EPA-related science and more on spreading an understanding of how poor a decision-making foundation existing knowledge provides. An appreciation of the limits of low quality might induce greater caution in regulation of the environment and greater ambition to understand it.

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There has been ample rhetoric from EPA Administrator Carol Browner about injecting good science into her agency's regulatory policies and decisions. Now it's time for actions, and the FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) biotechnology regulations for microbial biocontrol agents and for plants with pesticidal properties would be a good place to begin.

Biotechnology regulation by EPA has been consistently insensitive both to the scientific evidence and to official government policies attempting to rationalize regulation. For a decade, EPA has issued proposal after proposal that has sought to bring recombinant DNA–manipulated microorganisms into the regulatory net, despite broad scientific consensus that the method of manipulation is independent of risk. The quality of the science that EPA has brought to policy formulation was severely criticized by the independent National Biotechnology Policy Board (*1*) and by EPA's own blue-ribbon advisory panel (*2*), but the agency yielded on biotechnology only in a small way, in a 1993 proposed regulation on microbial biocontrol agents (*3*). Moreover, as recently as January 1994, EPA got the paradigm wrong again: for a biotechnology regulation on plants with pesticidal properties, EPA presented to an advisory committee "an option . . . using a criterion based on the process used to modify the plant, e.g., recombinant DNA methodologies."

The FIFRA biotechnology regulations for microbes and plants represent important opportunities for scientific principles to guide public policy. It will be interesting to see whether Browner and EPA seize them.

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1. *1992 National Biotechnology Policy Board Report* (Office of the Director, National Institutes of Health, Bethesda, MD 1992).
2. Expert Panel on the Role of Science at EPA, *Safeguarding the Future: Credible Science, Credible Decisions* (Document 600/9-91/050, Environmental Protection Agency, Washington, DC, 1992).
3. *Fed. Reg.* **58** 5878 (1993).

Administrator Carol Browner is quoted in Stone's article as advocating basing EPA's decisions on "the best possible science," a political ritual common to virtually all past EPA administrators (not only William Reilly, but even Anne Gorsuch claimed this as one of her primary goals). Notwithstanding the many unanswered questions in the natural and engineering sciences to which such statements usually refer, many of the most important uncertainties for improving EPA's policies lie not in these fields, but in the socioeconomic disciplines.

Despite recommendations from the National Research Council (*2*), however, and repeatedly from EPA's own Science Advisory Board (*3*), socioeconomic research support at EPA remains miniscule compared with investments in natural science and technical research. According to a recent AAAS study, EPA's annual budget for social science research was zero as recently as 1990; it is still only half a million dollars per year, compared with more than $346 million for research in the natural and health sciences, engineering, and computer science (*4*). A socioeconomic research strategy paper was developed in 1991, circulated for comment and even reviewed by the Science Advisory Board, but more than 2 years later it still has not been published, let alone implemented (*5*).

If EPA is truly to base its decisions on the best possible science, it will need not only to improve the quantity and quality of its research but also to correct the profound imbalance in *what* research it supports and to address equally important socioeconomic factors that determine the effectiveness of its policies. A likely result will be the discovery of many risk-reduction opportunities that are less costly and more effective than present policies.

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References and Notes

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2. Board on Environmental Studies and Toxicology, *Opportunities in Applied Environmental Research and Development* (National Research Council, Washington, DC, 1991).
3. *Reducing Risk: Setting Priorities and Strategies for Environmental Protection* (SAB-EC-90-92, Science Advisory Board, U.S. Environmental Protection Agency, Washington, DC, 1990); *Strategies for Risk Reduction Research* (Science Advisory Board, U.S. Environmental Protection Agency, Washington, DC, 1988), appendix E; *Review of the ORD Draft Pollution Prevention Research Plan: Report to Congress* (Science Advisory Board, U.S. Environmental Protection Agency, Washington, DC, 1989).
4. *Federal Funding for Environmental R&D: A Special Report* (American Association for the Advancement of Science, Washington, DC, 1992), p. 64. EPA officials estimate than an additional $2 million in nonresearch funds may also be spent on economic aspects of global change and other scientific issues (p. 48), but even this total would amount to only 7/10 of 1% of EPA's research budget.
5. A draft of *Stimulating Environmental Progress: A Social Science Research Agenda* (Office of Policy, Planning, and Evaluation and Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC, 30 December 1991).

Memories of Uranium

The article "Radiation: Balancing the record" by Charles Mann (Special News Report, 28 Jan., p. 470) brought back memories of my experience with radioactive materials during World War II. In the mid-1940s, as a teenager, I was an assistant in the mineral dressing laboratory of the Australian Council for Scientific and Industrial Research in Adelaide. For almost a year I ground samples of uranium ores into fine powder in preparation for analysis and enrichment studies with no protective clothing, not even a dust mask. The research officer and I did all our paperwork at a desk in the laboratory surrounded by many pounds of uranium ores and concentrates that were sitting on the bench tops. This was considered normal. Safety was not even thought about. Making a contribution to the war effort was the great concern.

While we cannot condone illegal or unethical actions, we should judge these early activities by the standards of safety, ethics, and secrecy that were in force at that time and not by the more stringent standards that came into force several decades later.

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The Odds of Retirement

There is uncertainty about how university faculty will respond to the elimination this year of mandatory retirement. Evidence from longitudinal studies of faculty retirement behavior before age 70 suggests that (absent additional incentives to retire) a large number of faculty will tend to remain indefinitely. But that analysis rests upon extrapolation: We have no direct data on the tendency for faculty to retire voluntarily in the absence of mandatory retirement.

No recent data, that is. A startling

message comes from 18th-century Oxbridge, data on the career histories of all of the 20 men to hold chairs of mathematics or astronomy at Cambridge or Oxford Universities at some time during that century (*1*). Of these 20, 18 (or 90%) held their chair until death; one (5%) was banished for heresy; and one (5%) actually retired. The retiree was Robert Smith of Cambridge, who retired with dignity at age 71 after holding the Lucasian Chair for 44 years. These 18th-century professors were not fragile specimens: their median age at death was 71, and their median number of years in the chair was 27.5. It is, of course, risky to draw a conclusion from these data, but they suggest that in the years ahead the number of university faculty retiring will be approximately equal to the number banished for heresy.

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1. N. Guicciardini, *The Development of Newtonian Calculus in Britain 1700–1800* (Cambridge Univ. Press, Cambridge, UK, 1989), pp. 150–152; *Dictionary of National Biography* (Oxford Univ. Press, Oxford, UK).

Corrections and Clarifications

In Jean Marx's Research News article "Learning how to suppress cancer" (10 Sept., p. 1385), a team led by Stephen Friend at Massachusetts General Hospital in Boston was credited with finding that *p*53 is the gene at fault in Li-Fraumeni syndrome. This work was published in *Science* on 30 November 1990 (vol. 250, p. 1233). Similar work was published in *Nature* in the issue of 20/27 December 1990 (vol. 348, p. 747) by the group of Esther H. Chang at the Uniformed Services University for the Health Sciences in Bethesda, MD.

The photo credit for the cover of the Women in Science 1994 cover (11 Mar., p. 1351) was incorrect. It should have read, "Tom Van Sant/Geosphere Project, Santa Monica, CA/ Photo Researchers."

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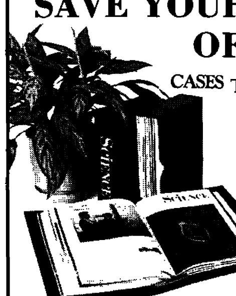

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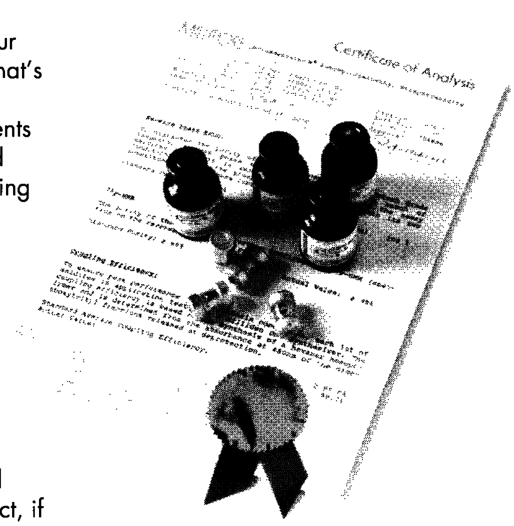

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