to be concentrated in the hands of one man, former AHERF Chief Executive Officer Sherif Abdelhak.

Perhaps it's understandable. Until the past year, everyone seemed to be benefiting from the Allegheny system's ascent under Abdelhak — its doctors, researchers, managers, directors and lenders.

Who were they to question what was going on? Who was anyone?

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Anatomy of a Bankruptcy

Lifeline for an institution

When the Allegheny Health, Education and Research Foundation filed for bankruptcy in July 1998, more than a century of health care history came crashing down. Below is a capsule summary of the North Side institution's history.

1886 -- On Feb. 15, the 50-bed Allegheny General Hospital opens the door to its first patients, becoming the only hospital in what was then the city of Allegheny and 20 years later would become the North Side. Backers include industrialists James Park and Oliver Scaife, who made their fortunes in steel and metals, and railroad, steel and banking financier John Chalfant.

1906 -- Iron broker and steelmaker William Penn Snyder joins the Allegheny board, beginning his family's long association with the hospital. Other board newcomers include philanthropist and railroader Henry Darlington, banker Edward Dravo and banker and industrialist Henry Rea.

1914 -- The William H. Singer Memorial Research Laboratory is established.

1928 -- William Penn Snyder Jr. joins the board, as a campaign for a new hospital heats up.

1930 -- Ground is broken for a new hospital, which is to be a 22-story high-rise, one of the nation's first skyscraper hospitals. But the Depression and cost overruns stall construction almost four years, until the U.S. Public Works Administration agrees to a $2 million loan to complete the $8 million building.

1965 -- William Penn Snyder III is elected to succeed his father as the head of Allegheny General's board.

1968 -- Allegheny General opens a heart center, followed by a cancer study center a year later.

1969 -- The second heart transplant in the city is performed at Allegheny General.

1971 -- Sherif Abdelhak is hired as purchasing and control coordinator in Allegheny General's dietetics division.

1978 -- Allegheny General launches LifeFlight Emergency trauma

service, becoming the first hospital in the region to offer helicopter flights for emergencies.

1980 -- Allegheny General opens the region's first sports medicine center. David McConnell joins the finance department at Allegheny General.

1981 -- The $104 million Snyder Pavilion opens, replacing the South tower as the operating and patient center.

1983 -- Nancy Wynstra is lured from the Michael Reese Hospital and Medical Center as general counsel for Allegheny General and its parent, Allegheny Health Services Inc. Allegheny General issues $66 million in bonds.

1985 -- Allegheny General uses two artificial heart pumps to keep a 60-year-old man alive for five days until his own heart resumes beating.

1986 -- After a nearly yearlong search, the Allegheny General board elects Abdelhak president. Anthony Sanzo, the 32-year-old acting president and CEO at Presbyterian-University Hospital, resigns to become senior vice president, operations, at AGH.

1987 -- Allegheny General strikes an agreement to take control of the Medical College of Pennsylvania, and completes the partnership in April 1988, pledging an infusion of $40 million to $60 million into the Philadelphia med school.

1988 -- Allegheny General issues $60 million in bonds.

1991 -- United Hospitals Inc., a group of four hospitals in the Philadelphia area, joins the Allegheny system. Allegheny says it will not assume United's $137 million of bond debt, but ultimately does. Allegheny Health Services is renamed Allegheny Health, Education and Research Foundation, effective July 1992. AHERF begins acquiring doctors practices for a physician network. Allegheny General issues $60 million in bonds.

1993 -- Hahnemann University joins the Allegheny network, forming one of the largest medical schools in the country in combination with MCP and giving AHERF a major Philadelphia stake, with four acute-care hospitals with 2,000 beds.

1994 -- Hahnemann and MCP are merged to form one medical school, Medical College of Pennsylvania and Hahnemann University.

1995 -- MCPHU re-establishes a School of Nursing and begins developing a School of Public Health. Allegheny General issues $100 million in bonds.

1996 -- AHERF issues $365 million in bonds for its Philadelphia medical school and hospitals. AHERF takes over management of the Graduate Health System's hospital affiliates. It says Graduate will remain responsible for the hospital system's $174 million of bond and related debt, but ultimately that is transferred to AHERF. AHERF commits $100 million to develop and support cancer programs through its statewide health care system.

1997 -- Forbes Health System merges into the AHERF system, followed months later by Allegheny Valley Hospital and Canonsburg Hospital. The moves add more than $121 million of bond debt. AHERF unveils plans for a $100 million Center City Philadelphia office and power plant project. Moody's Investor Service warns that the hospital climate in Philadelphia is worsening but applauds AHERF for taking steps to consolidate operations. AHERF announces it will close Mount Sinai Hospital, eliminating 500 jobs. AHERF announces 1,200 employee layoffs, and says it will trim salaries.

1998 -- AHERF says it will sell six of its nine Philadelphia-area hospitals to Vanguard Health Systems, a private for-profit company. Moody's says AHERF's fiscal situation is deteriorating and it may not recover. Abdelhak is ousted and replaced by Sanzo. Vanguard withdraws its bid for the six hospitals. McConnell resigns. AHERF, its Philadelphia-area hospitals and medical school, and its physicians practices subsidiary file for Chapter 11 bankruptcy.

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Anatomy of a Bankruptcy

Part 1: Wake up to break up

Sunday, January 17, 1999
By Steve Massey, Post-Gazette Staff Writer

Sherif Abdelhak was desperate. The health care behemoth he had built over a decade, the largest hospital system in the state, one of the largest medical schools in the country, was collapsing.

Losses were closing in on $1 million a day, and it was running out of money. Just making next month's payroll would be a feat. Suppliers were demanding cash up front, lenders were calling loans and his directors, who had been steadfast in their support for him, were beginning to waver.

But now was not the time to panic. It was time to act. In late April of last year, the 52-year-old mastermind behind the growth of the Allegheny Health, Education and Research Foundation called together his top managers in their luxurious Fifth Avenue Place headquarters and demanded more budget cuts. "No" was not an option.

Never mind that the executives charged with running the far-flung Allegheny empire already had pared, chopped and chiseled over the past year, or that some of its Philadelphia hospitals were running short of bandages, fresh bed linens and other basics.

Abdelhak had to find more money, and quick. The managers knew that to challenge their leader when he was in this take-no-prisoners mood was risky.

Still, Donald Kaye, head of the foundation's Eastern operations, protested that he must spend money on mandatory repairs to a hospital sprinkler system or he'd go to jail. Abdelhak would have none of it.

"Then you'll go to jail," he snapped. "I've done everything for you."

It was payback time, and Abdelhak was calling in his chits. Over the next hour, he alternately raged, fumed, even appeared to weep — then he stormed out of the meeting, something he'd done with increasing frequency that spring.

The financial fissures that had been developing almost imperceptibly in the Allegheny system over the past several years had suddenly become deep, inescapable crevasses.

Abdelhak's life work was going down, taking him and the reputations of some of Pittsburgh's most recognizable executives with it.

Almost from the start, the Egyptian-born businessman and University of Pittsburgh M.B.A. graduate relentlessly pursued his vision for Allegheny General and the Allegheny system — to be the best health care concern in the country, on par with the Harvards, John Hopkinses and Stanfords of the world. His powers of persuasion, and his willingness to spend money and listen to even the lowest-level employee captivated and motivated workers.

In public, he exuded power and confidence. He was a compelling speaker with a gift for crystallizing complex ideas and arcane health terms into eloquent, accessible language. "I remember seeing Sherif stand up at a meeting in the mid-1980s at the Hospital Council of Western Pennsylvania and ask questions in the most intelligent way, and I thought, who *is* this guy? He was really impressive," recalls a fellow hospital president.

Snapshot of AHERF
Spring 1998

Employees: 29,500
Revenue: $2.05 billion
Assets: $2.6 billion
Debt: $1.18 billion
Inpatient admissions: 128,388

* Based on Allegheny Health Education and Research Foundation and tax documents

Abdelhak was a bigger-is-better strategist, a win-at-all-costs coach who worked long hours and expected the same of everyone. His team of advisers and mentors was small. There was David McConnell, the chief financial officer who'd find the money, a task the amateur race-car driver approached with abandon. There was Nancy Wynstra, the chief counsel who knew the intricacies of corporate structure and law and made sure Allegheny took full advantage of them.

And there was William Penn Snyder III, the patriarch of a family that cut its fortune in iron and steel and traced its roots to Pennsylvania's first governor, Simon Snyder. There's been a Snyder on the board of Allegheny General or its parent almost as many years as the 113-year-old North Side institution is old, and W.P. Snyder III — friends call him Bill

— had been at the helm since 1965.

In Abdelhak, Snyder had found the man who could help his beloved Allegheny achieve the glory it so obviously deserved. It would mark a fitting end to a life dedicated to community and achievement, one marked by his early involvement in the business group that shaped Pittsburgh's original Renaissance.

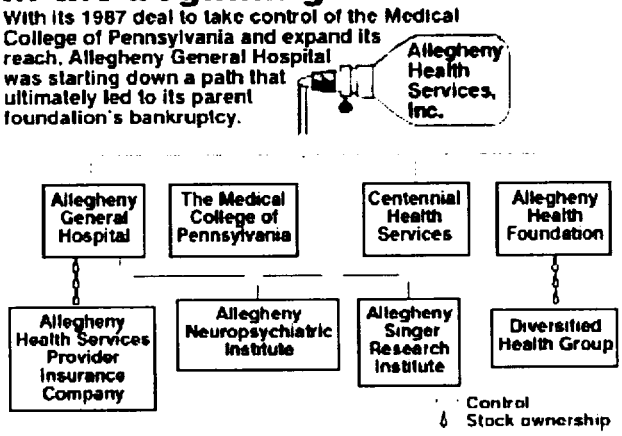
If there were signs of trouble brewing, surely Bill Snyder would let his directors know — not that they would need any help. The board was loaded with executives familiar with the rudiments of high finance, including former chairmen Douglas Danforth of Westinghouse Electric, J. David Barnes of Mellon Bank, and Francis Nimick of Dollar Bank.

Besides, under Abdelhak, Allegheny appeared to be making money even as it grew. Sure, it was relying more and more on endowment earnings and bond financing to make ends meet, but that's just because it was feeling the pressures all hospitals were feeling from the one-two punch of declining government reimbursements and the rapid rise of managed care.

The bottom line was Allegheny was getting a clean bill of health from its outside auditors, Coopers & Lybrand. To some extent, directors had to depend on the auditors.

In the beginning

With its 1987 deal to take control of the Medical College of Pennsylvania and expand its reach, Allegheny General Hospital was starting down a path that ultimately led to its parent foundation's bankruptcy.



And they also had to have some faith in management — the directors were, after all, busy men and women, and they really didn't have the time to study all the documents made ready for every meeting. Sometimes there'd be more than 1,000 pages.

Surely PNC and Mellon, hometown lenders who did business with Allegheny, would sound the alarm if things were awry. Both had representatives on the boards of the parent and its affiliates — and both profited from relationships with one of the country's fastest-growing health care concerns.

Indeed, everybody seemed to be thriving in a system that tossed money and perks around like candy.

In the Abdelhak years, salaries skyrocketed to the top tiers of the health care industry — by 1997, at least 77 managers raked in more than $200,000, more than Abdelhak himself was making a decade before.

Abdelhak's payout exceeded $1 million, as did the compensation of at least a half dozen doctors.

There also were perks like private jets, a skybox at Philadelphia's Veterans Stadium and box seats at Pittsburgh's Three Rivers Stadium, and through the Cayman Islands insurance subsidiary, meetings in Holland, Switzerland, and Iceland.

And there was a seemingly bottomless pit of money, for housing loans and luxury cars for doctors and top employees, the purchase of doctors' offices and medical buildings, and, of course, the takeover of hospitals.

The growth came at a price. Since 1987, bond and bank debt had skyrocketed from less than $70 million to more than $1.1 billion, bankrolling the Allegheny system as it gobbled up two medical schools, 14 hospitals and more than 500 physician practices.

But Allegheny really wasn't doing anything all that different from the rest of the industry. Hospital mergers and acquisitions soared the past two decades, from almost none in the 1970s to roughly 20 a year by the late 1980s to more than 200 in 1997 alone.

There's no mystery to the consolidation. With insurers pushing for cheaper outpatient care and restricting overnight stays in hospitals, almost four of every 10 hospital beds are empty on any given day in the country. By merging, hospitals can eliminate excess capacity, increase efficiency and boost market share — and their ability to bargain with insurers.

For Allegheny, the payoff was more than just money — to work there was to work at a company on the rise, a health care concern boasting big-name researchers and doctors performing some of the nation's most advanced surgery.

So what if the University of Pittsburgh Medical Center boasted being No. 1 in its hometown? In the state, the Allegheny health system was the king of the hill.

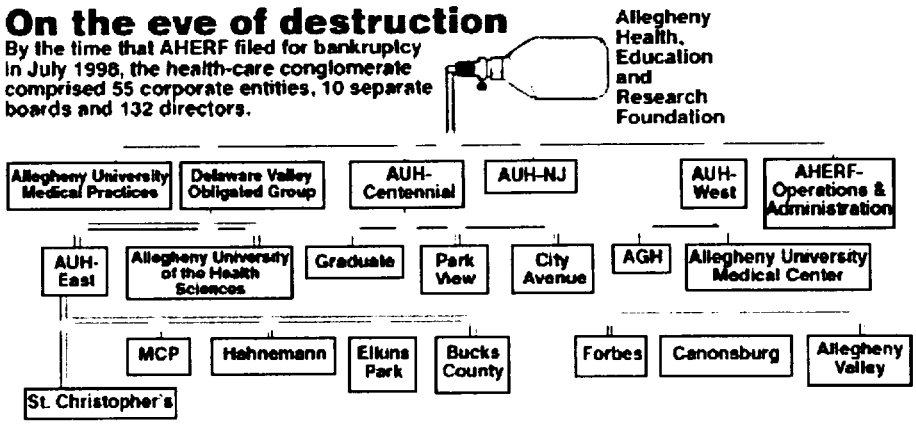
"From the top ranks to housekeeping, people were incredibly proud being there," says one former parent corporation executive, who was let go in July and who, like so many in this story, would speak only if promised anonymity.

"It was exciting," she said. "Good Lord, we all want to work for somebody who inspires us. And Sherif inspired us. He set high standards. And people want to aspire to high standards. People want to do their best."

On this late April day, however, the short and intense Abdelhak, known

as "the sheriff" or "big little man" by his minions, could see all his aspirations slipping away.

And he was angry. And alone. Never one to seek help or admit mistakes, and pretty much a loner, he had no one he could turn to.



Note: AUH = Allegheny University Hospitals

Although long-time associates in the room didn't know it, he had already turned on some of them. When queried by his directors about mounting troubles, he would blame his managers, saying they made decisions behind his back or in violation of his orders.

It was a claim that rang false to many board members, who knew Abdelhak to be nothing if not a control fanatic. It was unlikely, they felt, that anything of substance happened without his knowledge.

Within two months of that meeting, the board would fire Abdelhak. Within three, the parent foundation and its Philadelphia hospitals, medical school and physicians practices subsidiaries would be in bankruptcy.

And within six months, the Philadelphia hospitals and the medical school would be sold. And William Penn Snyder III would step down from his post.

Now all that's left is the old North Side flagship and its local affiliates — Forbes Health System, Canonsburg and Allegheny Valley hospitals.

Whether the group can avoid the fate of its Eastern Pennsylvania brethren remains to be seen. Administrators are weighing potential partnerships with other hospital chains.

Whoever comes in will have to deal with a Western Pennsylvania hospital system that's been drained of resources.

More than $65 million in building renovation and acquisition funds were siphoned out of Forbes Health System and Allegheny Valley Hospital last spring by McConnell and Abdelhak, roughly a year after the hospitals

joined the Allegheny system.

Allegheny General has racked up operating losses — income before earnings on endowments and other investments — of almost $80 million the past four years, draining its reserves and forcing it to openly seek a merger partner with deep financial pockets. Some of the losses simply reflect a tougher operating environment for all Pittsburgh hospitals; but AGH has had to carry the additional burden of supporting its Philadelphia brethren.

That's not all. To raise money, Allegheny in the last 10 years quadrupled the North Side hospital's bond and bank debt, from less than $70 million to roughly $250 million. And that doesn't include another $100 million of lease payments the hospital must make in future years because it sold, then agreed to lease back, two North Side offices and parking garages in 1996. The so-called sale-leaseback transactions, primarily done to get cash, don't show up on the balance sheet but are non-cancelable obligations akin to debt.

Even if Allegheny General and its Western affiliates are able to find a partner — and to get the U.S. Bankruptcy Court and the AHERF trustee, who was appointed last month, to agree to a deal that will let them survive on their own — the dismemberment of what a year ago was the state's largest health system has many befuddled and betrayed.

"This thing breaks my heart," says Norma Gentile, a retired nurse and manager who spent 34 years at Allegheny General. "This was MY hospital. It was the best."

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Pittsburgh Apartments
Where do you want to live?

Anatomy of a Bankruptcy

Part 2: Think globally, look locally

Tuesday, January 19, 1999
By Steve Massey, Post-Gazette Staff Writer

William Penn Snyder III felt good.

His and the Allegheny General board's experiment with going outside the organization for a chief executive had failed. Miserably.

John Westerman, lured from the University of Minnesota Hospitals in 1982 on the strength of his reputation as a thinker and national leader in the new era of hospital administrators, was abruptly shown the door three years later, having lost the confidence of Allegheny General's doctors, directors and managers.

Oh, everyone liked John OK. He was movie-star handsome, an engaging speaker with a creative mind, a penny-loafered and button-downed man of ideals and ideas, a wunderkind in the field of medicine. Named at 33 to the Minnesota post, he was one of the nation's youngest directors of a university hospital. He could toss around the new buzzwords — regional integrated system, fully integrated delivery — with the best of them.

The only problem was that Westerman wasn't much of a manager. He had a lot of intriguing suggestions — such as forming a regional coalition of non-academic research hospitals, but when it came to actually getting things done, Westerman was paralyzed by analysis.

He was a "democratic" manager; he'd solicit input from as many sources as possible and encourage open discussions and debate among his managers, doctors and directors. But making a decision and acting on it

didn't seem part of his make-up.

"He'd have one idea in the morning, and then three more in the afternoon,'' says Claude Joyner, former chairman of medicine at Allegheny General and a longtime board member. "He was a free spirit," recalls another director.

Snyder, and the AGH board, weren't going to make the same mistake again.

Instead of looking nationally for a big name to bring the respect and clout their institution deserved and needed if it hoped to be considered among the nation's top-tier hospitals, they found someone local. Oh, Allegheny went through a national search process, and even included several outsiders on a pared-down list. But Abdelhak was their guy.

And for good reason. Snyder liked Sherif Abdelhak, and Abdelhak was a known quantity. He had been at Allegheny General before, working his way up from a food service purchasing manager to chief operating officer in less than a decade. He had a reputation for getting things done, an image reinforced by his overseeing the almost seamless move from the hospital's landmark 22-story tower to its modern new Snyder Pavilion in 1981, toward the end of his first stretch at the hospital.

Abdelhak had left Allegheny General in 1982 when the board opted to go with Westerman as CEO. The decision tore Abdelhak up, but the board was concerned he might be a little too green to take over the reins. Besides, he was linked to a scandal involving Westerman's predecessor, Lad Grapski, the longtime chief executive.

Grapski had been forced to resign a year before his mandatory retirement, after it was revealed he and two other administrators were part-owners in an in-house pharmacy that catered to the hospital's doctors and staff. Abdelhak wasn't involved, but he was accused of acting on Grapski's behalf after the affair became public.

Still, that was ancient history now. The simple fact was the medical staff, particularly many of the big names on the board — Joyner, director of surgery George Magovern and director of the trauma unit Daniel Diamond — liked Abdelhak. Not only did he run things well, he seemed to share their goal of making Allegheny General a premier institution, one with a significant reach beyond Western Pennsylvania.

Snapshot of AHERF
June 30, 1986

Employees: 3,610
Revenue: $195.38 million
Assets: $329.15 million
Debt: $67.2 million
Inpatient admissions: 25,354

* Based on Allegheny Health Education and Research Foundation and tax documents

The desire to be more than just a well-run

regional hospital weighed on Snyder's mind, too.

Westerman had been brought in to fan the fires of change lit during the Grapski years. During his 13-year tenure, Grapski worked to make Allegheny General more than just a good community hospital.

Under Grapski, it drew patients from all over the region, and was noted nationally for its expertise in high-profile medical specialties, including cancer research, transplants, trauma and cardiology. It wooed Joyner from the University of Pennsylvania, and Magovern from Johns Hopkins. It launched the region's first helicopter service and opened its first sports medicine center.

Even before Grapski, Allegheny General was a noted research and teaching hospital. It benefited from a rich tradition of support from industrialists and financiers, and established a separate research arm, the William H. Singer Memorial Laboratory, in 1915. It also had a history of collaboration with the University of Pittsburgh, providing graduate medical education programs in a variety of fields.

It was even noted for its architecture. Its $104 million Snyder Pavilion received raves when it opened in 1981 for having the latest in electronic and medical gadgetry, including one of the country's first around-the-clock computerized monitoring systems for critical-care patients.

And its 22-floor South tower, one of the nation's first skyscraper hospitals when it opened in 1936, brought a new, luxury feel to medicine, evoking a northern Italian elegance with arches, columns, a courtyard and a lot of natural light.

But the hospital's love for the grand came at a price: Both building projects were plagued with cost overruns, so much so that the cream-brick skyscraper stood vacant and uncompleted for four years, until the government bailed it out in 1934 with a $2 million loan.

It would mark the last time Allegheny General confronted a severe fiscal threat — until a decade into Abdelhak's tenure.

For now, however, Snyder had his man.

A few directors would raise suspicions about the direction Allegheny General's parent would take under Abdelhak, but Snyder would hear none of it. He'd forget to show up for Duquesne Club lunches arranged by board members who wanted to talk about Abdelhak. Instead, he would turn to Abdelhak for most of his information about the corporation's affairs.

And board meetings were scripted and dull affairs. It was the "Bill and

Sherif Show.'' There weren't a lot of probing questions, and those who did speak up persistently were discouraged from doing so again — not openly, but in ways in which the don't-rock-the-boat message was clear.

Vincent Sarni, the former PPG Industries Chairman who chaired Allegheny General's board when it wooed Philadelphia's Medical College of Pennsylvania in late 1987, frequently raised concerns about the financial toll of expanding east.

Then one day, during the second half of 1990, Sarni got a call from Snyder informing him that his three years as chairman were up.

"I said, 'What three years?' " recalls Sarni, who was then told it was hospital policy to rotate its chairman every three years. "It was the first I'd heard of it.''

Others who tried to approach Snyder to talk about the affairs of the organization were put off. There could be no meetings, formal or otherwise, without Abdelhak.

It was as if the pair had a relationship of mutual dependence.

Abdelhak was Snyder's right-hand man, the person who'd carry out his dream for his adopted institution, one in which his family had devoted so much time and money over the years. And Snyder was Abdelhak's lifeline, the man who'd keep him in power and deflect naysayers.

It was a strange synergy between the Egyptian-born manager with the razor-sharp mind and driving ambition, and the tall, gangly WASP from an old Sewickley family.

"Sherif knew he was nothing without Snyder, that he could be gone in a minute if Snyder lost confidence in him," says one high-ranking doctor. In fact, when Snyder underwent a risky operation for a gastrointestinal ailment in the early 1990s, the doctor says, Abdelhak was openly shaken.

"Sherif practically spent the night in Snyder's room. He was wringing his hands, frantic that nothing should happen to Snyder," the doctor says. "It went beyond mere affection. It seemed like he was terrified about what would happen to him if Snyder didn't make it."

Just how tightly the two were intertwined was clear during a convocation address in 1992 at the dedication of a new medical office and research facility at the Medical College of Pennsylvania, the Philadelphia medical school Allegheny had taken over only four years earlier.

Snyder was the man of the hour. An endowed chair was being awarded in his honor, a recognition of his and his family's devotion and financial support for Allegheny.

When he rose to speak of his — and Allegheny's — beloved benefactor, Abdelhak made clear how much Snyder meant to him.

In a sonorous, measured voice, Abdelhak scanned the audience with his dark, piercing eyes and said: "I came to Allegheny because of William P. Snyder. And I stay at Allegheny because of William P. Snyder."

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Pittsburgh Apartments
Where do you want to live?

Anatomy of a Bankruptcy

Part 3: Full steam ahead

Wednesday, January 20, 1999
By Steve Massey, Post-Gazette Staff Writer

It didn't take long for Sherif Abdelhak, the newly named chief executive at Allegheny General and its parent organization, to make his mark — and in so doing, to lay out his plan of attack in the increasingly challenging environment of health care economics.

Even before he assumed the reins in 1986, Abdelhak was hearing the rumblings. If the hospital hoped to retain its longtime academic and research components, features that were vital to bringing in new dollars, it would have to link up with a medical school. Congress and the medical licensing bodies were saying so. So were hospital administrators and medical journals.

And so was Claude Joyner, the hospital's chairman of medicine. While nothing had been done yet, it had become accepted wisdom that, in order to better control Medicare and Medicaid expenditures, the government would soon move to require that subsidized hospital residency programs — something AGH had had for decades — go through an academic institution.

For Allegheny General, that meant one thing: It would have to go shopping for a medical school.

There was no way the University of Pittsburgh was going to allow its largest competitor to have anything more than an incidental relationship with its medical school. Pitt did send perhaps a couple dozen medical residents to AGH every year. But even that meager affiliation was beginning to fray.

There were some overtures to Carnegie Mellon University in the early 1980s about creating a medical school. But those inquiries didn't go anywhere. And Duquesne University, at this point in its life in the

mid-1980s, was simply too weak financially and academically to be considered an option.

But if others saw Allegheny General's plight as an obstacle, Abdelhak seized it as an opportunity. With its own medical school, Allegheny General would no longer be subservient to Pitt, a position that grated on the nerves of many AGH doctors as well as on William Penn Snyder III, the longtime chairman of the hospital and its parent board, and other board members too.

After all, Allegheny General in the mid-'80s was more profitable and bigger than Pitt's Presbyterian-University Hospital, and it was equally advanced in several areas of medicine, including trauma, cancer and cardiac care. It had been the first hospital in the region and among the first in the country to offer helicopter service. It had been an early pioneer in nuclear medicine and had a national reputation for heart transplants and cutting-edge cardiac surgery.

There may never be a better time to break ranks with the superior-minded University of Pittsburgh Medical School.

Besides, with cost pressures growing on hospitals from the stingier Medicare and Medicaid programs and from insurers, Allegheny General needed medical residents. They're the hospital's version of hamburger flippers and store clerks. Thanks to government subsidies, which cover the costs of training, they're low-wage worker bees. The only difference is they provide high-wage care, from the emergency room to the operating room.

And by expanding clinical and basic science programs, Allegheny General could woo research dollars and high-priced talent, raising its status as an integrated health care provider that not only heals the sick but also develops new cures and methods of care. If it had a weakness, it was the relatively meager amount of research dollars it attracted. A med school would address that and help fix it.

Allegheny General's shopping list wasn't long, and for good reason. There weren't many medical schools looking to be bought.

Moreover, its desire to stay in-state — and thus avoid problems with interstate licensing — limited its prospects. So did its goal of finding a school at least 250 miles away so that competition for clinical patients between it and its new partner wouldn't become an issue. The last things Allegheny General doctors wanted were another hospital trying to lure away patients and a bunch of academics meddling in their affairs and undermining their authority. Distance had a way of solving these problems.

Given the parameters of the search, there was only one clear place to

look — Philadelphia. It had six medical schools, and at least one, the Medical College of Pennsylvania, was in deep distress. It didn't even have enough money to repair a leaking roof in its main building. Joyner, who had worked in Philadelphia for two decades, put out feelers and was told the college would be open to a combination.

At Allegheny General, there was some apprehension among doctors and a few board members, including Vincent Sarni, the hospital's chairman and chairman of PPG Industries.

Sarni was skilled at counting pennies and perusing balance sheets, and he wanted assurances that an MCP acquisition wouldn't harm AGH. Doctors also were concerned that the medical school could end up detracting from their work in Pittsburgh.

But those concerns were easily overcome by Allegheny General's desire to have its own medical school. It would be unprecedented for a nonprofit hospital to buy a med school, but these were unprecedented times. Across the country, teaching and university-related hospitals, confronted with mounting fiscal pressures in the wake of government cuts, were starting to link up with for-profit chains.

The only difference here was that AGH was nonprofit. That made it easy for the state attorney general's office to sign off on the deal. By law, the office, which is responsible for overseeing charitable organizations, didn't even have to do a review because one nonprofit was taking over another. (The attorney general's office stuck to that position in subsequent years as Allegheny was building its empire, often as a white knight coming in to take over struggling nonprofit brethren.)

Most everyone agreed that a medical school would open the door to more research dollars, recruits and prestige. And Abdelhak assured doctors and the board that no more than $4 million to $5 million a year would be needed to prop up MCP. There was even some thought of moving the school to Pittsburgh. And doctors would soon discover they liked seeing the title, "Associate Professor," on their letterheads.

Snapshot of AHERF
June 30, 1992

Employees: 13,125
Revenue: $893.2 million
Assets: $1.12 billion
Debt: $367 million
Inpatient admissions: 68,394

* Based on Allegheny Health Education and Research Foundation and tax documents

So the deal was cut in late 1987. And on April 27, 1988, Allegheny General's parent — then called Allegheny Health Services — and MCP announced that the medical school would become part of the Allegheny organization and that Allegheny would pump $40 million to $60 million into the school over the next five years, with groundbreaking for a new office and parking complex to begin the following year.

No one knew it at the time, but Allegheny Health's Philadelphia story was just beginning.

Less than two years after the MCP deal, Allegheny and Hahnemann University, another Philadelphia medical school, only bigger and better endowed than MCP, began discussing a possible merger. The late 1989-early 1990 conversations were limited and relatively secret, involving just a few advisers as well as Abdelhak and Iqbal Paroo, Hahnemann's chief.

At the time, Hahnemann and its inner-city teaching hospital were beginning to feel the pinch all urban medical centers were feeling. It was brought on by mounting restrictions on payments for care to the poor and elderly and a shift by managed-care insurers away from higher-cost teaching hospitals. Hahnemann could use a stronger financial partner.

For Allegheny, Hahnemann brought to the table something MCP lacked — a wide array of clinical programs that could give medical school students more on-site training and a new avenue to attract more private dollars for research now that the government continued to cut back.

MCP's focus was more on basic research, the sort of arcane scientific experimentation that can lead to medical breakthroughs.

Hahnemann was more clinical — its doctors had their own practices and brought in both patients and industry-funded research. And it performed more open-heart surgeries than any other Philadelphia hospital by far.

The merger talks were fairly advanced when the potential combination collapsed. Some say the deal died because Abdelhak and Paroo were too much alike and clashed, others because of an uproar among MCP faculty who feared the loss of their new-found status as big fish in the hospital foundation's academic pond. MCP doctors and administrators clearly made their displeasure known when word of the potential combination leaked out, and Abdelhak, in a public statement after talks collapsed, said the decision to abandon the merger was MCP's to make and that he would stand by it.

Yet Abdelhak was undeterred. Even as his organization was talking with Hahnemann, it was eyeing St. Christopher's Hospital for Children, one of only two pediatric hospitals in the Philadelphia area. MCP was thin in pediatric specialties, and St. Chris, part of the ailing United Hospital System, appeared to be available.

But to get St. Chris, Allegheny also would have to pick up United's three struggling suburban hospitals — Warminster, Rolling Hills and Lawndale. The three hospitals didn't offer much to the mix. MCP didn't really need more beds in an already overbedded market; it was looking to

expand training and research through the reputable children's hospital. But when Allegheny offered $75 million just for St. Chris, it was rebuffed.

A few board members suggested putting off a deal until United went bankrupt. Then Allegheny could pick up St. Chris on the cheap. But Allegheny wasn't the only one interested in St. Chris, and it didn't want to get in a bidding war in the highly competitive Philadelphia market, where hospital mergers and acquisitions were starting to take off.

Temple University School of Medicine already had a strong affiliation with St. Chris, which served as its department of pediatrics. No way would Temple sit by idly and let Allegheny take over St. Chris in a bankruptcy court auction. United also had held merger talks with Hahnemann University Hospital and Graduate Hospital, another inner-city hospital.

Better to act now than to wait and possibly lose, Abdelhak argued. The suburban hospitals could serve as feeders, expanding Allegheny's reach into more affluent parts of Philadelphia, where patients with better insurance coverage and deeper pockets could be funneled into its inner-city teaching and research hospitals for higher-cost specialty care.

Everyone could see that the world of health-care economics was rapidly changing. Cost controls and declining government and insurance reimbursements had replaced the era of easy money. If you could control the flow of patients, you could have more control over your destiny.

Bigger was still better, but not just because it meant more money, but because it also meant there were more opportunities for efficiencies and to bargain with insurers.

Economies of scale — the ability to maximize profits by spreading costs over a bigger base of patients — was the driving force behind health care consolidation. Eliminate excess beds; centralize purchasing, accounting and information services; and gain enough market share to negotiate with insurance companies from a position of strength. That was a particular need in Philadelphia, where a bruising battle was taking place between health insurance giants U.S. Healthcare and Independence Blue Cross. Together they accounted for more than eight of every 10 privately insured patients.

For Allegheny, there was an added plus: with a major presence in Pittsburgh and Philadelphia, it could offer a true cross-state network of hospital care to PNC Bank, Mellon Bank and other organizations with statewide operations.

It was enough to convince the Allegheny board. So three years after taking on MCP, a second deal was cut — though not without

controversy.

For one, directors learned at the last minute that scores of United managers had obtained sizable severance packages — a surprise that was repeated just two years later, when Allegheny ended up getting Hahnemann after all.

And investors awaiting a $60 million bond issue by Allegheny General Hospital weren't told about the talks with United until after the bond sale. Now they were left wondering if Allegheny General could get stuck helping support the rapidly expanding Philadelphia operations.

Allegheny worked quickly to stem the fallout. It said it expected to generate substantial savings by slashing the United payroll, and, within a year, it closed the 63-bed Lawndale hospital and terminated almost 300 workers.

It also emphasized that the United transaction was entirely separate from the AGH bond issue, so that bondholders bore no financial obligation or guarantees for the United hospitals. Finally, it said it wouldn't assume any of United's $137 million in long-term debt.

Of course, over time, the parent organization did take on United's long-term debt, through the creation of a new subsidiary that fell under the Allegheny umbrella. And Allegheny General did help prop up the hemorrhaging Philadelphia operations — money made available because frequent bond sales helped free up cash for other uses.

Still, in January 1991, all that really wasn't an issue. The bottom line was that the troubled United system had a new owner, one that by all appearances was deep-pocketed and committed to quality. Its profit margins may have been on the decline, but it still had substantial resources and a track record for performance — a year after the merger, the United hospitals were posting profits and their bond ratings were upgraded.

The burgeoning Allegheny empire now consisted of a medical school and five hospitals in the City of Brotherly Love, while back at home in Pittsburgh, it was eyeing 100-plus-acre parcels in the North Hills and South Hills for expansion.

The Allegheny steamroller was going full steam.

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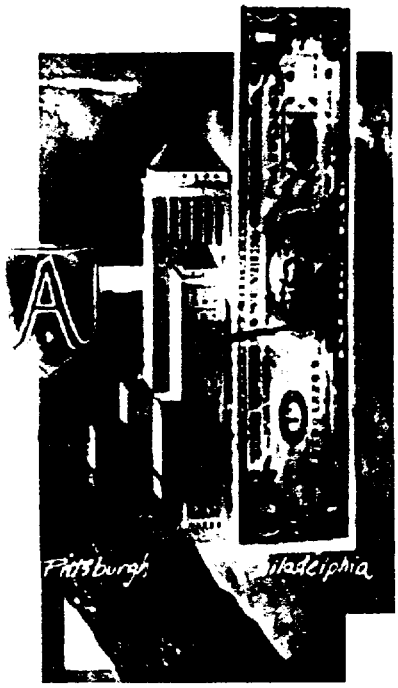
Anatomy of a Bankruptcy

Part 4: Running on the edge

Thursday, January 21, 1999
By Steve Massey, Post-Gazette Staff Writer



By January 1998, Bill Snyder had had enough. He'd been deluged with complaints that Allegheny wasn't paying its bills.

For some time, the health care giant had been stretching out its payments to suppliers, from 60 to 90 days and beyond. It was a way to preserve cash, an increasingly rare commodity these days. And it wasn't as if Allegheny was the only one in the health care industry doing it. Insurance companies were notorious for waiting 90 days or longer to pay hospitals for services.

But several suppliers weren't willing to take it anymore, and they let Snyder, chairman of Allegheny's parent foundation, know. He called Harry Edelman, a longtime member of the organization's board and chairman of a group of Allegheny's Philadelphia hospitals where the suppliers were complaining the loudest.

Snyder wanted to know what the heck was going on — and to make sure that the glitch in the system got fixed so that suppliers could get their money.

If only it had been just a glitch.

A decade of spending — on hospital mergers, new offices and renovations, on doctors, escalating salaries and executive perks — had caught up to the health care giant.

Money was going out a lot faster than it was coming in. And the well of

reserves that had seemed so deep a decade before was running dry.

There had been steep cutbacks the previous October, when Allegheny axed 1,200 Philadelphia hospital workers and vowed to slash the pay of top managers by 20 percent. That was on top of another 500 workers who were laid off with the closure of its Mt. Sinai hospital, acquired as part of the Graduate Health System merger the year before.

It was hoped the cost-cutting measures would stem the rising tide of red ink, but the losses just kept coming. And the problems went much deeper than declining government reimbursements and the increasing power of cost-conscious managed-care insurance plans. Years of miscalculations, missteps and running on the edge were taking their toll.

To many, the Graduate merger was the final straw. Outsiders and even some high-ranking insiders couldn't understand this one. It's true that the earlier acquisitions of the MCP and Hahnemann medical schools, their hospitals and the United group of hospitals had appeared to work out.

The hospitals were making money, which was more than many of their brethren were doing. But profit margins were starting to erode, just as they were at hospitals throughout Philadelphia, the state and the nation.

From fiscal 1994 to fiscal 1995, the United group and its St. Chris affiliate reported that revenue over expenses — hospital-speak for income — nearly doubled, from a combined $9.6 million to $15.7 million, before falling back to a combined $3.3 million in the fiscal year ended June 1996.

And MCP and Hahnemann, which had merged to form one medical school, were losing money on operations — their day-to-day costs. But they also were bringing new money in — federal and private research dollars at the combined schools totaled $75 million in fiscal 1996, and would top $120 million a year later. In contrast, Allegheny General a decade earlier — when it had no medical school — took in less than $10 million for research. The MCP-Hahnemann faculty wasn't getting along all that well. But combine any two schools and there would be clashes, particularly med schools, where egos are sensitive and often unyielding.

The bottom line: As 1997 was approaching, the board was comfortable that Allegheny's Philadelphia experiment was working, but that it needed more time to work out the kinks. And it bought into the idea that, in a struggling market, the best defense is a good offense: Buy market share on the cheap and, when the good times start rolling again, you make out like a bandit.

For Snyder and other board members, these were heady times. Allegheny's strategy was paying dividends. It had more than quadrupled in size in less than 10 years, and had risen in stature in medical circles,

attracting big-name researchers and serving as a new model for growth and survival in the pressure-packed health care business.

Still, Graduate, which Allegheny began managing in the summer of 1996 and formally acquired the following spring, presented a challenge. It came with a lot of problems, the least of which was that its hospitals were drifting into the red.

A dispute with the region's biggest insurer, Independence Blue Cross, threatened to drive business away. Independence had made a stab at buying Graduate in 1994, and there remained bad blood.

And four of Graduate's six medical facilities, including its flagship hospital, were in the city, where over-capacity and a high concentration of poor patients made for a deadly fiscal mix. Graduate's network of hospitals had been patched together over the past decade, and its management feared it was still too small to survive on its own in the ever-tougher environment of medicine in the 1990s.

Graduate also brought to the table $174 million of debt, primarily bonds assigned junk ratings by the major credit-rating agencies. At the time, Abdelhak said the debt would remain Graduate's responsibility, but ultimately it ended up under the Allegheny umbrella. Maybe that wouldn't have been so bad if Allegheny had also obtained Graduate's pot of gold — about $70 million in reserves from the previous sale of a managed-care venture. But that money would stay with Graduate's surviving foundation, which was not part of the deal.

But Abdelhak was a builder, and a convincing one at that. With Graduate, he told the board, he could build the biggest hospital system in Philadelphia, leapfrogging past No. 1 University of Pennsylvania and No. 2 Jefferson Health Systems, with a 13 percent share of metropolitan Philadelphia hospital beds.

He had designs on creating a nationally renowned sports medicine center, as well as a women's hospital, filling holes in Allegheny's Philadelphia network.

Snapshot of AHERF
June 30, 1996

Employees: 20,243
Revenue: $1.62 billion
Assets: $1.87 billion
Debt: $750.6 million
Inpatient admissions: 86,415

* Based on Allegheny Health Education and Research Foundation and tax documents

Allegheny also would pick up Graduate's physician practices subsidiary, adding 100 doctors to its growing network. Remember: If you control the hospitals and doctors, you have more control over your destiny. And as the biggest kid on the block, Allegheny would have more control than anyone.

It was time to let the world know it. Allegheny hung its banner on its

Philadelphia-area hospitals and its medical school, putting them all under the Allegheny University name. (The signs were often just canvas, presenting no problems two years later when new owner Tenet Healthcare took them down to put up its own.) It struck a multimillion-dollar deal for advertising and promotions with the Philadelphia Eagles and Veterans Stadium.

And the big-bucks announcements kept coming: In October 1996, it committed $100 million to cancer research; in December 1996, it created a New Jersey subsidiary and pledged to grow it to six or seven hospitals; and in March 1997, it unveiled plans for two Center City buildings totaling 450,000 square feet and costing $100 million.

But even as it was drawing the attention and praise of political leaders who saw the promise of jobs and prosperity, the pillars were starting to crack. The announcement that Graduate's Mt. Sinai hospital would close came in August 1997, followed by the 1,200 layoffs in the Graduate system in October.

Allegheny tried to put the best spin on the situation. It said it remained committed to Philadelphia and that Pittsburgh wouldn't be affected. But as often was the case, what Allegheny said was at odds with reality. The truth was, the empire was coming apart at the seams.

Just as it was completing its takeover of Graduate, the full impact of revenue-reducing changes in Medicaid and Medicare programs — which shifted a large portion of recipients into managed-care plans and forced hospitals to accept more free-care patients — started to hit. By the end of 1997, Allegheny officials estimated, those pressures were reducing revenue at their Philadelphia hospitals at the rate of at least $100 million a year.

The decline came as costs continued to rise. In 1997, annual payments on the Allegheny system's bond debt alone totaled $91 million, a chunk of which was added in June 1996 when the organization issued $365 million of bonds for its Philadelphia hospitals and medical school.

Costs were rising in other areas, too. For example, Allegheny's strategy of buying primary care physicians to funnel more patients to its hospitals was failing miserably. Losses at the medical practices subsidiary would swell to $60 million in the 12 months ended June 1997, and continued to mount into 1998.

It's not hard to understand why. Allegheny may have owned the practices, but the doctors legally couldn't be forced to refer all their patients to Allegheny hospitals for high-priced specialty care. Many had long-standing relationships with other Philadelphia hospitals, and their loyalties lay there. Many of their patients preferred other hospitals as well.

Moreover, like other hospital companies snapping up practices, Allegheny overpaid. It sometimes offered doctors guaranteed salaries and even raises, and the price of the buyouts often represented twice what the clinics were generating in revenue in a year. It hoped to make up the costs by squeezing expenses and luring more customers, and by including performance standards for the doctors.

But those performance clauses didn't appear to be worth much. Allegheny, like other hospital companies across the country, wanted doctors and was in a buying frenzy — and the doctors knew it. So, after working all hours to make their businesses go and then selling them to Allegheny, some worked less, not more, causing a decline, not an increase, in office revenue.

And Allegheny's expectations for making the offices more efficient proved wildly optimistic.

Take its centralized billing system. Doctors at clinics that were bought say Allegheny insisted that it handle the billing. Yet it often was slow to bill clients, and did a poor job at going after insurers for payments on small claims.

Never mind that small claims make up the bulk of a clinic's business. Allegheny's billing system was geared toward the big bills hospitals try to collect; it couldn't be bothered with what must have seemed like nickel-and-dime stuff.

"If they had a $100 bill denied, the hospital didn't follow up,'' said Joseph Calhoun, a partner in a North Hills primary care practice, Pine Richland Medical Associates, which Allegheny General opened in 1993.

Adding to its problems was what proved to be a deadly third rail in Allegheny's desire to be a full-range player in the health care business: insurance.

It didn't actually provide insurance, but it did contract with HealthAmerica and U.S. Healthcare in Pittsburgh and Philadelphia to provide medical services to 500,000 of their managed-care clients at a price equal to roughly 80 percent of the premiums the insurers collected.

At the time, in late 1996, Allegheny felt it could provide the care for that price — the insurers kept the remaining 20 percent to cover the accounting and other administrative functions that they still provided.

But far from making money, the so-called shared-risk contracts were money losers. HealthAmerica alone contends Allegheny owes it more than $100 million.

In some cases, the managed-care patients balked at going to Allegheny hospitals, forcing Allegheny to pay unaffiliated hospitals for care even though it had no control over their costs.

Even when patients came to its hospitals, Allegheny had trouble controlling costs. Its "mean administrative cost per adjusted discharge," a common benchmark used to measure hospital overhead, was an estimated $720, a third higher than the norm for Pennsylvania hospitals

It's not that surprising. Allegheny relished being a big spender well before it marched on Philadelphia, and in Philadelphia it spent even more freely, dangling big bucks in front of hospitals, doctors and medical researchers.

Getting bigger all the time

On the way to bankruptcy, the Allegheny Health, Education and Research Foundation grew into Pennsylvania's largest health care system.

	Revenues	Employees	Admissions
Allegheny Health, Education and Research Foundation	$2.05 billion	31,270	128,338
UPMC Health System	$1.5 billion	23,000	76,430
University of Pennsylvania Health System	$1.44 billion	18,000	75,400
Jefferson Health System	$1 billion	13,600	69,913

Sources: The health systems, for fiscal year ended 6/30/97.

Stories are legion about management retreats at Rolling Rock Country Club in Ligonier, Nemacolin Woodlands near Uniontown, and Camp AHERF, the nickname given to an educational seminar held every six months or so at a North Carolina resort formerly owned by tobacco baron R.J. Reynolds.

Fat car allowances and regular golf outings at exclusive clubs were showered on top administrators and doctors. Executive and committee meetings were common at Pittsburgh's private, and pricey, Duquesne Club, the traditional home-away-from-home for the region's captains of industry.

And though they were working trips, quarterly meetings in places like Amsterdam, Paris and Reykjavik, Iceland, made the Cayman Islands insurance venture seem extravagant. Never mind that, by law, the offshore subsidiary was barred from holding meetings on the mainland, or

that other hospital systems, including UPMC Health System, had similar operations to save on malpractice premiums. It just didn't look good.

Then there was the pay. Allegheny administrators and star doctors earned top dollar, and were unapologetic about it. In 1997 alone, the base pay of 26 senior administrators averaged more than $350,000, almost as much as the median for CEOs of large not-for-profit health care companies surveyed by the benefits consulting concern Hay Group. At $1.17 million, Abdelhak's compensation package almost tripled the $393,000 reported by his counterpart at UPMC Health System, Jeffrey Romoff.

The cost of all those perks and pay were exacerbated by a health care system that, by most any measure, was bloated. Almost from the beginning, bureaucracy and Allegheny went hand in hand. Even in the mid-1980s, when it was just Allegheny General and a few subsidiary organizations, there were four different boards and three dozen directors.

But by mid-1997, the Allegheny system had ballooned to 10 separate boards, 55 different legal entities, 132 directors, 117 senior managers and a parent organization with nearly 2,000 employees. A common joke was that the Allegheny system had more vice presidents than most major Wall Street banks.

There was little overlap on the boards, and directors say they never were sure what was going on elsewhere in the empire — each was under orders to focus on his or her own part of the world, largely out of the design of Abdelhak and his inner circle. It wouldn't do to have too much meddling in the organization's affairs; carving it up into a bunch of groups helped get around that problem. "It was divide and conquer,'' a former director says.

By late 1997, however, even the parent board could tell something was amiss. Money was running short, and the environment for health care wasn't improving any. In fact, it was getting worse; insurers were demanding more discounts, and the government was tightening more.

Tired of watching Allegheny stretch out bill payments, vendors began asking for money up front. Members of the parent board were uncovering sizable loans and fund transfers that they did not recall approving. And Abdelhak was growing increasingly defensive, blaming his managers for questionable actions.

The patient — the Allegheny health system — was critical.

Pretty soon it would be Code Blue.

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Committee on Biological Effects of Ionizing Radiation (BEIR) VII

September 2, 1999

Statement of Wenonah Hauter

Public Citizen, founded in 1971 by Ralph Nader with a current membership of 150,000, is an advocacy organization that exposes threats to health and safety and gives citizens a voice in the halls of power. Since 1974 Public Citizen's Critical Mass Energy Project has worked on issues related to nuclear power, radioactive waste, and energy production.

We are extremely concerned about the composition of the Biological Effects of Ionizing Radiation (BIER) VII panel, and the negative effect that a panel stacked in favor of the nuclear industry will have on public policy. Science does not operate in a vacuum and the policy implications of the composition of this scientific panel can not be underestimated. The expert panels that are convened by the National Academy of Science provide guidance to Congress and the federal agencies in developing public policy.

The recommendations made by the panel will play an important role in the outcome of the ongoing campaign by the nuclear industry and its allies in the U.S Department of Energy (DOE) and the U.S. Nuclear Regulatory Commission (NRC) to release thousands of tons of radioactive material to be "recycled" into household products. The nuclear industry and the associated agencies will save billions of dollars in operation and cleanup costs for contaminated sites if weak standards are adopted and they can argue that the radioactive material is not a health hazard. A recommendation by this panel to further weaken radiation standards will help justify the "free release" of this radioactive metal and other materials into the public sphere.

Radiation health effect research has been profoundly shaped by the nuclear legacy of stealth and secretiveness, and attempts by the federal government and the nuclear industry to minimize the public's concern about nuclear weapons, nuclear power, and ionizing radiation. The panel, which has been named, is dominated by individuals whose work has been conducted within the institutional settings that are heavily influenced by the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC) and the nuclear industry.

The BEIR panel does not include a sufficient number of individuals who have demonstrated independence from the nuclear industry and their federal agency cheerleaders in their peer-reviewed publications. Unless the panel is balanced, the credibility of the work and the policy recommendations will be in question.

Related to this is the fact that federal agencies, under the Federal Advisory Committee Act (FACA), are precluded from using recommendations of a National Academy of Science committee, which 1) is not genuinely balanced; 2) has members with conflicts-of-interest (unless that person's participation can be demonstrated to be so significant as to outweigh the conflict and the conflict is disclosed); or 3) violates requirements regarding openness and the opportunity for meaningful public comment on nominees for membership on the committee prior to their being named to the committee.

The NAS has violated all three requirements of FACA by creating a committee with membership dominated by individuals who have taken positions favorable to the nuclear industry in this scientific debate. Several individuals also have conflicts-of-interest because they work on contract with institutions that have a major economic interest in the outcome of the panel's recommendations. The requirement for meaningful public comment has also been violated by NAS's refusal to release the relevant information about the panel participants and then scheduling a meeting of the committee almost immediately after the public comment period, leaving no time to make appropriate changes in the composition of the panel.

We therefore must respectfully request that the panel members resign in order to maintain their scientific integrity and to distance themselves from a biased panel which they did not create.

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Mystery mailer sends radioactive material to Japanese government offices

June 12, 2000
Web posted at: 7:18 PM HKT (1118 GMT)

TOKYO (AP) -- Envelopes containing small amounts of radioactive powder were mailed anonymously last week to the Japanese prime minister's residence and other government agencies, officials said Monday.

At least one of the envelopes, dated June 6, contained a message warning that radioactive materials were being sent from Japan to North Korea, a police official said. Another government official reported getting a letter containing a sand-like substance.

Prime Minister Yoshiro Mori's residence received one of the envelopes last Thursday, said Chief Cabinet Secretary Mikio Aoki. The envelope contained 3 grams of powder of about 1 micro-sievert of radioactivity -- too little to harm humans, he said.

The Science and Technology agency said the average person is exposed to about 1,000 micro-sieverts of radioactivity a year.

Kyodo News agency reported that an initial examination indicated the substance may be ground monazite, a mineral containing thorium, a nuclear fuel material. The envelopes were postmarked in Tokyo.

Nine government offices received the mysterious mail, and the government has warned ministries and agencies not to accept packages without the name of the sender, said Kazuhiko Koshikawa, a Mori spokesman.

It was not immediately clear if the mailings were meant to injure anyone. The threat brought memories of the Aum Shinri Kyo cult's 1995 nerve gas attack on subways in Tokyo's central government district, which killed 12.

The Education Ministry received an envelope containing the mysterious substance with a letter warning that "radioactive substance is being sent to North Korea and police should investigate because it is dangerous," said Hajime Kajiwara, an official of the Kojimachi police station near the ministry.

Kazunobu Asada, an Education Ministry spokesman, said the envelope contained "a very small amount of a sand-like substance."

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Similar envelopes were sent to the Home Affairs Ministry, the national police, defense and public security investigation agencies, as well as the Agency of Natural Resources and Energy, and the National Public Safety Commission, Kyodo reported.

Yoshinori Inoue, an official at the Home Affairs Ministry, said the ministry received a letter dated June 6 but did not accept it because the sender's name was not on the envelope.

Also Monday, a package bomb exploded at a lawyers' office in Tokyo, slightly injuring a woman's right hand, police said, refusing the release further details. The office was located near major government offices in Tokyo.

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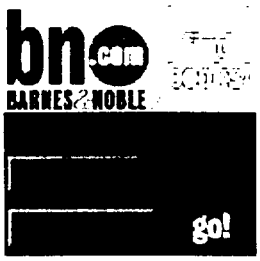

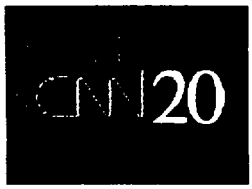

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Japanese leader, government offices target of radioactive mailing

June 13, 2000
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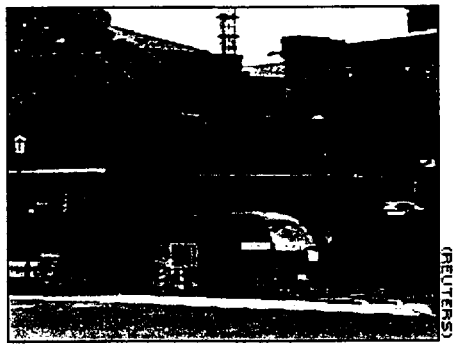
(REUTERS)

One target of the "radioactive mail" was the Japanese prime minister's official residence

TOKYO (CNN) -- Tokyo police are trying to find out who sent envelopes containing small amounts of radioactive powder to several government agencies and the Japanese prime minister's home.

Tokyo Metropolitan Police said Monday the nine anonymous envelopes contained traces of thorium, a radioactive element, but that they posed no health danger. The packages were received last week.

The Japanese government said Monday it held off releasing information about the contaminated envelopes for several days because it did not want to encourage copycat attacks.

AUDIO
CNN's Marina Kamimura reports from Tokyo on the envelopes containing radioactive powder received at several government agencies

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Also Monday, a package bomb exploded at a lawyer's office in Tokyo, slightly injuring a woman. The office is located near government offices, but police refused to release details about the bombing.

Recipients include police, education offices

Prime Minister Yoshiro Mori's residence received one of the envelopes Thursday, said Chief Cabinet Secretary Mikio Aoki. It contained 3 grams (a tenth of an ounce) of powder with about 1 micro-Sievert of radioactivity, too little to harm humans, Aoki said.

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The Education Ministry received an envelope June 6 with a letter warning that a "radioactive substance is being sent to North Korea and police should investigate because it is dangerous," said Hajime Kajiwara, an official of the Kojimachi police station near the ministry.

Kazunobu Asada, an Education Ministry spokesman, said the envelope contained "a very small amount of a sand-like substance."

Similar envelopes, all postmarked in Tokyo, were sent to the national police, defense and security agencies as well as the National Public Safety Commission and the Agency of Natural Resources and Energy, the Kyodo News agency reported.

Yoshinori Inoue, an official at the Home Affairs Ministry, said the agency received a letter dated June 6 but did not accept it because the sender's name was not on the envelope.

Government urges caution

(REUTERS)

A package bomb that exploded Monday at a lawyer's office in Tokyo slightly injured one woman

Government authorities on Monday warned ministries and agencies to refuse all parcels that lacked a sender's name, said Kazuhiko Koshikawa, a Mori spokesman.

For years, Japan enjoyed a reputation as one of the world's safest nations. Public confidence, however, has been shaken recently by a series of high-profile crimes as well as a growing juvenile crime rate.

In 1995, the Aum Shinri Kyo cult staged a nerve gas attack on subways in Tokyo's central government district that killed 12.

On Saturday, a nail bomb exploded at a festival in Sapporo, in northern Japan. Ten people were injured, one seriously.

Police don't believe Monday's bombing at the lawyer's office is related to the blast Saturday.

CNN Tokyo Bureau Chief Marina Kamimura and The Associated Press contributed to this report.

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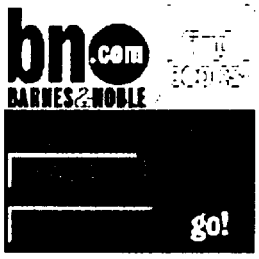

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Vol. 324 No. 7

The New England Journal of Medicine

BOOK REVIEWS

Feb. 14, 1991

HEALTH EFFECTS OF EXPOSURE TO LOW LEVELS OF IONIZING RADIATION: BEIR V

Prepared by the Committee on the Biological Effects of Ionizing Radiation, National Researdh Council. 421 pp. Washington, D.C., National Academy Press, 1990. $35.

RADIATION-INDUCED CANCER FROM LOW-DOSE EXPOSURE: AN INDEPENDENT ANALYSIS

By John W. Gofman. 480 pp. San Francisco, Committee for Nuclear Responsibility Book Division, 1990. $29.95.

Two national advisory groups have great influence with regard to the safe conduct of the population through an environment contaminated with ionizing radiation. These are the National Council on Radiation Protection and Measurements and the National Research Council's Committee on the Biological Effects of ionizing Radiation (BEIR). Over the years, both these groups have raised their estimates of the risk of radiation-induced cancer as new evidence has accumulated on the delayed adverse effects of low-level exposure. Now comes a book published by an independent education group (the Committee for Nudear Responsibility) that takes strong issue with the most recent report of BEIR (BEIR V). The author, John W. Gofman, is the founder and former director of the Biomedical Research Division of the Lawrence Livermore National Laboratory.

Both these works agree that previous assessments of the dangers of radiation underestimated the risk, but they reach substantialy different conclusions about the magnitude of the risk, especially when the radiation is at lower doses (below 10 rem) and the doses are delivered slowly. Both reports primarily concern ionizing radiations with a low linear energy transfer, such as gamma rays or x-rays, as opposed to radiations with a high linear energy transfer, such as neutrons or alpha particles. We compare some of the features and major conclusions of these books.

Beginning in 1950, more than 90,000 atomic-bomb survivor from Hiroshima and Nagasaki were enrolled in a lifetime health study. The Radiation Effects Research Foundation--an agency sponsored jointly by the U.S. and Japanese governments--has been in charge of this study since 1975. Its data provide direct quantitative evidence of

radiation-induced cancer from short-term exposure of organs at doses of 11 to 15 rem. This prospective study is the cornerstone of the epidemiologic evidence concerning the effects of radiation on humans. A substantial body of information about the health and mortality of the atomic-bomb survivors is in hand. Most of the people exposed at an early age are still living; their ultimate fate will provide critical new data in the ongoing analysis. Recently, the Radiation Effects Research Foundation altered the architecture of this study in major ways to account for new dose estimations, shifting thousands of survivors into different cohort groups and temporarily dropping about 15,000 survivors from the study because of "dose uncertainties."

During the past 40 years, various research organizations, committea, and governmental agencies have evaluated the atomic-bomb study and others in humans, plus data in animals, in assessing the consequences and deriving estimates of risk from exposure to ionizing radiation. Cancers, leukemias, and genetic effects have all been demonstrated to result from both short-term and long-term exposure. Over time, the growing body of scientific evidence showing that radiation is more hazardous than previously thought has resulted in upward revisions of the estimates of the risk of cancer. Since the guidelines for allowable or permissible levels of exposure to low-level ionizing radiation are based on these risk estimates, their accuracy has major public health implications.

The BEIR V document evaluates several aspects of the effects of low-level radiation on humans and animals, including the induction of leukemia, the induction of cancer both generally and at specific sites, genetic effects, and the effects of in utero exposure on brain development and childhood cancers. Three large chapters examine the induction of cancer and leukemia and formulate assessments of risk. The other chapters cover scientific principles and background information, genetic effects, other somatic and fetal effects, epidemiologic studies involving low doses of radiation, and data and analysis pertaining to research in animals. The text is well written, well organized, and extensively referenced. The executive summary outlines the major conclusions clearly. Certain sections on mathematical risk models are complex. Unfortunately, the glossary and index are incomplete, weakening the overall presentation and the reader's ability to find information quickly. For example, "dose-rate effectiveness factor" is an important concept in this work, and although we found it mentioned or discussed at least 17 times in the text, the index only noted 2 of the minor mentions. Some other key words and concepts are not indexed at all.

The second of these books, that by Gofman, focuses almost exclusively on the induction of cancer in humans as a result of low-level ionizing radiation. The book is well organized, clear, exhaustively detailed, and comprehensively referenced. As a result, lay persons or students of other disciplines will be able to master the information with some effort. Through the use of raw data, graphs, tables, charts, and calculations, the reader is taken step by step through the complexities of physics, statistics, and epidemiology. Some sections are highly technical. The book is organized into 25 major chapters, each of which lays the scientific foundation for the next, into which it flows, although some chapters could also stand alone. The 12 supporting chapters provide additional analysis or examples of key points made in the main body of the book. There are frequent cross-references from one section to another. Extensive direct quotations from other reports facilitate an understanding of the views of other analysts. The "index and glossary" is one of the most comprehensive and thoughtful we have seen--brief definitions often appear with the index entry, flagged entries locate the meaning of a term or phrase in context, and even images and phrases have their own entria.

Some of Gotman's major conclusions about the induction of cancer from low-level ionizing radiation are that **(1)** there are adequate human epidemiologic data on the effects of radiation at low doses to quantify risks directly at those dose levels, without extrapolating from studies of high doses; **(2)** there is no safe dose or dose-rate -- i.e., there is no threshold below which there is no risk; **(3)** there is no protection offered from fractionation or the slow delivery of low total doses -- i.e., dose-rate-effectiveness factors, which predict decreased risk under these slow-dose circumstances, should not be used for humans; **(4)** in the low- dose range, the risk of cancer is possibly more severe per dose-unit than in the moderate- and high-dose ranges -- i.e., the dose-response curve may be supralinear; **(5)** the approximate lifetime yield of fatal cancer in the low-dose range is 27 excess deaths from cancer per 10,000 person-rem (wholebody dose) in populations of mixed ages, but for young persons the risk is even higher; **(6)** over the course of several decades, about 400,000 people in Europe and the Soviet Union combined could die of cancer resulting from long-term exposure to fallout from Chernobyl, and **(7)** there is no scientific validation for the concept of hormesis (a net beneficial effect from radiation).

Gofman devotes 13 chapters to a detailed analysis of the atomic-bomb data base, and he relies heavily on those findings and other evidence in humans in deriving the conclusions listed above. As part of this process, he presents the raw data on mortality that were accumulated from 1950 to 1982 for the survivors of Hiroshima and Nagasaki. Although he is sharply critical of the ways in which the Radiation Effects Research Foundation is retroactively altering the atomic-bomb study (e.g., dismantling cohort groups and creating new ones) in order to account for new dose estimates, Gofman supports the use of improved dosimetry. He demonstrates the effect of a simple method of parallel analysis that he calls "constant-cohort, dual-dosimetry," which allows the incorporation of new dose estimates but leaves the original prospective architecture and cohort groups of the study intact. He pleads that failure to preserve continuity in this "uniguely valuable database" will invalidate its legitimacy as a true prospective epidemiologic study and throw into question the reliability of future results.

By contrast, some of the major conclusions of BEIR V about the effects of low-level ionizing radiation are that **(1)** there are insufficient epidemiologic data at low doses to quantify directly the risk of cancer in humans at those levels, and extrapolation from higher doses (above 10 rem) is necessary; **(2)** epidemiologic data cannot exclude the existence of a threshold in the millisievert dose range (1 millisievert equals 0.1 rem), and therefore the possibility cannot be ruled out that there are no risks from exposures comparable to the natural background level; **(3)** for low doses of radiation with a low linear energy transfer delivered slowly, the lifetime risk is less, "possibly by a dose-rate-effectiveness factor of 2 or more"; **(4)** for cancer other than leukemia, the dose-response curve is linear throughout the dose range under 400 rem, and for leukemia it is linear quadratic; **(5)** the approximate lifetime yield of fatal cancer (assuming short-term 10-rem whole body exposure to gamma rays per person) is eight excess deaths from cancer per 10,000 person-rem for populations of mixed ages, but for children the risk is probably twice as high; **(6)** in utero exposure can cause childhood cancers and leukemias, and possibly disease in adulthood; and **(7)** the most sensitive gestational age for radiation-induced mental retardation is 8 to 15 weeks, with the risk being a 4 percent chance of retardation per 10 rem of exposure.

Although the findings (and methods) of these two reports differ on major points, there are substantial areas of agreement. Both find radiation more hazardous than was previously believed. Both find that the dose-dependent excess of cancer is best expressed with a

"relative" risk estimate or model (i.e., "the number of excess cancers per unit dose induced by radiation is increased with attained age, while the risk of radiogenic cancer relative to the spontaneous incidence remains comparatively constant"). Both find that there is necessarily some uncertainty and imprecision in their risk estimates. They agree that with the completion (in a few decades) of the atomic-bomb study, a more precise estimate of the survivors' lifetime risk will emerge, and that future modifications of the risk will be made as more data from all sources become available. They find children at higher risk per dose-unit of radiation. Both indicate that x-rays (from medical exposures or other sources of x-rays) may be twice as potent a carcinogen as the comparable dose of gamma rays and that therefore their risk values may need to be doubled when the effects of x-rays are predicted. Neither finds scientific evidence to support the hypothesis of hormesis.

One might ask why continuing evaluations of the effects of low-level ionizing radiation are important. To take only one example, a former chairman of the International Commission on Radiological Protection indicated some 12 years ago that if the permissible occupational exposure were to be reduced by a factor of 10 (i.e., from 5 to 0.5 rem per year), he doubted whether the nuclear-power plants of the time would have been able to continue operations. The implications of making regulations that meet scientific and health standards become obvious.

We would like to examine the forecast of fatal cancer derived from both these reports, when it is applied to industry standards for protection from radiation in the past and the present. With either analysis, it appears that even the current permissible exposure of 5 rem of whole-body radiation per year for nuclear-power workers is not actually a "safe" dose. What, then, does a permissible dose of radiation really mean? Warren Sinclair, president of the National Council on Radiation Protection and Measurements, recently said that the current permissible limits "were likely to be reduced" because of the new BEIR report.

First, consider that in 1934 the International Commission on Radiological Protection proposed a 52-roentgen (1 roentgen equals about 0.88 rem, therefore 52 roentgens equal 46 rem) maximal permissible yearly whole-body radiation exposure for workers -- a standard the experts believed was safe. This standard was "used world-wide until 1950." With the BEIR V data, one arrives at a prediction of one extra death from cancer per 3588 person-rem exposure to low-level ionizing radiation (after the application of a dose-rate-effectiveness factor of 2 and adjustment of the risk values for a population of workers 18 to 65 years of age). Therefore, in a population of 3588 radiation workers who received this maximal permissible dose in one year, 46 extra fatal cancers might occur. The same per annum exposure for 16 years (1934 to 1950) could eventually result in the occurrence of 736 extra cancers in the same population. With Gofman's estimate of a cancer risk that is 3.83 times higher than the BEIR V estimate (with correction for dose-rate-effectiveness factor), 2819 workers of an original group of 3588 would have received doses of radiation causing fatal cancer in the 16-year period, if they had been exposed to the maximal amount permissible every year. The spread of potential fatality rates is certainly impressive.

Second, today's worker in an environment where radiation is present is allowed a maximum of 5 rem of whole-body exposure per annum. If 3588 workers received this dose slowly in one year, the BEIR V data would allow a prediction of 5 future excess deaths from cancer, whereas the Gofman method would predict 19.

Gofman and the BEIR V committee have each produced a fascinating document. They

analyzed many of the same data but arrived at different conclusions. Although BEIR V finds acute exposure to low-level ionizing radiation to be about three times more hazardous as a cause of excess deaths from cancer than was estimated by the BEIR III committee a decade ago, Gofman condudes that the new BEIR V calculations still underestimate the risk substantially.

We strongly recommend both these excellent and timely books for physicians, engineers, and public health officials concerned with radiation, the environment, and public health. As humans contemplate prolonged flight beyond the magnetosphere, in the intense radiation environment of the nearby solar system, a whole new generation of space-flight engineers, physicians, and safety offficers must become deeply involved in this process.

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THE BULLETIN
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REVIEWS

Low-dose danger

Radiation-Induced Cancer from Low-Dose Exposure

by John Gofman
Committee for Nuclear Responsibility, 1990
480 pages; $29.95

GREGG S. WILKINSON

Few topics divide scientists more than that of the human effects of low doses of ionizing radiation. Some hold that very small doses of ionizing radiation are beneficial, a phenomenon dubbed "hormesis." In contrast, other researchers argue that low doses are relatively more dangerous than higher doses (especially in relation to cancer). In *Radiation-Induced Cancer from Low-Dose Exposure*, John Gofman, an activist and scientist with the Committee for Nuclear Responsibility, argues that no level of radiation exposure is safe. His reasoning, and the criticisms he offers regarding the ongoing study of atomic bomb survivors, should provoke more discussion.

The first 25 chapters of Gofman's work contain his major points and supporting data. They are followed by 12 chapters of additional data and discussion. This text, amply illustrated with 113 tables and figures, explains not only his arguments, but their bases.

The debate on low-level radiation is not an academic exercise. Gofman warns: "Partly because radiation research has been so well funded, there are far more data about ionizing radiation as a potentially toxic agent than there are about many other agents to which entire populations are exposed. Thus the field can be regarded as the `canary' which can warn humanity about practices which mean `trouble ahead' if adopted in other fields of toxicology."

Gofman sets out to prove four basic points: First, researchers have retroactively altered bomb-survivor data in a manner that will destroy the scientific integrity of a valuable study. Second, his calculations of radiation-induced cancer risks correlate closely with those of major radiation studies at moderate and high doses, but he finds risks as much as 30 times higher than estimates from those same studies at lower doses and dose-rates. Third, contrary to recent speculation, low doses of radiation have no beneficial effects and there is no safe dose or dose rate. And finally, the outcome of the low-dose controversy has major practical

implications: if low-dose exposures are deemed safe, medical, industrial, and environmental exposures will escalate--with corresponding increases in cancer rates.

Gofman raises several important issues. Researchers have redefined the cohorts of atomic bomb survivors and deleted the original structure of those cohorts after many of the study's results became known. This practice should be carefully examined by epidemiologists and others to determine if serious biases have been introduced and if the study's integrity has been compromised.

Gofman's criticisms of "dose rate effectiveness factors" (reducing risk estimates to bring them in line with the results of animal studies) and his suggestion that the risk of cancer may be relatively greater in the low-dose range than in moderate and high-dose ranges have sparked controversy in the past and will continue to do so in the future. For instance, Gofman predicts that approximately 400,000 Europeans and Soviets may die of cancer due to fallout from the Chernobyl disaster, a figure far higher than "official" estimates.

Although Gofman has simplified the many complexities of a topic at the crossroads of radiation physics, medicine, epidemiology, and statistics, some readers will find the technical details difficult to follow. The thoughtful organization and an expansive index and glossary will, however, make the more complex sections of this important resource understandable to the well informed lay reader. ●

Gregg S. Wilkinson is chief of the Division of Epidemiology and Biostatistics in the Department of Preventive Medicine and Community Health at the University of Texas Medical Branch, in Galveston.

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May 11, 1999
LETTER OF CONCERN.

To Whom It May Concern:

During 1942, Robert E. Connick and I led the "Plutonium Group" at the University of California, Berkeley, which managed to isolate the first milligram of plutonium from irradiated uranium. (Plutonium-239 had previously been discovered by Glenn Seaborg and Edwin McMillan.) During subsequent decades, I have studied the biological effects of ionizing radiation --- including the alpha particles emitted by the radioactive decay of plutonium.

By any reasonable standard of biomedical proof, there is no safe dose, which means that just one decaying radioactive atom can produce permanent mutation in a cell's genetic molecules. My own work showed this in 1990 for xrays, gamma rays, and beta particles (Gofman 1990: *Radiation-Induced Cancer from Low-Dose Exposure*). For alpha particles, the logic of no safe dose was confirmed experimentally in 1997 by Tom K. Hei and co-workers at Columbia University College of Physicians and Surgeons in New York (*Proceedings of the National Academy of Sciences (USA) Vol.94*, pp.3765-3770, April 1997, "Mutagenic Effects of a Single and an Exact Number of Alpha Particles in Mammalian Cells").

It follows from such evidence that citizens worldwide have a strong biological basis for opposing activities which produce an appreciable risk of exposing humans and others to plutonium and other radioactive pollution at any level. The fact that humans cannot escape exposure to ionizing radiation from various natural sources --- which may well account for a large share of humanity's inherited afflictions --- is no reason to let human activities *increase* the exposure to ionizing radiation. The fact that ionizing radiation is a mutagen was first demonstrated in 1927 by Herman Joseph Muller, and subsequent evidence has shown it to be a mutagen of unique potency. Mutation is the basis not only for inherited afflictions, but also for cancer.

Very truly yours,

John W. Gofman, M.D., Ph.D.
Professor Emeritus of Molecular and Cell Biology

Curriculum Vitae of Dr. John W. Gofman, M.D., Ph.D.

The following comes from pages 379-381 of
Preventing Breast Cancer: The Story of a Major, Proven, Preventable Cause of this Disease,
by Dr. John W. Gofman, M.D., Ph.D., 2nd Edition, 1996.

About the Author

John William Gofman is Professor Emeritus of Molecular and Cell Biology in the University of California at Berkeley, and Lecturer at the Department of Medicine, University of California School of Medicine at San Francisco.

He is the author of several books and more than a hundred scientific papers in peer-review journals in the fields of nuclear / physical chemistry, coronary heart disease, ultracentrifugal analysis of the serum lipoproteins, the relationship of human chromosomes to cancer, and the biological effects of radiation, with especial reference to causation of cancer and hereditary injury.

A Narrative Chronology

While a graduate student at Berkeley, Gofman co-discovered protactinium-232, uranium-232, protactinium-233, and uranium-233, and proved the slow and fast neutron fissionability of uranium-233.

Post-doctorally, he continued work related to the chemistry of plutonium and the atomic bomb development. At that early period, less than a quarter of a milligram of plutonium-239 existed, but a half-milligram was urgently needed for physical measurements in the Manhattan Project. At the request of J. Robert Oppenheimer, Gofman and Robert Connick irradiated a ton of uranyl nitrate by placing it around the Berkeley cyclotron (to capture neutrons), for a total exposure period of six weeks, with operation night and day. In 110 Gilman Hall, they scaled up Gofman's previous test-tube-sized sodium uranyl acetate process for the plutonium's chemical extraction. Dissolving 10-pound batches of the "hot" ton in big Pyrex jars, and working around the clock with the help of eight or ten others, they reduced the ton to a half cc of liquid containing 1.2 milligrams of plutonium (twice as much as expected).

After the plutonium work, Gofman completed medical school. In 1947, he began his research on coronary heart disease and, by developing special flotation ultracentrifugal techniques, he and his colleagues demonstrated the existence of diverse low-density

lipoproteins (LDL) and high-density lipoproteins (HDL). Their work on lipoprotein chemistry and health consequences included the first prospective studies demonstrating that high LDL levels represent a risk-factor for coronary heart disease and that low HDL levels represent a risk-factor for coronary heart disease. His principal book on the heart disease research is *Coronary Heart Disease* (1959, Charles C. Thomas, Publisher).

In the early 1960s, the Atomic Energy Commission (AEC) asked him if he would establish a Biomedical Research Division at the Lawrence Livermore National Laboratory, for the purpose of evaluating the health effects of all types of nuclear activities. From 1963-1965, he served as the division's first director, concurrently with service as an Associate Director of the entire Laboratory, for Biomedicine. Later he stepped down from these administrative activities in order to have more time for his own laboratory research in cancer, chromosomes, and radiation, as well as his analytical work on the data from the Japanese atomic-bomb survivors and other irradiated human populations.

In 1965, Dr. Ian MacKenzie published an elegant report entitled "Breast Cancer Following Multiple Fluoroscopies" (*British J. of Cancer* 19: 1-8) and in 1968, Wanebo and co-workers, stimulated by MacKenzie's work, reported on "Breast Cancer after Exposure to the Atomic Bombings of Hiroshima and Nagasaki" (*New England J. of Medicine* 279:667-671), but few were willing to concede that breast-cancer could be induced by low-LET radiation.

Gofman and his colleague, Dr. Arthur Tamplin, quantified the breast-cancer risk (1970, *The Lancet* 1:297), looked at the other available evidence, and concluded overall that human exposure to ionizing radiation was much more serious than previously recognized (Gofman 1969; Gofman 1971).

Because of this finding, Gofman and Tamplin spoke out publicly in favor of re-examining two programs which they had previously accepted. One was the AEC's "Project Plowshare," a program to use hundreds or thousands of nuclear explosions to liberate natural gas in the Rocky Mountains and to excavate harbors and canals. Experimental shots had already been done, for example, in Colorado and Nevada. The second program was the AEC's plan to license about 1,000 nuclear power plants as quickly as possible and to build a "plutonium economy" based on breeder reactors. In 1970, Gofman and Tamplin proposed a five-year moratorium on licensing of commercial nuclear power plants.

For Gofman and Tamplin, the public health was the issue of prime importance. The Atomic Energy Commission was not pleased. In 1973, Gofman returned to full-time teaching at the University of California at Berkeley, until choosing an early and active "retirement" --- a retirement to full-time research on radiation health-effects. This research led to publication of four scientific books, and to the current work, *Preventing Breast Cancer*. The previous books are:

1. *Radiation And Human Health*, 908 pages (1981).

2. *X-Rays: Health Effects of Common Exams* (with Egan O'Connor), 439 pages (1985).

3. *Radiation-Induced Cancer From Low-Dose Exposure: A Independent Analysis*, 480 pages (1990).

4. *Chernobyl Accident: Radiation Consequences for This and Future Generations*, 574 pages (1994). It is in the Russian language. An English-language edition will be

published in the future.

Recent Honors and Awards

December 1992, in Stockholm, Sweden: The Right Livelihood Award of the Right Livelihood Foundation. Dr. Jakob von Uexkull's statement, in presenting the award for John Gofman's "pioneering work in exposing the health effects of low-level radiation," was:

"The Right Livelihood Award for vision and work forming an essential contribution to making life more whole, healing our planet, and uplifting humanity."

November 1993, in Atlanta, Georgia: Selection as Honored Speaker for the 1993 Meeting of the Arteriosclerosis Section of the American Heart Association, in recognition of work described by Donald S. Fredrickson in *Circulation* (Suppl., Vol.87, No.4: 1-59, April 1993).

Curriculum Vitae

Birth: September 21, 1918 in Cleveland, Ohio.

Education:

- Grade and high school in Cleveland. A.B. in Chemistry from Oberlin College, 1939.
- Ph.D. in Nuclear/Physical Chemistry from the University of California at Berkeley, 1943. Dissertation: Discovery of Pa-232, U-232, Pa-233, and U-233. Proof of the slow and fast neutron fissionability of U-233. Discovery of the 4n + 1 radioactive series.
- M.D. from the School of Medicine, University of California at San Francisco, 1946. Internship in internal medicine at the University of California Hospital, San Francisco, 1946-1947.

Positions:

- Academic appointment in 1947 in the Division of Medical Physics, Department of Physics, University of California at Berkeley. Advancement in 1954 to the full professorship, a position held to the present time, with shift to Emeritus status in December, 1973. Under recent University reorganization, the affiliation is now the Division of Biochemistry, Department of Molecular and Cell Biology.
- Concurrent appointment since 1947 as either Instructor or Lecturer in Medicine in the Department of Medicine, University of California, San Francisco.

Additional appointments held:

- Associate Director, Lawrence Livermore National Laboratory, 1963-1968. Resigned this post to gain more time for research and teaching. Remained as Research Associate at Livermore through February,

1973.

- Founder and first Director of the Biomedical Research Division of the Lawrence Livermore Laboratory, 1963-1964. This work was done at the request of the Atomic Energy Commission.
- Member, Advisory Board for NERVA (Nuclear Engine Rocket Vehicle Application), approximately 1963-1966. Member of the Reactor Safeguard Committees University of California, Berkeley, approximately 1955-1960.
- Group Co-Leader of the Plutonium Project (for the Manhattan Project) at the University of California, Berkeley, 1941-1943. This work included meetings at Chicago and Oak Ridge to exchange information and to help DuPont engineers prepare for the reprocessing operations at Hanford, Washington.
- Physician in Radioisotope Therapy, Donner Clinic, University of California, Berkeley, 1947-1951.
- Medical Director, Lawrence Radiation Laboratory (Livermore), 1954-1957.
- Medical consultant to the Aerojet-General Nucleonics Corporation, with special emphasis on the hazards of ionizing radiation, for approximately eight years during the 1960s.
- Consultant to the Research Division of the Lederle Laboratories, American Cyanamid, 1952-1955.
- Consultant to the Research Division of Riker Laboratories, approximately 1962-1966.
- Scientific consultant to Vida Medical Systems, 197O-1974; co-invented the VIDA heart monitor, a pocket-worn computer to detect and announce the occurrence of serious cardiac arrhythmias; invented a skin cardiographic electrode subsequently used widely throughout the USA.
- Chairman of the Committee for Nuclear Responsibility, 1971 to the present; pro-bono work; no book-royalties or compensation of any type has ever bean accepted.

Patents:

- # 3,123,535 (Glenn T. Seaborg, John W. Gofman, Raymond W. Stoughton): The slow and fast neutron fissionability of uranium-233, with its application to production of nuclear power or nuclear weapons.
- # 2,671,251 (John W. Gofman, Robert E. Connick, Arthur C. Wahl): The sodium uranyl acetate process for the separation of plutonium in irradiated fuel from uranium and fission products.
- # 2,912,302 (Robert E. Connick, John W. Gofman, George C. Pimentel): The columbium oxide process for the separation of plutonium in irradiated fuel from uranium and fission products.

Earlier honors and awards:

- Gold-Headed Cane Award, University of California Medical School, 1946, presented to the graduating senior who most fully personifies the qualities of a "true physician."
- Modern Medicine Award, 1954, for outstanding contributions to heart disease research.
- The Lyman Duff Lectureship Award of the American Heart Association in 1965, for research in atherosclerosis and coronary heart disease; lecture published in 1966 as "Ischemic Heart Disease, Atherosclerosis, and Longevity," in *Circulation* 34: 679-697.
- The Stouffer Prize (shared) 1972, for outstanding contributions to research in arterioslerosis.
- American College of Cardiology, 1974; selection as one of twenty-five leading researchers in cardiology of the past quarter-century.
- University of California, Berkeley, Bancroft Library, 1988; announcement of the "Gofman Papers" established in the History of Science and Technology Special Collection (October 1988, *Bancroftiana*, No. 97: 10-11).

Radiation-Inducible Chromosome Injuries: Some Recent Evidence on Health Consequences --- *Major* Consequences

John W. Gofman, M.D., Ph.D., Spring 1992

- **Part 1 – "Permissible" Doses Established in an Ocean of Ignorance**
- **Part 2 – "Genetic" versus "Inherited," and Some Other Terms**
- **Part 3 – The Pre-Cytogenetic Era, up to 1956**
- **Part 4 – The Establishment of Cytogenetics, 1956-1959**
- **Part 5 – The Pre-Banding Era of Cytogenetics, 1959-1970**
- **Part 6 – The Banding Era of Cytogenetics, 1970-1985**
- **Part 7 – The Era of Molecular Cytogenetics, 1985 Onward**
- **Part 8 – What Else Will the New Technologies Reveal?**
- **Reference List**

Courtesy of Malcolm Hancock.

Chromosomes are the structures, in the nuclei of our cells, which are composed of helical, double-stranded DNA and associated proteins. The DNA molecules encode our human and individual genetic heritage. Two types of genetic injury which are readily caused by ionizing radiation at very low doses and low dose-rates are chromosomal deletions and translocations.

Recent evidence links a great variety of chromosomal deletions and translocations with

devastating birth defects and mental handicaps. Nonetheless, pressure to "forgive" more nuclear pollution --- and thus "forgive" more involuntary exposures to ionizing radiation --- is reviving in a big way. One consequence of additional exposure would be additional injury of the population's chromosomes, our library of genetic information.

1 • "Permissible" Doses Established in an Ocean of Ignorance

The chromosome story is a classic example of how "permissible" levels of radiation and other pollutants are recklessly established under the "prove harm" doctrine before technologies even *exist* for proving which agents can be the cause of dreadful health effects.

This CNR paper describes the evidence which links chromosomal deletions and translocations with mental handicap and structural defects of the heart, kidneys, digestive tract, skeleton, and genitalia, and it also describes the limits of technology which have delayed this evidence for so long.

The essay is a non-technical introduction to just a small part of the story of chromosomal injuries, for it omits any consideration of health consequences such as cancer, schizophrenia, and metabolic diseases (for instance, diabetes, hyper-lipidemia, cystic fibrosis). My next book, in 1994 (*Chernobyl Accident: Radiation Consequences for This and Future Generations* (Russian Language)), will provide detailed evidence and analysis of the under-estimated health effects which can arise from radiation-induced chromosome damage. The information also has implications far beyond nuclear pollution, to the extent that chemicals and viruses (and possibly other types of radiation) may induce permanent chromosome injuries too.

The fact that ionizing radiation can break chromosomes has been "answered" between 1970 and the present day by questioning the health effects (see the three boxes [1], [2], [3] in this essay). With respect to this and many other pollutants, the "prove harm" proponents see nothing wrong about establishing "permissible" levels of involuntary exposure, despite an ocean of ignorance regarding the potential, miserable consequences --- some of which are identified in this essay.

2 • "Genetic" versus "Inherited," and Some Other Terms

Among the permanent genetic injuries which can be inflicted by ionizing radiation are three types:

A. **Single-gene damage:** Chromosome damage confined to a segment of DNA representing a single gene.

B. **Deletions:** Breakage of a chromosome, followed by permanent loss of part of a chromosome carrying some or many entire genes, or just part of one gene.

C. **Translocations:** Breakage of one or more chromosomes, followed by permanent removal of some or many genes (and partial genes) from their normal place in the DNA chain; these relocated DNA segments can end up in an abnormal place within the same DNA chain or within the DNA of an entirely different chromosome.

All three types of permanent chromosomal injury are now called "genetic mutations," and types (**B**) and (**C**) are also called "structural chromosome aberrations."

The terms "genetic" and "inherited" are not synonymous. Genetic injuries or mutations can occur in cell-nuclei

1. Before conception, in an ancestor's germ cells (sperm or ova).
2. After conception, during the person's gestation (in-utero).
3. Anytime during childhood and adulthood.

When genetic mutations occur before conception (inherited) or during early gestation (not inherited), the health consequences can be virtually identical. Distinctions are poorly defined between "genetic diseases," "irregularly inherited disorders," "constitutional diseases," "chromosomal disorders," "congenital diseases," and "birth defects" or "anomalies."

An explosion of new information on these topics has occurred. Indeed, a large share of all bio-medical research in recent years has been devoted to the genetic basis of disease and health, and existing results await coherent assembly and analysis. Part of the explosion is generated by the Human Genome Project, in which the U.S. Department of Energy is extremely active.

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3 • The Pre-Cytogenetic Era, up to 1956

The field of chromosome study, broadly, is called cytogenetics. Although the existence of chromosomes has been known for over a century, very little progress was made for a long time.

Chromosomes are not visible, unless you "catch" a cell which is preparing to divide. Then the very long, string-like chromosomes "condense" by folding themselves into enormously shorter and thicker objects. Ordinary stains used in biology showed their existence, but the objects appeared entangled with each other, and no one was even able to establish the correct *number* of human chromosomes per cell-nucleus during the pre-cytogenetic era.

In 1953, Hsu developed a simple but enormously powerful technical advance in chromosome studies. When cells are bathed in a solution with salt-concentration lower than their own salt-concentration, the cells swell. The chromosomes in cells preparing to divide become so well separated that quite a few details of individual, separated chromosomes can be noted, when the division is halted by a chemical inhibitor and the cells are flattened on a glass slide. Hsu's advance in laboratory techniques would soon establish the field of cytogenetics.

The year 1953 was also the year in which Watson and Crick announced the structure of the gene and DNA helix. The required technologies for *that* kind of very sophisticated analysis had become available before the availability of techniques which would permit us merely to count the number of structures which *carry* the genes.

4 • The Establishment of Cytogenetics, 1956-1959

Within three years of Hsu's low-salt cell-preparations, Tjio and Levan were able to establish conclusively, in 1956, that the normal number of human chromosomes per cell-nucleus is 46.

The father contributes 23 chromosomes and the mother also contributes 23 chromosomes to the fertilized ovum, from which the 46 are replicated in the cell-nuclei of all the descendant cells --- when everything goes well. There are 22 matched pairs called autosomes, grouped by letters A-G (for instance, paternal and maternal B-5 chromosomes). In addition, each cell has a pair of sex chromosomes which are not necessarily matched (X+X makes the child female; X+Y makes the child male). Each chromosome has a region somewhere along its length called the centromere, which divides the chromosome into a shorter arm (called the p-arm) and a longer arm (q-arm).

Each pair of undamaged autosomes provides the cell with *two* copies of each gene on the autosome --- a full set of this genetic information from the father and a full set from the mother. In 1956, we were yet to learn that there can be severe consequences for the children who have either *more* than two complete copies or *fewer* than two complete copies of the genetic information on both arms of each chromosome. But in 1959, our ignorance on this matter began to retreat.

5 • The Pre-Banding Era of Cytogenetics, 1959-1970

Banding is a technique which will be described in Part 6. Here we will summarize some insights which were gained in the pre-banding era.

In Part 2, we described two types of *structural* chromosome aberrations (deletions and translocations). There are also *numerical* chromosome aberrations. When an extra copy of one complete chromosome is present in cells, so that the cells contain 47 instead of 46 countable or "free" chromosomes, the condition is called a trisomy. When one complete copy of a chromosome is missing, so that cells have 45 instead of 46 countable chromosomes, the condition is called a monosomy. Of course, neither condition could be verified until the normal number of chromosomes was discovered in 1956.

In 1959, the cause of Down's Syndrome was discovered by Lejeune and Jacobs to be the presence of a third copy of the G-21 chromosome in a child's cells. Individuals with Down's Syndrome almost all suffer from mental handicap and characteristic facial features, and about 28% also suffer from a congenital heart defect. Approximately 1 per 700 liveborn children is a Down's child.

At first, it was assumed that Down's Syndrome required the trisomy-21 to involve a third copy of the full chromosome in every cell. We can call this an all-cell, full-chromosome trisomy-21. It accounts for about 92% of all cases of Down's Syndrome. The rest of the cases arise from two other types of trisomy-21. Although we will explain them here, with the pre-banding era, these other types were not discovered as early as all-cell, full-chromosome trisomy.

In-Utero Events: Mosaicism

When an infant has 47 chromosomes in every cell, it means that the numerical aberration was present in the fertilized ovum. But when only some *fraction* of a child's cells has 47 chromosomes, it means that the numerical aberration occurred in a cell which was ancestral to only *some* of the child's cells. Thus, the aberration occurred during gestation, in-utero. Individuals with two types of cells (some with 46 chromosomes, some with 47) are mosaics, and they have a some-cell, full-chromosome trisomy. For Down's Syndrome, mosaicism accounts for about 2.7% of the cases.

Translocations and *Partial* Trisomies

It has been shown that Down's Syndrome can be caused also by a *structural* chromosome aberration --- one which is readily induced by ionizing radiation. We mean the translocation (see Part 2). An estimated 5.8% of all cases are due to a translocation in one ancestor of a child. Although a thorough explanation would require more space than we have here, Figures 1 and 2 may convey a sense of the problem.

Figure 1 depicts a normal E-18 chromosome and a normal B-5 chromosome. Figure 2 depicts their possible status after a translocation. When a chromosome carries a mixture of information belonging to more than one chromosome, its name is set by the information around its centromere (depicted by the black area). In Figure 2, the chromosome on the left is called the E-18, and B-5 is on the right.

The condition of *partial* trisomy arises for a child as follows.

Suppose that both the mother and father transmit normal E- 18 chromosomes to their child. But suppose that in the transmission of B-5 chromosomes, one parent transmits the damaged B-5 chromosome from Figure 2. It carries translocated genes belonging to the q-arm of the E-18 chromosome. The child, whose numerical count of separate chromosomes is the normal 46, will nonetheless have *three copies* of part of the genetic information on the q-arm of the E-18 chromosome. The child will have a partial trisomy-18. This structural aberration can be described as an all-cell 18q trisomy.

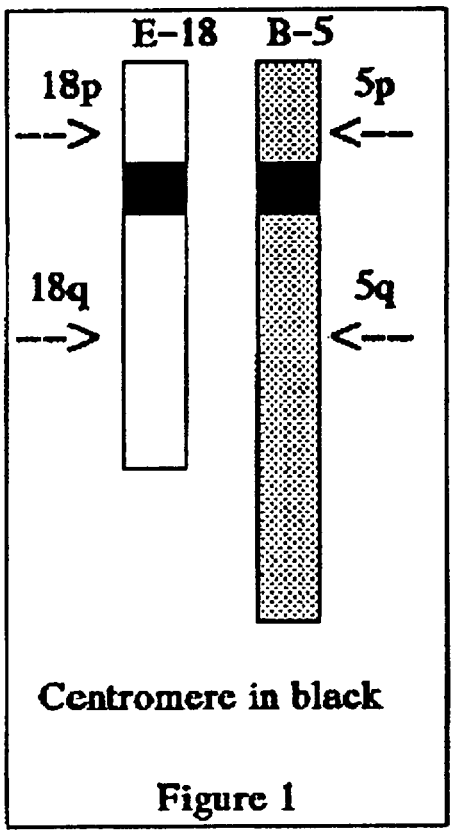


Figure 1

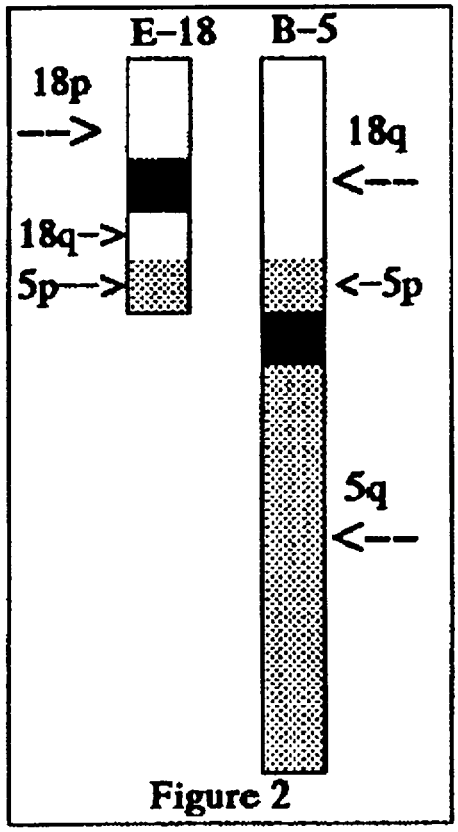


Figure 2

Translocations and *Partial* Monosomies

In the example above, the child simultaneously has a partial monosomy because the child has received a B-5 chromosome which lacks part of its p-arm and lacks the genetic information which was on it. Even though the other parent sends the child a normal B-5 with a complete p-arm, the child will have only *one* copy (instead of the normal two copies) of some genetic information belonging to the p-arm. This condition can be described as an all-cell 5p monosomy. Because the chromosome-count will be the normal 46 per cell, this is not a numerical aberration.

Emphasis belongs on the fact that the effect of a partial monosomy is no different from an inherited deletion (see Part 2). The net effect is an all-cell deficit of chromosomal information. The deficit may or may not be limited to genes which code for specific enzymes. The deficit will often include **(A)** some segments of DNA which have presently unknown but presumably important functions, and **(B)** some chromosomal proteins whose functions are presumably important too.

The Discovery of Trisomies Additional to Down's Syndrome

In 1960, Patau presented the first clinical observation of a full-chromosome trisomy-13 patient. Since then, the frequency has been estimated between 1 case per 4,000 and 1 case per 10,000 live births. The clinical features of trisomy-13 include (percentage of cases): Mental handicap 100%, undescended testicles 89% of the males; abnormally small jaw 87%; eye defects 88%; low-set or malformed ears 85%; heart defects 79%; apparent deafness 77%; cleft

palate 77%; extra fingers 77%; kidney defects 66%; seizures 41%.

And also in 1960, Edwards described the first patient with a full-chromosome trisomy-18. The frequency is now estimated at 1 case per 8,000 live births. The clinical features of trisomy-18 include (percentage of cases): Mental handicap 98%; undescended testicles in 77% of males; abnormally small jaw 95%; low-set or malformed ears 95%; congenital heart defects 95%; kidney defects 60%; prominent heel-bone 74%; elongated (front to back) skull 87%.

Box #1, A Contrast in Warnings: Examples from 1969-1970

● -- On October 29, 1969, at the IEEE Symposium on Nuclear Science, Gofman and Tamplin upset the nuclear community by their call for an immediate 90% reduction in the radiation guidelines set in 1960 by the Federal Radiation Council (FRC) for members of the public. These were "permissible" doses of 0.17 to 0.5 rem each year. A few months later, Gofman and Tamplin challenged the government's authority to legalize involuntary radiation doses at *any* level.

● -- In testimony presented to Congress in June 1970, Gofman and Tamplin posed a series of detailed questions for the FRC chairman concerning genetic injuries from the permissible dose.

"We are just *beginning* to learn the meaning of a variety of chromosomal anomalies, including deletions and translocations for numerous aspects of human health and disease . . . Does it make you feel at all uneasy that this spectacular field of human cytogenetics is now in its infancy, *after* all the decisions had been made which led to the setting of FRC guidelines for radiation exposure of populations?" (Gofman and Tamplin 1970, p.1554).

● -- On August 5, 1970, Dr. John Totter, director of the Bio-Medical Division of the Atomic Energy Commission (AEC), was asked about radiation-induced chromosome injury during his testimony before a Senate hearing chaired by Sen. Mike Gravel.

Sen. Gravel: "What happens to cells [if they receive 10 rads]?"
Dr. Totter: "You would see chromosome breakage."
Sen. Gravel: "Would that be significant in your terms?"
Dr. Totter: "Well, it is undoubtedly significant, but what significance it has, we don't know" (Totter, p.677).

Nonetheless, the AEC vigorously opposed any reduction in the permissible dose (AEC Oct. 31, 1969, pp.203-209 --- an example of many subsequent statements). Unofficially, there was talk of increasing the permissible dose. Back then, the AEC had ambitious plans to build "a plutonium economy," to license 800 to 1000 large nuclear power plants by the year 2000 (AEC 1970, p.685), and to loosen natural gas in the Rocky Mountains by exploding hundreds of underground nuclear bombs.

The plans and the public's exposure to the permissible dose would

probably have become a reality, if it were not for rising public concern in the 1970s over the potential health effects.

Later, with the advance of technology, it was discovered that both trisomy-13 and trisomy-18 --- like trisomy-21 --- also can occur as mosaics (in-utero) and as partial trisomies (inherited as a result of translocations).

The Linking of Cause with Consequence

No one is claiming that all individuals who have the health effects listed above are cases of trisomy-13, -18, or -21. Many additional genetic causes of these health problems have been discovered, and it is possible that some cases arise without any genetic injury at all. Then how can anyone be sure that a trisomy *causes* the problems of trisomic individuals?

Whenever a variety of causes might produce the same health effect, two types of study can establish causation.

In a prospective cohort study, you start with a suspected cause and then you measure the occurrence of presumed consequences. You measure the health of one group which has trisomic cells (a presumed cause of the listed health effects) and another group which does *not* have trisomic cells, and you discover which group has the higher rate of the health effects. The frequency of mental handicap, for example, approaches 100% in the trisomic individuals, while the frequency is certainly lower in the general population.

In a retrospective case-control study, you start with presumed health consequences and then you measure the occurrence of a suspected cause. You measure the rate of trisomic cells in one group which has the health effects (a presumed consequence of trisomy) and in another group which does *not* have these health effects, and you find out which group has the greater frequency of trisomic cells (a presumed cause). There is no doubt that the frequency of 47 chromosomes is higher among the persons who have the health effects listed above. Indeed, the rate of full-chromosome trisomy among persons who *lack* such health effects is so low that we are unaware of a single known case.

The First Discoveries of Deletion Syndromes

All-cell, full-chromosome trisomies were open to study in the early era, since this was a matter of just counting chromosomes. But the opposite possibility --- namely, a *deficit* of certain chromosomal information --- was not nearly so easily studied, since only arm-lengths and centromere positions were available to identify such losses.

Cri-Du-Chat Syndrome. Nonetheless, by 1963 progress was underway when Lejeune and co-workers described the first three cases of the 5p partial monosomy or deletion syndrome. It was called Cri du Chat Syndrome because infants with it have a peculiar, cat-like mewing cry. Hundreds of cases were subsequently reported, and they are missing 30% to 85% of the short arm of the B-5 chromosome. The disorder is severe. Besides the cry, clinical features in most cases include profound mental handicap, small head, low-set ears, and growth failure.

Box #2, A Contrast in Warnings: Examples from 1980-1981

● -- The BEIR Committee replaced the Federal Radiation Council. In 1980, what sort of warning did it issue concerning radiation-induced chromosome damage? First, it grouped "small deletions" with single-gene mutations, and then stated: "Disorders due to chromosomal aberrations . . . will amount to fewer than 10 anomalies per million liveborn, and most subcommittee members felt that the true value may be near zero. (BEIR-3, Chapter 4 Summary). Instead of any warning flag, a strong suggestion of *no* effect was produced.

● -- In 1981, the book *Radiation and Human Health* (Gofman 1981) bristled with warnings in its last 150 pages of analysis. For instance:

- "The author's opinion is that small deletions occurring in-utero produce mosaicism which will prove to be an important basis for congenital anomalies. This is an opinion, not a fact. It is a fact that the technology for studying this question is not currently available" (p.721-22).
- "With respect to both deletions and translocations, the author would like to warn the reader about a very poor practice in a great deal of the medical and scientific literature. The technology for recognizing and measuring relatively small deletions and translocations is most appropriately described as *primitive, even after taking the new banding techniques into account*. The large majority of *small* deletions and translocations can not possibly be recognized with the use of available technology. Yet many authorities treat these injuries as though they simply do not occur" (p.766).
- "The extent to which the genetic-chromosomal effects of radiation are under-estimated, just on the basis of a total absence of appreciation of the deletion problem, can not be known. Any guesstimate would be highly speculative. But the author of this book would not be at all surprised if future evidence showed that the `deletion cost' from radiation exceeds most of the costs which have been estimated already" (p.843).

Wolf-Hirschhorn Syndrome. In 1965, the 4p partial monosomy or deletion syndrome was discovered by Wolf. Between 10% to 80% of the short arm of chromosome B-4 is missing. Clinical features of this Wolf-Hirschhorn Syndrome include severe mental handicap, seizures, delayed psychomotor development, pre-natal and post-natal growth failure, and multiple malformations such as cleft palate, cleft lip, congenital heart malformations, genital abnormalities in males, defects of the urinary tract, skeletal abnormalities of fingers, hips, spine. As we shall see in Part 7, special facial features are associated with Wolf-Hirschhorn Syndrome, too. About 40% of infants who are born with the 4p deletion syndrome die in infancy or childhood.

The banding era began around 1970, when special stains made it possible to start differentiating segments (or bands) along chromosomal arms. Gradually it became possible to distinguish about 400 pairs of bands (total) among the 46 chromosomes. Advanced, high-resolution banding techniques today extend the total to over 800 pairs. The naming of each band begins with the number of the chromosome, then the arm (p or q), and then single digits indicating large regions. Number 1 is always the region closest to the centromere, and then additional digits indicate sub-sections of specific regions.

Banding made it possible to start finding and correctly identifying translocations and deletions. In the pre-banding era, the true identity of the injured chromosomes was easily mistaken, because they acquired new shapes and sizes.

Thanks to the development and improvement of banding techniques, de Grouchy and Turleau were able to publish a second edition of their remarkable *Clinical Atlas of Human Chromosomes* in 1984. Based on the worldwide literature of reported cases, the Atlas demonstrates the discovery of partial trisomies or partial monosomies (deletion syndromes) involving *every* autosome. There is not enough space here even to list them all --- over 70 types known by 1984.

Are these structural chromosomal aberrations associated with important health effects? Mental handicap at various levels is one feature shared by almost all 70 types. A few examples follow:

- For chromosome 3, for instance, there is a partial trisomy involving the 3q2 region. It is associated with severe mental handicap, heart defects in about 33% of cases, abnormalities of kidneys and digestive tract "frequently," skeletal abnormalities at "many sites," and genital abnormalities in males "always" and in females "most cases."
- For chromosome 3 also, there is a partial trisomy of the p-arm from 3p2 to the distal end. This is associated with severe mental handicap, heart defects in about 75% of reported cases, skeletal abnormalities at many sites, and genital abnormalities in all males.
- On chromosome 3 also, there is a partial *monosomy* involving the 3p2 region. This is associated with very severe mental handicap skeletal abnormalities at several sites, and genital abnormalities in both sexes.

The Issue of Causation

This type of evidence in the Atlas, accompanied by some photos of the infants, is virtually screaming at the world: *CAUTION !* Structural chromosome aberrations --- readily inducible by ionizing radiation --- can cause extremely serious mental handicap and other birth defects. And yet, in some circles, denial or "we don't know the meaning" is still heard (Box #3).

Thus, we expect a challenge from some circles to the presumption that the chromosome aberrations are *causing* the handicaps described in the Atlas --- a presumption which is made in the Atlas and elsewhere, and a presumption which I predict will be systematically validated in the future.

Consider that there is a continuum of genetic mutations. At one end, we learned that an

all-cell full-chromosome trisomy *causes* serious handicaps. At the other end, we know that a single-gene mutation can *cause* devastating health effects, such as cystic fibrosis and Huntington's Disease. Every few weeks now, the genetic basis of an additional disease is announced. Would it make sense for anyone to deny that partial trisomies and partial monosomies, which lie in the realm between single-gene mutations and full trisomies, have a *causal* relationship with the associated health effects described in the Atlas?

---

7 • The Era of Molecular Cytogenetics, 1985 Onward

Very strong evidence in favor of causality is provided by a medical mystery whose solution was described during 1991 by Michael Altherr and co-workers in the *American Journal of Human Genetics*. The solution depended not only on human tenacity, but also on the availability of the new laboratory technologies in molecular biology such as RFLP (Restriction Fragment Length Polymorphism) and FISH (Fluorescence In-Situ Hybridization) --- which we will not attempt to describe in this paper.

The mystery involved a female child with the facial features of the Wolf-Hirschhorn Deletion Syndrome noted at birth. Serious additional abnormalities included a septal defect between the cardiac auricles. On the basis of the facial features, the diagnosis of Wolf-Hirschhorn was considered, but an ordinary chromosome analysis detected no abnormality of chromosome 4.

At age one, the child had heart surgery, and as she grew older, her facial features increasingly had the characteristics of Wolf-Hirschhorn Syndrome. So a high-resolution chromosome analysis was performed on her and on both parents. But even the best banding technologies in cytogenetics could not provide a conclusive answer (see Box #2).

Altherr persevered. First he tried RFLP, with DNA probes for seven different segments within the most distal band of chromosome 4's p-arm. These DNA probes were able to establish that the child did not inherit a maternal copy for two of the segments. When Altherr also used FISH on the mother's chromosomes, he discovered that she had a small part of 4p translocated onto the p-arm of chromosome 19. When she transmitted only 23 chromosomes to her daughter, the daughter received the copy of B-4 which was missing some information, but not the copy of chromosome 19 which carried the missing information --- and which spared the mother from the obvious health effects.

Which is the more reasonable conclusion from this story: **(A)** the very small 4p deletion in this child *caused* the characteristic abnormalities observed in other cases of Wolf-Hirschhorn 4p Deletion Syndrome, or **(B)** the very small 4p deletion was present in this particular child just by coincidence?

Box #3. A Contrast in Warnings: Examples from 1988 to Now

● -- Depreciation of chromosome aberrations occurs in Dr. Thomas Luckey's 1991 book, the thesis of which is that good health requires *more* radiation exposure, not *less*. Going even further than Dr. Totter (Box #1), Dr. Luckey says, "Although chromosomal aberrations are proportional to radiation dose and appear after very low doses of radiation, no medical diseases are associated with these changes" (p.77).

● -- In 1990, the BEIR-5 Committee made some major moves toward realism with respect to admitting high spontaneous rates of genetically-related diseases and afflictions. On the other hand, when it came to assigning responsibility to radiation, the BEIR-5 Report sent mixed messages. For instance:

"Although chromosome aberrations can be induced by relatively low doses of radiation . . . the health implications, if any, of an increase in the frequency of such aberrations in circulating lymphocytes is uncertain" (p.34).

Uncertain? If aberrations increase in a population's lymphocytes because of whole-body irradiation (from either natural or man-made sources), the aberrations also increase in all other cells, including the germ cells. "Health implications" are described in the text.

● -- Analysts at RERF write extensively about the Hiroshima-Nagasaki children who were in-utero during the bombings and who showed an elevated frequency of mental handicaps. RERF is the foundation which controls the A-Bomb Study for the U.S. Dept. of Energy and the Japanese Ministry of Health. In five papers published in 1988 through 1991, the RERF analysts speculate for **pages about how radiation could have caused the mental handicaps — without** even mentioning radiation-induction of chromosome injuries.

● -- The contrast is stunning between the depreciation of chromosome injuries in some circles, versus the evidence described in this 1992 essay.

Altherr and co-workers comment (1991, p.1235), "This provides the first evidence, in chromosome 4p, of a molecular deletion due to a subtle, inherited translocation leading to the Wolf-Hirschhorn phenotype. Such subtle translocations may become an important mechanism for some recurrent genetic defects." We could hardly have conjured up a better-matching and independent agreement with our own warnings and predictions of 1970 and 1981.

8 ● What Else Will the New Technologies Reveal?

The Altherr report confirms a logic which may be self-evident to many objective analysts in this field: If single-gene mutations can cause drastic health consequences, then

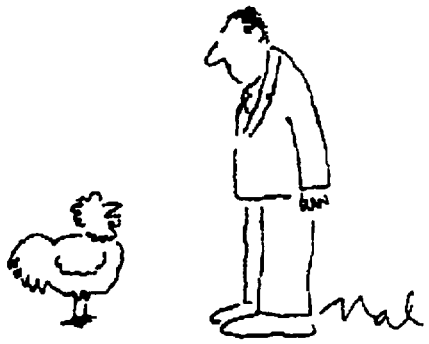
surely small, sub-visible deletions (either inherited or occurring early in gestation) can also cause them. In my opinion, if any radiation expert today were to say "We do not know the significance of small deletions and translocations," it would be a strangeness lasting 20 years too long.

Readers may consider the estimate of Dallapiccola and Forabosco (1987, p.25): "A chromosome contains about 100 million base-pairs of DNA. Any visible deletion of a chromosome involves at least 2% to 5% of a chromosome. A deletion would involve enough space for 2 million base pairs, or about 50 genes (a gene typically takes up about 40,000 base pairs of space)." The point is that chromosome injuries can delete *multiple* genes and still be completely undetectable by the best banding technologies.

If readers consider the limitless variety of micro-deletions and translocations which may exist --- undetected --- in today's population, then they may agree with our prediction:

The new discoveries being made with molecular biological techniques will confirm that a large part of the congenital defects of unknown origin, and a large part of the irregularly inherited diseases of unknown origin, are really consequences of deletions and translocations at the sub-microscopic level. The Altherr report is only the very tip of an iceberg which will be seen more fully in the next decade.

This "iceberg" should be taken into account *today* when people discuss "permissible" levels of involuntary exposures to possible chromosome-breakers and to *proven* chromosome-breakers such as ionizing radiation.



"It's very strange. Every morning, just as soon as I say cock-a-doodle-doo, the sun comes up."

Courtesy of Malcolm Hancock.

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# # # # #

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Periodic Table of the Elements
Thorium

Atomic Number: 90

Atomic Symbol: Th

Atomic Weight: 232.0381

Electron Configuration: $[Rn]7s^2 6d^2$

Cost

Thorium metal (99.9%) costs about $150/oz.

Source: Los Alamos National Laboratory, US Department of Energy.

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