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**"Women in Science and Mathematics:
Is Marie Curie Relevant Today?"**

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By

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To

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The 1990s include many centennials related to radiation and nuclear science: The properties of x-rays were discovered by Roentgen in 1895, radioactivity was discovered by Becquerel in 1896 and polonium and radium were discovered by Pierre and Marie Curie in 1898. To commemorate these anniversaries, the French National Museum of Natural History mounted special exhibits on x-rays and radioactivity. I had the good fortune to travel to Paris this past September and to visit one of these exhibits. While doing so, I was reminded of the pioneering role that Marie Curie played in that era. But it is not only her role as a scientist that deserves our attention. Marie Curie has been a role model for young women inspiring them to pursue careers in the sciences and mathematics. I believe that she will continue to be an inspiration into the twenty-first century, not only for young women, but for all young people.

Earlier this month, I attended a reception sponsored by the American Nuclear Society at the French Embassy honoring Marie Curie. The keynote address at the reception was given by Annick Carnino, the Deputy Director General for Nuclear Safety at the International Atomic Energy Agency in Vienna, Austria. She spoke of how she was inspired by Marie Curie to pursue a career path in science and engineering.

Marie Curie had many firsts to her name, perhaps most notably the first woman to receive the Nobel Prize. The 1903 award in physics was shared with her husband Pierre and with Henri Becquerel for their work in radioactivity. She is one of very few to have received a second Nobel Prize, this in 1907 in chemistry, awarded to her alone for her discoveries of the radioactive elements polonium and radium.

Pierre Curie died tragically in a Paris traffic accident in 1906 leaving her to raise their two daughters. Her younger daughter, Eve, became an accomplished musician and her biographer. Her older daughter, Irene, became the second woman to win a Nobel Prize when the chemistry prize was awarded to her and her husband Frederick Joliet for discovering artificial radioactivity.

The Nobel Prizes awarded to the Curie family encircle the beginnings of the atomic age. Becquerel and the Curies, Marie and Pierre, discovered radioactivity. That discovery provided the experimental path to uncovering the secrets of the atom. The discovery of artificial radioactivity, by the daughter, Irene and her husband, showed that elements could be transmuted, a phenomena that enables the creation of the artificial radioactive materials that are used today so effectively in medicine and in industry.

Marie Curie's life path was not smooth. At the time that she moved from Poland to France to continue her education, academic pursuits by women were not an accepted notion. To some extent, the fact that she was a foreigner mitigated some of the barriers in France. She had the good fortune to have as mentors and friends many individuals who appreciated her intellect and insights, but this was not, by any means, universal. That the Nobel Prize that was given to her in 1903 was going to a woman was not without controversy when the matter was under consideration because of her gender. While she was a recipient of many academic honors, she was denied membership in the prestigious French Academy of Sciences in 1911 although this was tempered somewhat eleven years later when the French Academy of Medicine made her the first Frenchwomen to enter that institution.

During the first World War, Marie Curie donated the radium that she used for research so that it could be used for medical purposes. In 1921, she visited the United States to receive from President Harding a gram of radium purchased on her behalf by Americans so that she could continue her research. While in the U.S., she received a number of honorary degrees. All of this was accompanied by considerable media coverage. In that year, 1921, all of forty-one American women received doctorates in science.

In 1929, eight years later, when she again visited the United States, that figure had risen to one hundred and thirty eight. While the numbers were small, the increase from 1921 to 1929 is believed by many to be attributable to the inspiration provided to young women by this wonderfully talented and, yet, modest woman.

But, what meaning do these numbers have to today's young men and women? Clearly, today, young men and women must make choices about their future. Is Marie Curie's life relevant in the twenty-first century?

I think that the answer is, yes. And the reason for that answer can be found in a recent report of the Hudson Institute.

Let me briefly tell you about the Hudson Institute. It is a not-for-profit research foundation, founded in 1961 that analyzes and makes recommendations about public policy for business and government executives and the public. It does not advocate or express an ideology or political position.

In 1987, the Institute published *Workforce 2000*, a landmark study of the changing American workforce. Unusual for a product of a "think-tank," this report became a best seller. It showed that the workforce of the future would no longer consist primarily of white males in manufacturing jobs. Women and minority workers would become more prominent. Most importantly, it pointed to the need for higher skill levels in the U.S. workforce in order to effectively compete in a global economy.

The eleven years that have elapsed since its publication have shown that *Workforce 2000* was very much on the mark. This year, the Hudson institute published an update, *Workforce 2020*.

Workforce 2020 has many messages that bear on whether America will successfully meet the challenges facing the American workforce in the twenty-first century. For example, will our educational institutions be up to these challenges? This is a most important question and we all have a stake in how well it will be answered. To those of you in the audience who are involved in or concerned about how our educational systems will meet the

challenges of the twenty-first century, I think that you will find this report of great interest. But, what does this report have to say to the young people in the audience who are preparing to enter this workforce? Let me select some of the comments that are relevant.

"First, the pace of technological change in today's economy has never been greater. It will accelerate still further, in an exponential manner."

This will have an impact on the job skills that young people will need and their prospect.

"Automation will continue to displace low-skilled or unskilled workers in America's manufacturing firms and offices. Indeed, machines will substitute for increasingly more sophisticated forms of human labor."

"On the whole, the new jobs [that will be created in the future] will...be safer, more stimulating and better paid than the ones that they replace."

"The best jobs created in the Innovation Age will be filled by Americans (and workers in other advanced countries) to the extent that workers possess the skills required to compete for them and carry them out."

"In the early twenty-first century, the best paying jobs will demand high skill levels, particularly in the areas of reading, writing, math, reasoning and computing."

"In fact, *Workforce 2000* emphasized more strongly that all new workforce entrants -including women and minorities - would need to be better skilled. We emphatically endorse and repeat this recommendation."

For young women, there are these messages:

"Because the best new jobs will demand brains rather than brawn, and because physical presence in a particular location at a particular time will become increasingly irrelevant, structural barriers to the employment of women and older Americans will continue to fall away."

"Gender is particularly irrelevant in the service sector, which will employ the overwhelming majority of Americans in the early twenty-first century."

And, note this observation:

"[W]omen seem to be preparing themselves more assiduously than men for professional careers in the information age: women now garner 55 percent of bachelor's degrees, 53% of master's degrees and nearly 40% of doctorates."

That last observation would, I'm sure, be a revelation to Marie Curie but one that would please her. Increasing the numbers of young people entering the sciences, engineering, mathematics and computing is essential if the United States is to successfully compete in the global economy of the twenty-first century. For young people, this is where opportunity lies. Go for it.

For young women, you need to know this. The composition of the workforce will change. One change is that the proportion of women in the workforce will increase. As a matter of fact, between 1994 and 2005, women of all ethnic groups are expected to make up 62% of the new entrants into the job market.

Some other observations about the changing workforce should be noted. One is "the death of distance." We no longer can afford to consider the American workforce in isolation. We exist, indeed, we compete in a global economy. Exports will increase. Workers with low skills will be at a disadvantage. There will be a decline in manufacturing and, therefore, an increase in the need for skilled workers. And, the market will be volatile market.

An observation that is especially pertinent to today's teachers and education planners is the following:

"Expanding the pool and participation of skilled labor is vital, but positive scenarios for Workforce 2020 depend most of all on the promotion of mobility...Upward mobility in the labor force depends, quite simply, on education. The single most important goal of workforce development must be to improve the quality of American public education substantially...The crucial factor accounting for long-term success in the workforce is a basic education provided at the primary and secondary levels - encompassing the ability to read and write, do basic math, solve problems, and behave dependably."

In this regard, I wish to mention NRC's School Volunteers Program which involves 300 NRC employees in the Washington metropolitan area. Volunteers lecture in classrooms, participate in career awareness seminars, serve as science fair mentors and judges, serve as tutors and mentors, and counsel and instruct students and teachers on specific science topics. In Montgomery County, NRC employees visit science fairs and recommend projects

that would be of interest to the NRC. Students are then invited to personally describe these projects at a meeting with the Commission and the NRC provides its own awards. The dividends from these activities can be wide reaching and the work performed by NRC employees in this program is deeply appreciated by the Commission.

Let me close by recounting some of my personal experiences in the context of some of the comments made in Workforce 2020. I had the good fortune to be encouraged to take advantage of educational opportunities that eventually lead to bachelor's and master's degrees. My education was in the sciences, specifically radiation biology, and this led to work as a researcher. Later, I joined the State of Arkansas radiation control program, building on my radiation biology background. I worked in progressively responsible positions eventually becoming Director of the Division of Radiation Control and Emergency Management. I also served as Chairman of the Central Interstate Low Level Waste Commission and on advisory groups to the Southern States Energy Board. Later, as you know, I was appointed to the Board of Directors of the United States Enrichment Corporation and to the U.S. Nuclear Regulatory Commission.

There are a couple of keys in this personal account. First, the research I performed was highly interesting, I had no problems with advancement, and many of my co-researchers were women. However, while there were no problems with advancement on account of gender, opportunities were limited. Second, when I decided to change careers, I found that my education provided the springboard to enable my move to another career path. This path, you'll note, led me other fields, including management. Third, my advancement and appointments reflected acceptance by my male counterparts and by my constituents, including licensees and registrants who used radiation sources regulated under my State program. That acceptance happened not because I was a women, but because of my technical, administrative and management skills. Skills, I should add, that were developed and honed, and are still being developed and honed, through additional training and experience.

The bottom line is that education never stops. But, those who have a solid educational base are the ones best prepared to take advantage of the changing challenges of the future.

There's your message.

And, for young women looking at how to take maximum advantage of the future, more than ever, Marie Curie is an outstanding role model for you. She was simply a century ahead of her time.