NSF: Being Blown Off Course?

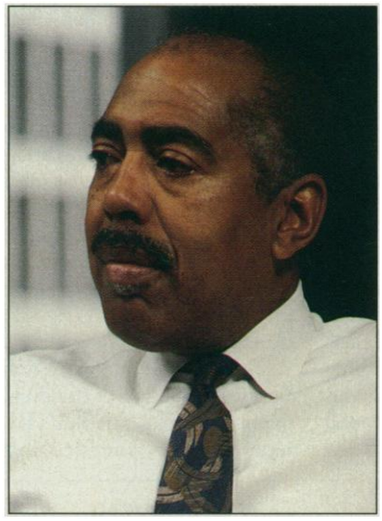
Walter Massey, sensing the prevailing political winds, has suggested steering the agency more toward applied research, prompting an outcry from the research community

The mail has been running hot and heavy in Walter Massey's office ever since the National Science Foundation (NSF) director thrust the agency into a raging debate about its future. Massey triggered the torrent of concerned letters when he wrote a memo to the National Science Board last August suggesting it was time to steer the foundation in a new direction, away from its traditional focus on investigator-initiated research toward broader social goals (*Science*, 21 August, p. 1035). But the message from NSF's constituents, echoed in a majority of the 700 invited comments from university presidents, center directors, senior professors, and junior scientists, is a simple one: Don't try fixing a system that, in the opinion of many, "ain't broke."

The anguish in the community is being heard beyond Massey's office. The letters are now being read and studied by members of a special commission appointed by the National Science Board (NSB) that is looking into the future of the agency. It began work just 6 weeks ago and is racing at breakneck speed to deliver its conclusions by 20 November. But the flood of concern may not change the general course of events at NSF. In writing his memo, after all, Massey was reacting to strong political winds already blowing from Capitol Hill, where the committees that hold NSF's pursestrings have told the agency to pay more attention to research that will enhance U.S. economic competitiveness. Even some of science's staunchest congressional supporters have been warning the agency that it will have to find a new rationale to maintain support from Congress.

The basic problem, Massey told *Science* in a recent interview, is that there is a "mismatch" between what the foundation is expected to do and what it can afford to do. Even before Congress cut the growth out of NSF's research grants in the 1993 budget, the agency was struggling to fund only about one-third of the applications it received, though many of the rejected ideas were excellent, according to Massey. Now the foundation is being asked to support a portfolio of large instruments—such as radio telescopes, magnet labs, a laser gravity sensor—while expanding special educational programs and technology projects like the high-performance computing initiative. "I don't think we can count on having the resource base" to support everything NSF is supposed to do "with the rationale that we give now," Massey says.

He sees three alternatives: cling to the status quo, reduce the agency's ambitions, or expand its claims by promising to play an even more dramatic role in improving society. The first response, he believes, is not one Congress would accept. As for the second, "I don't agree with that," Massey says, because it would isolate NSF both from the mainstream of science and technology and from the public. That leaves number three—a broadened mandate designed explicitly to boost U.S. industrial performance and increase support for science. Yet this expanded mission, many scientists fear, would bring extra sacrifices for basic research. It was this specter that sent many of NSF's constituents rushing for their word processors.



STEVE TURNER

In the eye of the storm. NSF Director Walter Massey.

A new political era

What some scientists see as a gamble is just realism to Massey. He and members of Congress who shape NSF's future warn that reform is already on its way, whether or not the agency welcomes it. The 1993 appropriations bill for NSF includes language from the Senate saying the agency must concern itself more directly with the nation's "economic strength." It demands that NSF draw up a new "strategic plan" emphasizing a "change in direction" and not "simply the wish for obtaining additional federal appropriations." And the Senate appropriations committee has served notice that if the special commission on NSF's future doesn't come up with such a plan for the agency by Christmas, Congress may impose one itself. Specifically, the finance committees favor a "reallocation" of funds "to strengthen certain priority areas: Process research and development, engineering research, emerging and precompetitive technologies, and fundamental research with ties to future industrial interests."

NSF is not alone in feeling the pressure for economic relevance: The National Institutes of Health (NIH) is also hammering out a new statement of purpose that ties NIH research to national goals (see story on page 882). Nor is this theme being promoted by anti-intellectuals. Even old friends of basic research—like Representative George Brown (D–CA), chairman of the House Science Committee—have been telling scientists they must prepare for a new era. Brown's committee prompted an outcry in the scientific community and a quiet protest from the National Academy of Sciences over the "confrontational" tone of a report last summer that advised research leaders "to consider a fundamental reformulation of science policy principles." The aim, the report says, should be to exploit research "as a tool designed to achieve national goals, rather than as a black box into which federal funds are deposited." It also talks about the need for "performance assessment" to be carried out by "persons or organizations independent of the research performers." It may be necessary to establish "a clear statutory mandate to redirect or terminate programs that are not making sufficient progress toward stated goals."

In private, congressional aides are even more emphatic. One House Science Committee staffer, for example, finds it "outrageous" that there is "no accountability" for federal funds spent on basic research. A science budget expert on the House staff explains that Congress is trying to "redefine the context" in which science is done. A key Senate staffer emphasizes that congressional leaders are trying to shift science funding from a defense-based to an industry-based rationale, now that the cold war is over, and he insists that NSF must "get ahead of the curve." Says another Senate aide, "Most of Congress agrees with" Senator Barbara Mikulski (D–MD), chairman of the appropriations subcommittee that funds NSF, who was largely responsible for inserting the language in NSF's budget bill urging the agency to pay more attention to applied research. Mikulski is "using a pretty heavy hammer" to let NSF know it must make its programs look

useful to the economy, this aide acknowledges, but he says that academic institutions have lost some credibility on Capitol Hill because of scientific fraud scandals, improper overhead cost charges, and skyrocketing tuition fees.

Letters from the trenches

These looming clouds are what prompted Massey to warn in August that NSF is in an "unstable" situation. But the scientific community, judging by the letters that have been pouring into NSF, is not yet convinced that Massey has the right prescription for bending NSF to these political winds. Not all the letters defend the status quo; many set forth other agendas for change. But few welcome the shift of emphasis Massey has proposed. Among the recurrent themes:

■ **Directed research drives out original research.** Many writers argue that NSF is the only agency devoted to science for its own sake, and that this unique role should be protected. An effort to set social goals for research could turn it into just another bureaucracy. The only way to encourage originality, these letters say, is to continue to let the investigators propose ideas, and to make awards based on excellence—as NSF does now. Asking NSF to become a promoter of technology would stifle basic research, they say.

■ **In any case, it's not NSF's job.** More than one industrial leader—for example, John Armstrong of IBM, a member of the Future Commission—argued that changing NSF's mandate would have little or no impact on U.S. commerce. Armstrong said that, "contrary to myth," U.S. companies have had little trouble identifying promising new technologies. Their problems are "downstream"—in designing new products and keeping up with marketing tactics of competitors.

■ **What the agency really needs is better PR.** Many writers, including some members of the future commission, believe that Congress is pushing NSF in a new direction without understanding the value of its existing support for basic science. For example, James Duderstadt, president of the University of Michigan and chairman of the NSB, said one of the most important jobs of the NSB and its special commission will be to "educate" the public.

■ **If you really want reform, break down the walls within NSF.** Many who would like to shake up the existing system argue that the most important change would be to knock down barriers between academic disciplines. Ideas that fall on the boundaries, they say, often get harsh reviews from each side. Several writers propose new ways of stimulating interdisciplinary studies, but few tie it to an economic agenda.

Even so, a few writers were enthusiastic about the prospects for expanding NSF's mission. This group includes some NSF engineering center directors, and a few others

The View From the Community

The following excerpts are from more than 700 letters sent to the Commission on the Future of the National Science Foundation (NSF), which is due to report on 20 November. They were prompted by a suggestion by NSF Director Walter Massey that the agency should broaden its mission to focus more on applied research.

"...The mission of NSF can be fine-tuned. However, in regard to its basic mission, consensus from the bottom looking up is: 'It ain't broke.' While NSF may need a tune-up, it doesn't need a major overhaul."

Thomas E. Everhart,
President, California Institute of Technology

"The commission should question changes that are proposed by some in Congress, and others, if they are a part of the continuing unrest about a national technology strategy. That problem should be joined in its own right and resolved accordingly, not by changes in the only court of last resort for leadership in fundamental science, namely, the National Science Foundation."

Philip M. Smith,
Executive officer, National Research Council

"...NSF is neither well enough funded nor equipped with the appropriate personnel to tackle a problem that has defeated large, research-oriented corporations like AT&T, IBM, etc. as well as other far more lavishly supported branches of the federal government. NSF is for many academic areas the primary means of support, and despite the claim of research largesse, individual workers are, I find, less well-supported now in terms of equipment and personnel than they were 10 years ago. Past NSF departures into engineering, education, and centers have contributed to this state of affairs and I think that further expansion of the role of NSF should be resisted."

Roger D. Blandford
Theoretical astrophysicist, California Institute of Technology

"I am enthusiastic about the decision of NSF to initiate a fundamental review of the role of NSF in serving the nation....NSF has a good history of responding to national needs....It is time to explore a new dimension that continues to recognize the importance of basic research and education, but pursues creative opportunities in linking multiple federal agencies, state and local governments, academia, national research labs, and industry. NSF is the optimal agency to pursue these new endeavors."

D. Lansing Taylor
Director, Center for Light Microscope Imaging and Biotechnology, Carnegie-Mellon University

"It is far from clear to me that NSF is the best agency for dealing with technology transfer and economic competitiveness. There are compelling reasons for utilizing other agencies, and there are compelling reasons for not utilizing NSF. If NSF makes promises and fails to deliver, we are sure to face reduced funding. This to a certain extent is happening in Congress right now as a result of promises made in the '80s."

Walter G. Klemperer
Professor of chemistry, University of Illinois at Urbana-Champaign

"I believe that the very close, symbiotic relationship between academia and industry, especially within NSF, as favored by Dr. Massey, would be a disaster: It would shift resources from basic research toward the development of new technologies....This runs counter to the unique mission of NSF, and I'm afraid it would ruin the soup."

Michael J. Greenberg
Director, The Whitney Laboratory, University of Florida

"Mission-oriented science at NSF already snuffs out the small projects that have nothing to do with the perceived mission, and a fundamental change in character at NSF would continue what I feel is a distressing trend."

J.A. Whitehead
Senior scientist, Physical Oceanography, Woods Hole Oceanographic Institution

NIH's Strategic Planning Rorschach Blot

Back in 1975, National Institutes of Health (NIH) molecular biologist Martin Gellert wasn't looking for a commercial payoff when he and colleagues Howard Nash and Kiyoshi Mizuuchi began to study the ways certain viruses integrate themselves into their host bacteria. Soon after beginning work with *E. coli*, however, the team made an unexpected discovery—that of DNA gyrase, an enzyme responsible for twisting the bacterial genome into its normal "supercoiled" state. The team found that, lacking DNA gyrase, the bacterium simply died. Within a year, the researchers had not only defined the mechanism of supercoiling, but also discovered a family of DNA gyrase antagonists. Last year, one such antagonist—norfloxacin—racked up $410 million in sales for Merck, which markets it as a broad-spectrum antibiotic.

Gellert thinks his story has an inescapable moral—particularly today, when, like the National Science Foundation, NIH is under increasing pressure to emphasize directed, applied research. "If someone had told me in 1975, 'Go forth and find a new antibiotic,' I probably wouldn't have had any better ideas than to go scrounging through soil samples looking for new compounds," he says. "If you say you want to cure disease X and limit yourself to exploring the things you can see in the near future, you're likely to have bad luck."

But Gellert, like many scientists working for and funded by NIH, believes that NIH may be falling into exactly this trap. The focus of their concern is a year-long strategic planning exercise kicked off by Director Bernadine Healy, which has drawn fire for emphasizing applied, disease-oriented research—including work with potential commercial applications—at the possible expense of basic biology (*Science*, 14 February, p. 788; 3 July, p. 20; 24 July, p. 476). Those sentiments are not universally shared, however. Instead, the current draft of the strategic plan—a 204-page, double-sided, loose-leaf draft that outlines NIH goals, a philosophy, a mission, a statement of means, and six "trans-NIH objectives"—is something of a Rorschach blot for the research community, whose members mostly seem to be reading into the plan either their greatest fears or fondest hopes about the way research should be managed.

Since last December, Healy has been promising a strategic plan aimed at justifying NIH's $10 billion budget in terms of its contribution to the nation's welfare. Without such a plan, Healy has said, NIH faces the prospect of declining public and political support, shrinking budgets, and an inevitable cutback in basic research. This year, Congress may have helped make her case by failing to increase NIH's budget much over the rate of inflation for the first time in recent memory—a move that NIH officials take as an indication that their agency can't afford to be without a strategy much longer.

To the extent that this strategy implies that NIH will focus more intently on research with commercial applications, however, it has created sharp divisions within the research community. Consider, for instance, the views of just two scientists who responded to Healy's outline of the strategic plan in the 17 July issue of *Science*. "A lot of work in NIH grants is on basic [biological] mechanisms and so forth," says Abulkalam Shamsuddin, a University of Maryland pathologist who thinks that a new emphasis on applied work would be welcome. "Now, if you come up with a practical application, there's not any interest in it. Instead, we're all in a rat race for the Nobel Prize." On the other hand, Joaquin Fuster, a University of California, Los Angeles, neuroscientist, complains that the NIH strategy amounts to little more than "a reflection of a desire to capitalize whatever we've got, whatever its sources, for short-term profit, and to satisfy [near-term] political aims."

The NIH officials in charge of the plan are eager to reassure the research community that Fuster's fears are unfounded. NIH associate director for science policy and legislation Jay Moskowitz casts the strategic plan not as a series of top-down directives, but as a process for bringing the research community together with NIH officials to determine when important research areas that touch on the plan's overarching goals aren't being met by the R01 investigator-initiated grant program. Once officials and institute research councils, study sections, and outside researchers hammer out a consensus about the best way to fill such research gaps, Moskowitz says, the problem may well be solved by a flurry of R01 proposals spurred by the discussions themselves. "The point is to shape the future, not let the future shape you," he says.

But researchers like Gellert remain unconvinced that the consensus approach to research management will produce the results promised for it. "In my view, modern biology is not yet ready for that kind of engineering approach—not in the sense of 1960, of saying, 'Let's send a man to the moon,'" he says. "We know a lot, but it's all in bits and pieces. What we know is far outstripped by what we don't know."

–David P. Hamilton

with research management experience like Edward Frieman, director of the Scripps Institution of Oceanography. In his letter, Frieman urges NSF to "seize the opportunity to play a key and fundamental role in helping to forge the nation's new overall R&D posture," arguing that it is the agency best suited to take on the task. He makes several suggestions for orchestrating the "new order," predicting "an enormous amount of community support."

Assembling all those divergent opinions into a consensus statement will be a tough job—all the more so because the NSF's special commission has just the next 2 weeks for the task. Indeed, even members of the NSB, such as Charles Hosler, senior vice president for research at Pennsylvania State University, have grumbled openly that the strategy is being cobbled together with undue haste.

For NSF traditionalists, it will only get worse next year. The House Science Committee is planning a 12-hearing review of the NSF's programs and objectives, and the Senate, too, will be taking a close look because the NSF's 5-year reauthorization comes due in 1993. And this scrutiny of federal science is likely to be more intense in coming years because R&D will be supported by a weak economy, predicts Edward David Jr., retired chief of research for Exxon and former White House science adviser. He believes the cold war's end will bring a period of deflation, with a depressing 25% to 30% drop in funding for R&D. "It's been 50 years since we've operated a peacetime economy and we have no idea how to do it—no idea," David says. In the private sector, big companies like Chrysler have already closed central labs, and others will follow suit, he expects. David doesn't expect NSF-supported research at universities to be immune. "Downsizing," David warns, may be the theme of the decade. "I'm not advocating any of these terrible things," he says. "It's just the way things are going."

And Massey says he has done his best to elicit reaction from the community. Though he concedes that he was "a little surprised" by the number of critical comments and by the overwhelming concern "that we might do something to damage the foundation," he notes that, "I was deliberately provocative" in presenting the issues to the public and the science board last summer. "I wanted to make sure the issues were addressed sharply," Massey says, "and I must say I have been very successful in that."

–Eliot Marshall