Letters

Hornig's Accomplishments

I was distressed to read "The Hornig years: Did LBJ neglect his science adviser?" (31 Jan., p. 453) which purported to evaluate the performance of Donald F. Hornig as Special Assistant to the President for Science and Technology. The article was both inadequate and unfair and gave a distorted view of Hornig's years of fine service to his country.

The basic error of the article was the implied assumption that Hornig's effectiveness and success could be judged either by the public record or by the comments of those staff members or other scientists who are willing to talk. Hornig was an adviser to the President, and most of his advice is necessarily not on the record. Only the President himself can judge whether the advice of one of his counselors was adequate to meet his needs.

As I have stepped into Hornig's position, I have become tremendously impressed with the wide range of activities which he and the President's Science Advisory Committee initiated and carried out, and with the keen insight which he showed in preparing recommendations for the President and for many other agencies of government. He aided in the initiation of many international scientific and technological activities, prepared recommendations on various defense problems, on problems of housing and urban development, transportation, civilian technology, academic science, and many others. It is not true that he neglected the technological problems of the Vietnam war. He set up a talented task force to study this problem and conveyed to suitable authorities important recommendations on this situation.

Hornig served as Special Assistant during a very difficult period in our nation's history. I am proud to follow in the footsteps of a man who served his country so long, so faithfully and so well, and at such great personal sacrifice.

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Federal Funding: What Are the Priorities?

Two items in the 3 January issue illustrate conflicting approaches to federal funding of science—the editorial by William Carey, assistant director of the Bureau of the Budget, page 23, and recommendations from the New York Academy of Sciences, page 57.

Carey suggests using some reasonable test of social return for public investment in R & D, as a possible way of setting priorities. In apparent contrast, the New York Academy, in its recent report entitled "The Crisis Facing American Science," recommends, in part, that federal spending on scientific research grow at a rate of 15 to 20 percent per annum, "because the growth of the economy can well sustain such a rate," and "because existing programs do not use available scientific knowledge and manpower to the fullest extent." The report adds, parenthetically, the qualification that "*ideally*, spending on science should be defined by human needs—social, economic and cultural . . ." (italics mine).

Evidently Carey is talking mainly about *mission-oriented* R & D—that which enhances socially useful goals, such as national security, better health care, clean water at lower costs, or more rapid, safer transportation—and the New York Academy is talking mainly about *pure* research—which does not serve immediate needs, but the longer-range missions of enriching education, developing trained scientific manpower, or simply expanding the frontiers of science.

Each type of research has a role, but can priorities for spending on each type be subject to similar criteria? And can they be set at a centralized point in the government for both? As a second point in his editorial, Carey implies that the current, decentralized, pluralistic decision-making patterns for R & D are not good. But *mission-oriented* R & D can well be decentralized in the same manner in which the missions themselves are assigned to different federal agencies.

It is most appropriate that a water resource agency does the water R & D and that a transportation agency develops the programs and funding for transportation R & D. One should not apply standards of balance or priorities to water R & D versus transportation R & D, for example. On the other hand, one should apply standards of balance and priority to water resource development vs. transportation development; that is, to the total package, including R & D. But once that package has been agreed on and its level of support defined at the top echelon of government, then the specific R & D investment can be measured by the mission agencies in terms of the return for that particular goal.

As an example, the federal government is spending approximately $149 million in FY '69 on water resources research, ranging from artificial rainmaking to soil conservation practices, desalting, and public health aspects. (It includes, quite properly, a small amount of money for "basic," mission-*relevant* rather than mission-oriented research.) The research involves 11 agencies, and this is so because water research touches on the statutory missions of all these agencies. (Actually, about 75 percent of the research is done by the Department of the Interior.) The White House Science Office acts as a coordinating body which allows agencies to compare programs, eliminate overlaps, and define priorities and new initiatives. Now it turns out, within the water resources field, that the national R & D effort is responsive to a total national investment need of well over $100 billion over the next 10 to 15 years, for municipal and industrial water facilities alone (*1*); agricultural investment increases this figure substantially.

In the water case, then, a test for a return on the R & D investment is fairly simple. If we can save, say, 2 percent in the total national investment, we will have recovered fully the cost of the research. In general, then, it is necessary to show Congress that mission-related R & D will produce a return well in excess of the cost of investment, and to demonstrate that additional investments will increase the return, and perhaps even the rate of return.

In the case of pure science, the "social return" criterion still applies but the metric is more difficult to define. There is abundant diversity regarding methodology for arriving at such a metric, but there is no generally ac-

cepted, usable methodology for evaluating, even in relative terms, "the social return commensurate with the cost of investment" of various research activities. What is actually taking place is that agencies doing pure science on a large-scale—NSF, NASA, AEC, and NIH—respond to pluralistic pressures from the various segments of the scientific community and also apply judgments on what areas of research are ripe for major investments. Inasmuch as these agencies, except for NSF, act as spokesmen for particular scientific research areas, Carey's arguments for setting priorities and for centralized decision-making may be quite legitimate.

Lacking an accepted metric for deciding, that is, between expanded lunar exploration versus high-energy physics, the Budget Bureau works with the Science Advisor, who may seek guidance on priorities from the President's Science Advisory Committee, from the National Science Board, or from the National Academy of Sciences. Perhaps it would be desirable to combine federal departments, or at least those sections that deal with pure science, with the National Science Foundation as its core, as was suggested by Science Advisor Donald Hornig at the Dallas meeting of the AAAS. The advantage would be that decisions on priorities can then be made within a single department rather than at the White House level, and that there would be a single spokesman for pure science at the level of a cabinet officer. On the other hand, there is no guarantee that Congress would approve a departmental budget as large as the sum of its components.

Regardless of whether a Department of Science is established, pure science, which has a $2.354 billion budget for FY '69 as compared to the total R&D budget of $18.077 billion (*2*), could well be set at a fixed percentage of the total R&D, and perhaps even grow at a moderate rate. [It came to 11.7 percent in FY '67, 12.5 percent in FY '68, and 13.0 percent in FY '69 (*2*).] The justification would be, of course, that money spent on pure science provides the basic knowledge as well as the manpower to later undertake the mission-related R&D for direct economic and social returns.

One final point: Even mission-oriented R&D cannot be expected to give an immediate return and may require a time scale of, say, 5 to 10 years. As the New York Academy points out, the argument for long-range funding of both mission-oriented and pure research, particularly in the universities, cannot be made too strongly.

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References and Notes

1. *Report to Office of Water Resources Research* by the American Society of Civil Engineers, Urban Water Resources Research Program of Harvard University (Cambridge, Mass., February 1969). Note also that, while R & D funding is nearly all federal, the total national investment is mostly nonfederal.
2. *Federal Funds for Research, Development, and Other Scientific Activities*, vol. 17, NSF Publ. 68–27 (National Science Foundation, Washington, D.C., August 1968).

Panama Canal: Widespread Effects

The correspondence of Sheffey and Rubinoff (Letters, 20 Dec.) about the biological effects of a sea-level linking of the Atlantic and Pacific oceans brings to mind an experience I had some years ago as an explorer in the Upernivik district of West Greenland.

On an extensive sledge trip to examine a number of glaciers, I made a stop at Kigtorsak, a small winter colony whose director was a combination of dictator and sage. He was an old man among Greenlanders, but his watery eyes were penetrating and, with the help of a cane fashioned from a willow, he was as spry as a man of 20. He claimed that ice in the area became poor when the Panama Canal was opened and joined the two oceans. This, of course, had an effect upon seal hunting, and the lives of the natives thereabouts were consequently endangered. In many areas of Greenland at that time the seal was still the staff of life. Without it the native would have been unable to penetrate north of the timber line. It provided him with oil for light and heat, with meat to eat, and fur to keep him warm. Because of the lack of seals, hunting had been poor in the Kigtorsak area. Many dogs had to be killed and others kept on starvation rations. No wonder the director was righteously indignant. Two years earlier he had gone so far as to draw up a petition to have the Panama Canal closed (the petition got as far as Godthaab before being shelved).

Fortunately for me, an American, he did not know the exact location of the canal. He believed it to be in Denmark and therefore I was able to enjoy his unstinted hospitality. He entertained me