BOOKS: NUCLEAR POLICY

A Brief For Power and Against Weapons

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Megawatts and Megatons
A Turning Point in the Nuclear Age?
by Richard L. Garwin and Georges Charpak
New York, Knopf, 2001. 431 pp. $30, C$45. ISBN 0-375-40394-9.

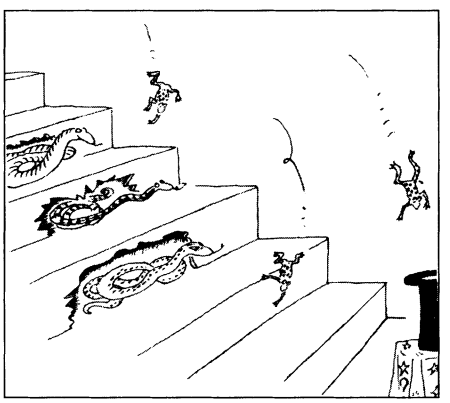
The world certainly needs an authoritative introduction to issues of nuclear power and nuclear weapons for the intelligent and concerned layperson. With *Megawatts and Megatons*, Richard Garwin and Georges Charpak have done the best job at providing such an account to date.

Early in his career, Garwin helped design the first U.S. thermonuclear explosive during a summer spent at Los Alamos with his Ph.D. advisor, Enrico Fermi. Currently a senior fellow at the Council on Foreign Relations, he has advised the U.S. government and public on various aspects of nuclear weapons over the past several decades. Georges Charpak, a French physicist at the European Organization for Nuclear Research (CERN), won the 1992 Nobel Prize in physics for his work in developing particle detectors. *Megawatts and Megatons* builds on a book the authors published in French in 1997 (*1*).

Their new book divides naturally into two halves. The first is a primer on nuclear weapons, nuclear energy, and ionizing radiation. The authors exert a special effort to make the physics accessible. They effectively use illustrations by the French cartoonist Jean Jacques Sempé, reminiscent of the drawings in the *Mr. Tompkins* books with which George Gamow demystified quantum mechanics and relativity a half century ago. For example, neutrons slowing down in a reactor are depicted as frogs jumping down a stairway on which uranium-238 atoms, represented as snakes, lie in wait ready to swallow them and transmute into plutonium (see the figure). Once the authors have thus oriented the reader, their pedagogy becomes more conventional.

The second half of the book presents the authors' views on topics ranging from the futures facing nuclear power and weapons to "making the best use of scientists." The chapter with this phrase as its title is particularly interesting because it includes brief accounts of some of Garwin's experiences on a number of panels of "independent and competent" scientists advising the U.S. government on a variety of the major nuclear issues of the past 50 years.

Some of these panels provided invaluable peer review for half-baked proposals. From such inside positions (and as an outside critic), Garwin has argued time after time that proposed national missile defenses could easily be circumvented or tricked by even unsophisticated attackers. He also tells of less well-known proposals such as the bizarre Project Pacer, in which scientists from Los Alamos suggested that turbines for generating electrical power could be driven with steam heated by daily 60-kiloton nuclear explosions in huge steam-filled cavities beneath the power plants. Other panels helped launch much more practical programs, such as the spy satellites whose images of Soviet nuclear weapon sites provided a much better basis for U.S. policy than worst-case projections such as the 1960 "missile gap."



Breaks in the chain reaction. As the neutrons (frogs) slow down, they can be captured by uranium-238 nuclei (the snakes), which then change into plutonium-239.

This collaborative work required the authors to deal with the issue of separating and recycling the plutonium in spent nuclear fuel, a central irritant in relations between the United States and France for more than two decades. The United States became disenchanted with recycling plutonium for use as a fuel after India used the first plutonium it separated from spent fuel rods to make a "peaceful" nuclear explosion in 1974. France, however, went ahead with recycling plutonium and has even earned about $10 billion by reprocessing spent fuel from countries that encountered political opposition to long-term domestic storage of the material. Today, the French nuclear establishment insists that the recycling of plutonium is environmentally preferable to the American plan for burying spent fuel from U.S. reactors under Yucca Mountain, Nevada.

The authors agree that either approach can be made acceptable but emphasize that plutonium separated from spent fuel from civilian power reactors—of which there is currently more than 200,000 kilograms—must be guarded as nuclear weapons material. This fact is uncomfortable in a world newly concerned about nuclear terrorism. It took only six kilograms to make the bomb that destroyed Nagasaki.

Terrorists could explode a small weapon to destroy the heart of a city. The United States or Russia could do much worse. Both possess the means to destroy all of the world's 2300 cities having populations greater than 100,000. Garwin and Charpak worry that this destructive potential has become invisible since the end of the Cold War. The United States and Russia each still keep about 2000 warheads on missiles that are ready to launch within 15 minutes. The authors note the urgency "for reasonable minds to work toward a reduction in the stockpile of weapons to a level that no longer threatens the lives of hundreds of millions of totally innocent people." They suggest that the United States and Russia reduce their arsenals to 1000 total warheads apiece, including stocks of weapons-usable materials counted in warhead equivalents. After reaching this immediate goal, further reductions could come through multilateral negotiations, first with Britain, France, and China and eventually including Israel, India, and Pakistan. These steps might lead to a single nuclear force of 200 weapons controlled by a veto-less United Nations Security Council.

Megawatts and Megatons concludes by reminding us that progress in nuclear disarmament has only been achieved as a result of an aroused citizenry: "[I]t is well within the ability of governments and industry to achieve these goals. But it will happen only if an informed and concerned public pushes them to recognize and solve these problems." Perhaps the wake-up call of September 11 will re-engage the public with the problem of eliminating the nuclear Doomsday Machine with which we have come to live too comfortably. Reading this instructive book will help.

CREDIT: SEMPÉ/FROM *MEGAWATTS AND MEGATONS*

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Reference

1. G. Charpak, R. L. Garwin, *Feux Follets et Champignons Nucléaires* (Odile Jacobs, Paris, 1997).