REDEFINING THE ENDLESS FRONTIER: NSF CONFRONTS THE 'NEW REALITY'

It has been basic United States policy that government should foster the opening of new frontiers. It opened the seas to clipper ships and furnished land for pioneers. Although these frontiers have more or less disappeared, the frontier of science remains. It is in keeping with the American tradition—one which has made the United States great—that new frontiers shall be made accessible for development by all American citizens.

Moreover, since health, well-being and security are proper concerns of government, scientific progress is, and must be, of vital interest to government. Without scientific progress the national health would deteriorate; without scientific progress we could not hope for improvement in our standard of living or for an increased number of jobs for our citizens; and without scientific progress we could not have maintained our liberties against tyranny.

—VANNEVAR BUSH,
Science—the Endless Frontier

In his annual presidential address to the National Academy of Sciences last April, Frank Press explored some new routes for government science policies in what he called the post-Vannevar Bush era. It was Bush the cantankerous MIT engineering professor and Carnegie Institution president who ran the Office of Scientific Research and Development in World War II. It was also Bush who provided an outline for the National Science Foundation in a perceptive 34-page monograph, "Science—the Endless Frontier," prepared in 1945 at the request of President Franklin Roosevelt. Today, nearly a half century later, Bush's vision of basic science's ability to serve the nation continues to be sound advice. Even so, said Press in his talk, the boundaries between basic and applied research have disappeared in the post-Bush world. In years to come, Press declared, "the new reality will be an even more direct connection between fundamental science and engineering and their commercial applications."

It so happens that NSF's director, Walter Massey, who took charge of the agency in April 1991, was already taking his first steps toward the "new reality" when Press delivered his speech to the academy. The direction in which Massey is boldly moving the foundation now has the approval of the National Science Board, the foundation's governing organization, as well as some powerful members of Congress. On 14 August Massey issued a memo to the board on the agency's future as he foresees it. Although he states that it is part of the long-range strategy the board is currently discussing to augment its existing five-year plan, which was the basis for doubling NSF's funding, the memo suggests that the agency needs to undergo a great transformation.

A cultural divide

According to Massey, Vannevar Bush's uncharted frontier, which NSF opened to academic researchers, is approaching a cultural divide: "The continued strength of NSF depends not only on remaining flexible and adapting to new circumstances, but also on anticipating change and recognizing opportunities," Massey declares in his memo. "In recent years the interval between discovery and commercialization has been dramatically shortened. Advances in fundamental science now often have near-term utility to industry in developing and improving products and processes. Incremental gains in fundamental knowledge can provide a comparative advantage in world markets."

Massey paraphrases Press when he observes that in such fields as biotechnology, computing and materials, the distinction has blurred between basic and applied research. Both Massey and Press say independently that scientific advance and technological progress now drive each other. Examples abound, writes Massey: "Instruments developed to probe the furthermost points in the universe, such as radio and infrared detectors, have proven valuable in more Earthbound pursuits; lasers have progressed from being a trivial curiosity to being an indispensable tool in telecommunications, manufacturing and medicine; and advances in our understanding of human behavior are now recognized as keys to increasing worker productivity."

At this point Massey makes a dash for Bush's promised land: The foundation should now turn away from its historical roots as "a small agency predominantly dedicated to the support of individual investigators and small groups at universities" and should become "the lead agency in transferring the results of basic research from the academic community to the marketplace." At another point in his memo Massey asserts, "I am convinced that if we fail to exercise leadership and to expand our role, the nation will suffer a decline in its science and technology capabilities."

Massey's outlook is indeed post-Vannevar Bush. During World War II, Bush had marshaled much of the scientific and engineering contribution that eventually proved decisive—in particular the Manhattan Project, which invented nuclear weapons. Now, Massey writes in his memo: "Superpower tensions have declined, and national security based on military strength will no longer be the predominant Federal research and development priority. The US economy now competes in a global arena where success is increasingly linked to capitalizing on scientific advances and new technologies."

In this new era, says Massey, NSF is uniquely placed for "building on its success in supporting research ideas by accepting a major role in fostering the links between research and technology." Indeed, during the past decade, under two previous directors, Edward A. Knapp and Erich Bloch, the foundation had expanded its portfolio by establishing centers for engineering, supercomputing and multidisciplinary research for industry–university cooperation. So the time has come, Massey declares, to integrate NSF's ongoing programs with industry and other government agencies.

How would all this be accomplished? "It is much too soon to provide details on what NSF might look like in the next stage of its

evolution," Massey writes. To help develop a wide consensus on the changes, the science board, meeting the same day that Massey distributed his memo, unanimously passed a resolution creating a commission of 15 people "whose wisdom, knowledge and abilities can promote an objective examination of NSF's role in contributing to major national objectives, such as research excellence, economic growth, international competitiveness, industrial productivity and quality of life." The board's chairman, James Duderstadt, president of the University of Michigan, has said that the commission members will be appointed as soon as possible and that the panel will hold three public meetings where scientists, educators, industrialists and others can offer their views on where NSF should head.

Though the board now backs Massey's concept for the agency, some of its members were not so enthusiastic about it when they saw an earlier version in June. According to the provisional minutes of the closed session of the June board meeting, Massey's plan provoked "a lengthy, spirited discussion concerning the role of basic research. Several members stated the importance of emphasizing NSF's primary mission to support basic research within the strategic vision." In some respects the board's discussion was a milder version of the acrimonious debate over the strategic plan that Bernadine Healy is advancing as director of the National Institutes of Health to chart the future course of her agency. Healy's plan has alarmed many medical researchers, who argue that it gives NIH too much discretion in defining priorities and places too much emphasis on the commercial exploitation of their work. Some scientists complain that Healy is attempting to initiate a national industrial policy. Healy and her supporters use the same rationale that Bloch made at NSF: If scientists and the agency do not set clear priorities, Congress and others who do not know or understand the problems will do it for them (see PHYSICS TODAY, August 1990, page 57).

A troubling budget

It is ironic that NSF is seriously considering ways to widen its horizon at a time when its budget is unlikely to keep pace with inflation. The House version of NSF's appropriation bill for fiscal 1993 would hold spending for research at this year's level of $1.88 billion. The Senate version, which has been approved by the appropriations committee and is awaiting action by the whole body, would actually cut that figure by $20 million—some $352 million below the Administration's request for 1993. Massey is resigned to a flat budget and admits to his staff that he expects cries of anguish from academic scientists when the agency is forced to reduce or eliminate grants.

Massey's immediate options are limited not only by budget pressures. The Senate appropriations committee has given him some prescriptive directives about running the agency. These often read like Massey's own memo. "While recognizing the role the foundation has played in establishing US leadership in basic research over the past 40 years, the committee believes that the new world order requires the foundation to take a more activist role in transferring the results of basic research from the academic community into the marketplace," the report declares. "This role should include: opening up applied research programs to greater participation by nonacademic personnel; making education programs better prepare future scientists and engineers for the needs of industry; and building day-to-day working relationships with other Federal agencies whose missions require cutting-edge technology." The appropriations committee directs NSF to revise its strategic plan accordingly by addressing the new role and to provide Congress with a budget that would enable the agency to achieve such ends. The committee also wants NSF to establish a formal working relationship with the National Institute of Standards and Technology in such fields as manufacturing, materials and engineering research. The report also calls on the agency to establish new centers for manufacturing processes, environmental technologies and advanced materials.

The Senate report bears the imprint of Barbara Mikulski, a feisty Democrat from Maryland, who heads the subcommittee with jurisdiction over NSF, as well as NASA, the Office of Science and Technology Policy, the Veterans Administration and several other agencies. Massey claims he had no warning that the committee would want to micromanage the foundation, and he has requested a meeting with Senator Mikulski. Though reports by committees of Congress do not carry the binding force of bills that become the law of the land when signed by the President, they are forceful messages to Federal agencies.

In an appendix to Vannevar Bush's report, a committee headed by Isaiah Bowman, president of Johns Hopkins University, provided a vigorous defense of basic research: "... it is important to emphasize that there is a perverse law governing research. Under the pressure for immediate results, and unless deliberate policies are set up to guard against this, *applied research invariably drives out pure.* The moral is clear: It is pure research which derives and requires special protection and specially assured support."

—IRWIN GOODWIN

GOOD NEWS FOR THE SSC AS SENATE APPROVES FUNDS AND MAGNETS WORK

Fears that the House had dealt the Superconducting Super Collider a fatal blow last June were quelled on 3 August when the Senate decided to keep the project alive another year. After three and a half hours of debate on an amendment introduced by Dale Bumpers, a combative Arkansas Democrat, to eliminate all funds for the SSC from the 1993 Energy and Water Development Act, the Senate voted 62 to 32 against the motion. The margin was somewhat wider than the 62 to 37 tally on a similar effort by Bumpers to scuttle the project a year ago. The Senate vote knocked topsy-turvy the 232 to 181 decision in the House on 17 June to bury the SSC before construction begins on an oval tunnel 54 miles in circumference around the gingerbread town of Waxahachie, Texas.

In passing the energy and water bill, the Senate agreed to provide $550 million for the SSC. While that is $100 million less than the Bush Administration requested for fiscal 1993—which begins on 1 October—it ensures that the SSC proceeds. Even so, the question that now awaits an answer by a conference committee of House and Senate members is not whether the project will receive any money next year, but how much. Congressional staffers say that because the conference committee will be made up mostly of members of the appropriations subcommittees with jurisdiction over energy research in