NSF: Hard Times Amid Plenty

In spite of hefty budget increases during the past few years, the size of the average individual grant is shrinking and a diminishing fraction of applications is getting funded

AT FIRST GLANCE, the National Science Foundation appears to be doing very well these days. Its total budget is on a healthy trajectory—up 12.5% this year with another 12.3% increase requested for next year—and it's launching new projects and bankrolling several major new science facilities. So why have low-temperature physicists formed an advocacy group to do something about "the miserable level of agency funding for university-based small science?" Why does Cornell University physicist Robert Richardson say, "I have never seen things as difficult as this." Why does NSF director Erich Bloch say, "Is our budget big enough? No, it's not."

Part of the answer is that no one ever says research dollars are in ample supply. That would be sacrilege. But from the perspective of the individual scientist, NSF's budget picture is far from rosy. In fact, while the foundation's total budget has been going up, the average size of NSF grants awarded to individual investigators has been dropping and a declining proportion of applications is getting funded (see charts, below).

The chief reason for this apparent contradiction is that a large chunk of NSF's growth has not been going directly into research grants: Money for large facilities like the NSF computer network (NSFNet) and a new radiotelescope to replace the one that collapsed in Green Bank, West Virginia, is up. Money for science and engineering education—zeroed out in the early years of the Reagan Administration—is way up. And new initiatives like the Science and Technology Research Centers have enjoyed comparatively huge increases, primarily because just a few years ago they had no budgets at all.

In contrast, money for many of the foundation's core science budgets has either remained level or declined in constant dollars. According to an analysis* by John C. Crowley, vice president of the Association of American Universities, two-thirds of the 84 NSF competitive research programs in four major areas (mathematical and physical sciences; engineering; biological, behavioral and social sciences; and computer and information sciences) have dropped below their 1988 levels in real dollar terms.

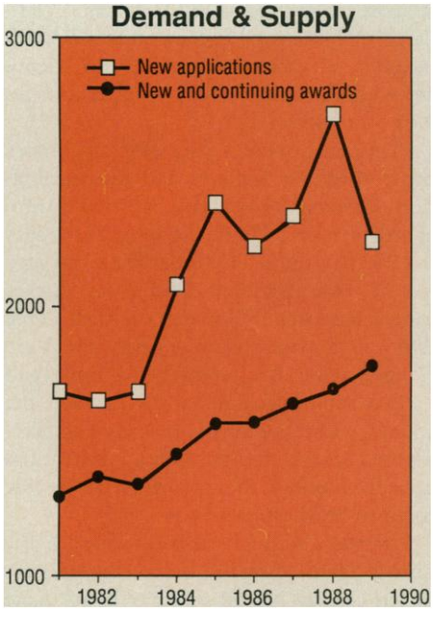
In their frustration over this rather grim picture, many scientists have blamed the new science and technology centers and their older counterparts, the engineering research centers, both of which have enjoyed relatively robust funding increases. But growth in the centers' budgets is only part of the answer. The real difficulty is that a lot of new initiatives and big-ticket items are being shoehorned into a research budget that is not expanding fast enough to accommodate them.

It was not supposed to be that way. In 1987, the Reagan Administration announced a plan to double NSF's budget by 1992 and Congress enthusiastically endorsed the idea. But when it came to ponying up, Congress didn't make it past the first turn. NSF's total budget has gone up in real terms since 1987, but doubling isn't expected now until 1994, if then.

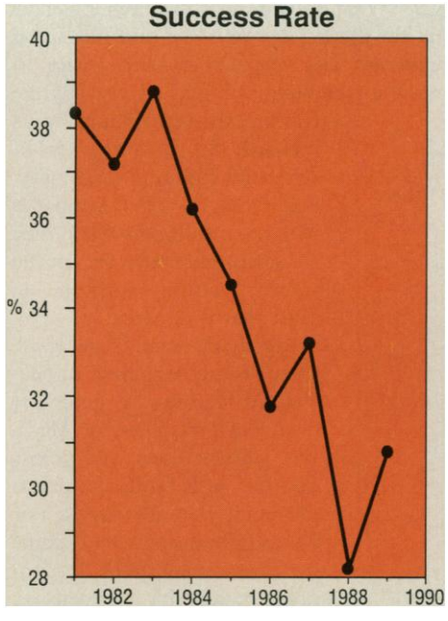
NSF's Bottom Line

	1988	1989	1990	1991*
	(billions of dollars)			
Research and Related Activities	1.453	1.583	1.763	1.954
Science and Engineering Education	.139	.171	.204	.251
U.S. Antartic Programs	.125	.131	.152	.175
TOTAL	1.717	1.886	2.122	2.383

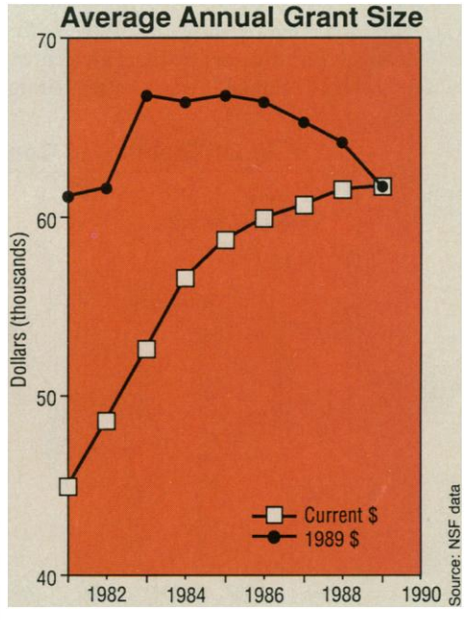
*requested



Falling behind. *The number of grants is rising, but not as fast as applications for new ones.*



Tough competition. *The success rate for new applications has dropped precipitously.*



Ups and downs. *Inflation has reduced the buying power of grants since the mid-1980s.*

For many researchers, the difference between promise and reality has led to "an Alice-in-Wonderland type of existence where you have to run harder just to stay in the same place," says Crowley. Certainly many scientists agree. "NSF funding used to be adequate to get the job done," says Joel Cooper, chairman of the psychology department at Princeton University. "Now we find that if NSF likes a proposal and wants to fund it, their first response is typically that the budget has to be pared by 30 or 40%." Robert Hallock at the University of Massachusetts at Amherst says the same is true for physics. "I have not seen my support increase in 5 years," he says.

Robert Silsbee, a physicist at Cornell University, says the funding situation simplified a recent career decision. At age 61, Silsbee was trying to decide whether to seek renewed NSF support when his current grant ran out or close up his lab and devote his time until retirement to other research interests that would not require federal support. "It was a decision hanging in the balance," he says. "The NSF situation put a lot of weight on one pan. In some sense it made the decision easier than it would have been." Silsbee is closing up shop.

Funding difficulties are causing problems at the other end of the pipeline as well. Hallock says many students are abandoning promising scientific careers because of the uncertainties of long-term support. He says that his best graduate student agonized over whether to accept a Sloan Foundation award and go to the University of Oregon for a postdoc in low-temperature physics. In the end, he decided to go, says Hallock, but "it was a very, very difficult choice, and it shouldn't have been."

NSF's own figures show the problems for individual investigators with stark clarity. The average annual award, after rising slightly in the early part of the last decade, has shrunk steadily in constant (1989) dollars from almost $68,000 in 1985 to $61,700 in 1989, the last year for which figures are available. Add to that what President Bush's science adviser, D. Allan Bromley, calls "sophistication inflation"—the cost of the latest equipment and techniques tend to go up faster than general inflation—and the average grant begins to look rather meager.

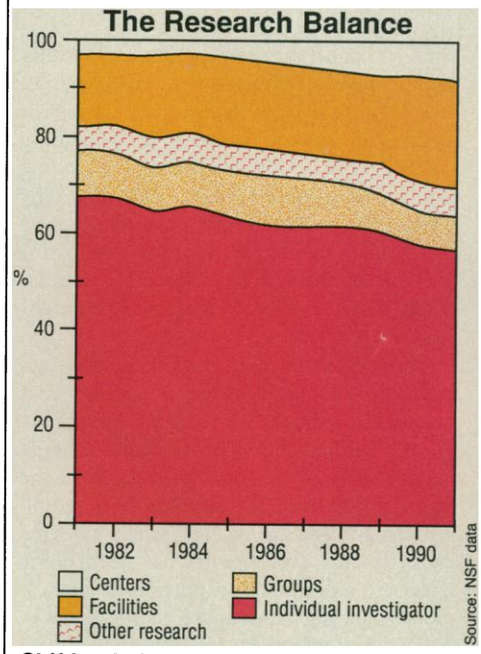
But a majority of applicants cannot complain about the size of their NSF grants for the simple reason that they don't get funded at all. Throughout the past decade, the number of applications has been rising much faster than the number of grants NSF can award. The result: a precipitous decline in the percentage of successful applications, to around 30% this year.

"The system has outgrown its support," says Bloch, with the number of researchers in universities increasing far more rapidly than the level of federal support. Bloch says he is sympathetic with his program officers who must constantly decide among grants that get excellent ratings from reviewers. "The quandary is adequate grant size, or more grants," he says. "It's very difficult to say no to somebody who has an outstanding proposal."

When Bloch began his 6-year term as NSF director in 1984, he clearly was interested in altering the balance of NSF activities, putting more emphasis on computer science and engineering. But he absolutely rejects the suggestion that he has not done enough during his tenure to address the needs of the scientific community when it comes to the individual investigator's budget. "What do you think I've been trying to do for the last 6 years?" he said during an interview last week. "I've been trying to make it [the budget] bigger, for exactly the reasons the community puts forward. So I have a lot of sympathy with the community. I don't have a lot of sympathy with the community when they are saying that they are on the verge of getting destroyed, because that is not true."

But that's exactly how some scientists are beginning to feel. Vincent Pirotta, a geneticist from Baylor College of Medicine who has reviewed grants for NSF, says, "It has gotten to the point that it's almost not worth getting together a panel [to review new grant applications] because it's so expensive, you could almost fund another grant with that money. And if you're only going to be funding seven or eight grants, adding a ninth makes a difference."

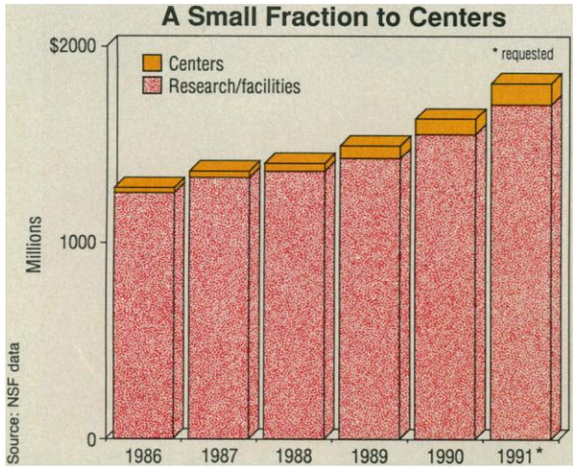
Bloch says researchers like Pirotta do not look at the big picture: "The majority of our dollars, over 60%, is in what it always has been, which is individual investigators." But NSF's own figures do not bear Bloch out on this point. In 1990, support for individual investigators accounted for 58% of the research budget; it would drop to 57% in the 1991 budget request. Ten years ago, nearly 68% of the foundation's research budget went to support individual investigators. If support for individual investigators is compared with the total agency budget—which includes substantial new money for science and engineering education—the percentages look even worse.



Shifting balance. *Individual investigators have been getting a declining share of the pie.*

In contrast, there is unquestionably more being spent on facilities and instrumentation. Funding for facilities has grown from approximately 15% of the research budget in 1980 to around 22% today. This category includes the National Center for Atmospheric Research in Boulder, the Very Large Array in Socorro, New Mexico, the Very Long Baseline Array now being built, and other national facilities dotted around the country. And funding for the new engineering and science and technology centers has gone from zero at the start of the last decade to a projected 6% next year.

For many researchers, the blame for the dismal plight of small science falls squarely on the centers. "In the presence of adequate funds for everything [the centers] are fine ideas," says Hallock, who heads the low-



The big picture. *Though they have grown fast, centers still only account for a small fraction of the research total.*

temperature physics advocacy group. "On the other hand, it is clear that some of the funds for those things, no matter what one is told, seem to be drained from [research] programs. We consider that a negative." Psychologist Cooper feels the same way: "I can't say we know this for sure, but our suspicion is the drive to fund centers is responsible for the diminished funding, and that makes us not very enamored of the move for centers." What researchers often fail to realize, however, is that funds would not automatically go back into the general pot if particular programs were canceled.

Tough choice. *NSF Director Erich Bloch: "The system has outgrown its support . . . the quandary is adequate grant size or more of them."*

The engineering research centers program, proposed by President Reagan's science adviser George Keyworth III and former NSF director Edward Knapp, and implemented by Bloch, was an attempt to link academic engineering research and education with engineering practice. There are now 19 engineering centers, with an overall budget of approximately $48 million. The request for 1991 is $55.3 million. In 1987, NSF announced plans to extend the idea to more basic areas of science and technology. The first 11 science and technology centers were launched in February 1989 with a total budget of approximately $27 million. The request for 1991 is $52 million.

In spite of this healthy growth, Bloch says blaming the centers for other budget problems is both irresponsible and "sheer nonsense." The figures sustain him. Centers represent only 4.5% of the NSF's research budget. Eliminating them would not make much of a dent in the problem of declining support for individual investigators. Besides, Bloch says, the centers provide research support for numerous scientists. "Our centers support something like 500 individual investigators. They're the colleagues of the same people that are complaining. They're doing research. They're not robots."

Bloch also rejects the argument enunciated by Robert Park of the American Physical Society that "you don't start a new activity when times are tight without incurring someone's anger." Says Bloch: "We need to start up new things, regardless of the so-called crisis. If you only do what you did yesterday then I think you will become obsolete in a hell of a hurry."

Some of the tensions among NSF's supplicants would be eased with a few years of strong overall budget growth. On that score, there are a couple of mildly hopeful signs. The first—a measure of the bizarre way in which the budget is handled—is the fact that some politically popular housing programs received better treatment in Bush's budget proposals than they have in the past few years. Since NSF's budget happens to fall in the same appropriations bill as the Department of Housing and Urban Development, a new synchrotron light source can in effect be competing for funds with an urban renewal project. This year, the competition may not be quite so severe.

Then there is the shift from defense to civilian programs in the overall budget. Bloch suggests this may provide a chance to shift the balance of research support. "The federal government spends $71 billion on research and development, and I think that's enough, but we're not necessarily spending it right," says Bloch. "I've been after spending more in basic research, and less in the applied area, especially the military. That's where one has to start." But Bloch, who is leaving NSF this August, warns that difficult times could still lie ahead. "We're in a zero sum game. I've got no doubt about that, I've seen it too many times," he says.

Another factor is that researchers' complaints about shortages of funding are getting louder. "By and large the small science types don't complain terribly loudly about financial problems," says physicist Robert Schrieffer of the University of California at Santa Barbara. "That's because they have traditionally been able to tighten their belts yet one more notch and still function," he says. But "There is a point where belt-tightening cuts off the main flow of the body fluids, and we're feeling that at least in this field [condensed matter physics] it has happened. My guess is that it has happened in other fields, too." The call to arms has been picked up by industry-university lobby organizations like the Coalition for National Science Funding and Coretech (the Council on Research and Technology), which have been pushing hard for a strong NSF budget on Capitol Hill. As the appropriations committees start making their spending plans this summer, it will become apparent whether Congress is listening.

■ JOSEPH PALCA

*AAAS Report XV: Research and Development FY 1991, Intersociety Working Group, AAAS Committee on Science, Engineering, and Public Policy.

How More Can Mean Less

National Science Foundation Controller Sandra D. Toye likes to point out how the bottom line can be misleading when it comes to judging how well NSF is doing. NSF requested a research budget of $1.803 billion for its 1990 budget, 11.3% ahead of the 1989 figure. The congressional committees responsible for NSF's budget recommended that figure be cut to $1.715 billion. Then came across-the-board cuts to fund the war on drugs, bringing the budget to $1.688 billion, and then sequestration brought on by the Gramm-Rudmann Deficit Reduction Act reduced that figure to $1.665 billion, just 2.7% ahead of 1989.

But while Congress takes away, it also gives back. Money to replace the collapsed radio telescope in Green Bank, West Virginia, additional earthquake funds following the World Series quake in San Francisco, and a $20-million boost for facilities for "have-not" universities kicked an additional $60 million into the research pot. That brought the total to $1.725 billion, or 6.4% ahead of 1989. Add in another $38 million for the Green Bank telescope carried over from 1989, and you come to a total of $1.763 billion. While all that money will eventually find its way to support research and scientific facilities, NSF officials complain that congressional earmarks tie their hands when it comes to spreading funds equitably—or at least in a way that meets scientific policy priorities.

But on the other hand, there is no direct trade-off between earmarked funds and more general research support. If Congress had not appropriated funds for those particular projects, it's not likely that it would have put the same amount into the foundation's core budget. ■ J.P.