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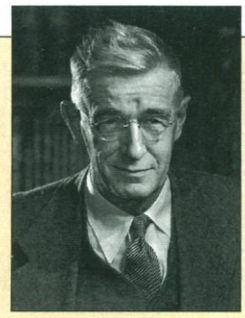

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Visions of Science

Science: The Endless Frontier by Vannevar Bush (right), published in 1945, has not been forgotten. Rustum Roy contrasts Bush's message with that of Byerly and Pielke, whose 15 September Policy Forum "The changing ecology of United States science" drew a number of comments. Roy would like to see policies for "strategic" science separated from those for "curiosity-driven" science and wants "informed outsiders" to have a voice in debate on science policy. Other letters include a response from the Environmental Protection Agency to Philip H. Abelson's 13 October editorial on animal testing and a report from Europe about new manufacturing processes that may help produce an electric car that will not pollute.

Effective U.S. Science

The Policy Forum "The changing ecology of United States science" by Radford Byerly Jr. and Roger A. Pielke Jr. (15 Sept., p. 1531) is a solid first step in calling on the "institution of science in the United States—scientists, organizations, and culture" to come out of the clouds and negotiate its *first* "social contract" with its "societal environment."

In *The Endless Frontier* (*1*), Vannevar Bush did not write a contract; he argued for a "gift" to science based on faith. There were no specific "quos" for society's "quids." Society would send money; scientists would do their thing. In our book *Lost at the Frontier* (*2*), an early critical assessment of the Bush "contract," Deborah Shapley and I detailed how scientists have been selective in their quotations from Bush. We showed how Bush the engineer also says, "Science . . . can be effective . . . only as a member of a team," how scientific research is related to "full employment," and how to study "nature's laws and apply new knowledge to practical purposes." Scientists, Bush says, should act like ministers (clergy not prime) in serving society.

The two major questions Byerly and Pielke propose for national debate—(i) how does "science" contribute to national welfare? and (ii) how can "science" help solve societal problems?—are essentially rhetorical for "strategic" science. We must separate policies for "pure curiosity-driven" science from policies for "strategic, purposive, or utilizable" science. No longer can we allow the former to be tucked in under the latter. They have little in common. The only thing holding what is euphemistically called "the science community" together are the funding agencies they share. It is surely one of the ironies of history that a Republican Congress, rushing to cut off every kind of welfare, or to privatize or hand over to the states many responsibilities, has so far missed the "curiosity-driven" science area. I argue that privatizing (or handing over to the states) all of "curiosity-driven" science would be as healthy for science as it has been for religion in America.

I especially wish to commend Byerly and Pielke for their insistence that the debate on science policy "give equal voice to informed outsiders" and "sober critics." The public that pays must have a major hand in deciding what money is provided for what science. For 20 years, I argued within the structure of the National Research Council (NRC) to put exactly such persons on *every* NRC committee. It didn't happen then. I hope it will now.

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References

1. V. Bush, *Science: The Endless Frontier* (Government Printing Office, Washington, DC, 1945; reprinted July 1960).
2. D. Shapley and R. Roy, *Lost at the Frontier—U.S. Science and Technology Policy Adrift* (ISI, Philadelphia, PA, 1984).

Byerly and Pielke, in their Policy Forum "The changing ecology of United States science," call for national discussion of the position of science in society and, in particular, its support and goals. We could begin by ceasing to press the technical term "ecology" into vague, general uses, such as "ecology of science." Call it culture or politics.

Scientists should not be directed to solve social problems such as racism, drug abuse, and the breakdown of community. These problems have been intensively studied by

scientists already, but the tentative solutions put forth have been largely ignored by politicians and others. For example, punishing criminals (whether in luxury prisons or in chain gangs) does not reform them. But there is a remote hope that education will solve social problems. Scientists have, some 20 years late, partially grouped to design and engage in the reform of public education.

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Animal Testing and EPA

Philip H. Abelson's editorial "Flaws in risk assessment" (13 Oct., p. 215) is the latest in a series of misdirected attacks on the risk assessment process and the Environmental Protection Agency (EPA). Abelson comments that laboratory studies of chemicals and their use in risk assessment have not been shown (through epidemiology) to have substantially benefited human health. Yet, laboratory studies are the basis of safety assessments in the food, drug, occupational, and environmental arenas and have prevented risk to untold numbers of Americans. Given the insensitivity of epidemiologic studies in establishing causality, we are fortunate that little evidence exists to suggest a failure to protect the American public from chemical hazards. At that point, the impact would, by necessity, be large and it would be too late.

Abelson focuses his criticism of risk assessment on the use of ad libitum–fed strains of laboratory rodents. Factors (including diet and genetics) modulating responses to chemical carcinogens have long been recognized by EPA and others as a concern in the interpretation of the 2-year carcinogenicity bioassay in rodents. This concern is clearly exemplified by EPA cosponsorship of the conference and proceedings cited (*1*) by Abelson in his editorial. As a part of its commitment to strengthening the scientific basis for environmental risk decisions, EPA has championed the need to consider mechanistic data as important information in improving reproducibility and reducing the uncertainties associated with extrapolating rodent bioassay data to characterize and estimate human cancer risk. This is evidenced by EPA's recent draft revisions to our 1986 *Guidelines for Carcinogen Risk Assessment.* The newly revised guidelines (soon to be published for public comment) emphasize analysis of all relevant biological data in assessing cancer risk, particularly information concerning mechanisms of tumor induction. EPA has also actively interacted with academia, other federal agencies, and industry to incorporate mechanistic considerations in research and testing programs. Given these facts, we see no basis for Abelson's allegation that we do not share the goals of good science on this issue.

Diet is, indeed, a variable that needs to be addressed in the cancer bioassay. To this end, we and other federal and industry scientists are pursuing a careful process that involves broad participation and peer review toward the development of informed scientific consensus. What is the most appropriate animal model for a generally overweight, genetically diverse U.S. population? The report cited by Abelson provides an example of the diversity of opinions on this particular issue at present; it does not suggest consensus about a fundamental change in testing protocols. We challenge Abelson to use his editorial pulpit constructively to encourage additional research in this and other important areas of risk assessment science.

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