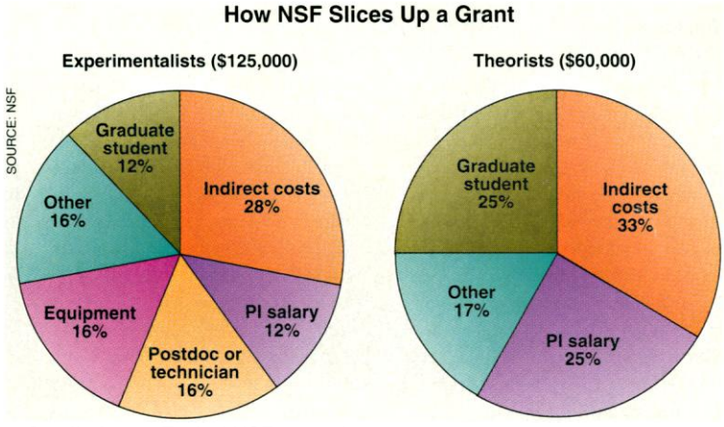
At NSF: Fewer, Longer Grants

The agency wants to give the best scientists what they need, but new policies may mean stiffer competition for everybody else

Since 1987, the National Science Foundation (NSF) has supported University of Georgia biologist Michael Hahn's work on signal transduction in plant cells. That sounds good until Hahn explains that before this year, his grants—$40,000 a year for 2 years, followed by $75,000 a year for 3 years—didn't let him hire a postdoc and buy the supplies needed to do the molecular genetics that will enhance his work. "NSF has been unusually generous with me, as a young investigator," he acknowledges. "But even a $100,000 grant—which is less than $70,000 after indirect costs are taken out—isn't enough to do cutting-edge research." The solution, he says, is bigger and longer grants, like the 3-year, $150,000 a year award he received in February.

Down the hall, Hahn's colleague Debra Mohnen has a different—and more serious—funding problem. Mohnen is still looking for her first NSF grant, and she's facing tough odds. "It's almost suicidal," she says, to move into a new area—as she did a few years ago to study cell-wall synthesis in plants—without having a considerable amount of preliminary data to show funding agencies. After her application was rejected last year, she scrounged up enough money from other sources to do some initial experiments; this month, she's submitting another request for funding. Mohnen's solution is the opposite of what Hahn wants: "If they cut down on the size of grants, they could afford to take a few more chances on a good idea," she says. "The difficulty of rewarding those already in the system is that new people are hurt."

Hahn's and Mohnen's funding situations symbolize a harsh dilemma that confronts NSF. For years, researchers have complained that NSF grants are too small to allow them to do their best work, and the grants have to be renewed so frequently that scientists are forced onto a grant-writing treadmill. Yet the obvious solution—making grants bigger and longer—means fewer grants unless NSF's overall budget goes up sharply for several years. The National Institutes of Health (NIH) learned these lessons in the late-1980s when it increased the average size and duration of its grants and then watched the annual number of new and competing grants plummet (*Science*, 8 December 1989, p. 988). The heightened competition would also tend to favor experienced researchers from the most prominent labs over segments of the community that NSF believes deserve special consideration: younger and minority investigators and those at undergraduate institutions who teach the next generation of scientists.



Small pieces. Typical NSF grants have many components.

In spite of these limitations, NSF officials in the past few years have tentatively been moving toward longer, bigger grants, while trying to protect funding for programs aimed at supporting researchers most likely to be hurt by this policy. Since 1990, the average size of competitive, single-investigator grants has risen 9%, matching the increase over that time in NSF's overall research budget. During the same period, the average duration of research grants has risen from 2.4 years to 2.7 years. These changes have been accompanied by a 3% drop in the number of research grants awarded, excluding those from the education directorate, and the overall success rate has remained level at 30%.

"Yes, this will mean fewer winners, but it means letting the winners really win," says Richard Zare, a Stanford chemist and longtime NSF grantee who is also a member of the policy-setting National Science Board. "The alternative is peanut butter—spreading the money as thinly as possible—and in the long run that's a recipe for mediocrity."

Although individual directorates have been given considerable autonomy to meet the needs of their particular community, the figures within disciplines generally reflect those foundation-wide trends. Last year, for example, the average size of competitive grants within mathematics and physical sciences went up 3% while the number of competing awards dropped by 15%. Biology, which has made larger grants a priority, has increased the average size of its competing awards 13% since 1989 by giving out 8% fewer awards. Engineering, which has emphasized duration, has made its average grants half a year longer since 1989, but the size of a typical grant has dropped by almost $1,200.

With the exception of mathematicians, who last year complained bitterly about the new policy (*Science*, 23 October 1992, p. 541), the research community has been slow to respond to these changes. One reason is that NSF has moved cautiously and quietly, so most researchers are not aware of what NSF has begun to do. Such changes also take time to register. "A declining number of awards is not terribly visible to the community right away," says Maryanna Henkart, a 12-year NSF veteran and director of the cell biology program within the biology directorate.

Expansion in tight times

The changes respond to longstanding complaints that NSF's grants are too stingy. "There's a general feeling that one's ability to do the proposed research on an NSF grant, without additional sources of support, is deteriorating and that the amount of time people must spend on applying for grants is going up," says Princeton physicist Peter Eisenberger. He is cochair of a new advisory committee to NSF's mathematics and physical sciences directorate that has put a study of the implications of increasing grant sizes and duration at the top of its agenda.

Such concerns received official endorsement in 1990, when an internal task force proposed bigger, longer grants as part of a broader revamping of NSF's grant-making process to make it more efficient. The task force's recommendations were not adopted at the time, but then-Director Erich Bloch promised to make increasing the size of the average grant a priority. Bloch's successor,

Walter Massey, repeated that pledge, and in 1992 the Commission on the Future of NSF —a panel of outside experts established by the National Science Board—told NSF to study the issue, adding that "we favor research grants sufficient to do the work for which the grant is awarded." Last spring, an NSF task force decided program managers should remain "flexible" in deciding how to achieve that goal. NSF's new director, Neal Lane, agrees that increasing grant size is important but says the preferred response varies widely among disciplines.

NSF had hoped to achieve longer and larger grants relatively painlessly, by steadily increasing its research budget. Indeed, three successive presidents submitted annual requests for double-digit increases as fulfillment of a promise to double NSF's budget. But Congress has refused to go along. Although NSF's overall budget has risen each year, the agency has gotten much less than it asked for, and the biggest increases have gone for educational programs, not the six research directorates. Last year the news was grim indeed—an actual cut of $13 million in NSF's nearly $2 billion research budget.

This fall, Congress gave NSF an increase of 8% for research in 1994—less than half of what the Administration had requested but still a healthy boost compared to the rest of the government. That may temporarily ease some of the strains, but it would require several years of such increases—an unlikely prospect given pressure to cut the budget deficit—for NSF to expand the size and duration of its awards without reducing the number of grants. The reason: If Congress trims NSF's budget next year, commitments to bigger grants awarded this year would still have to be met, and that would leave NSF with less money for new grants and for a variety of initiatives already on the books.

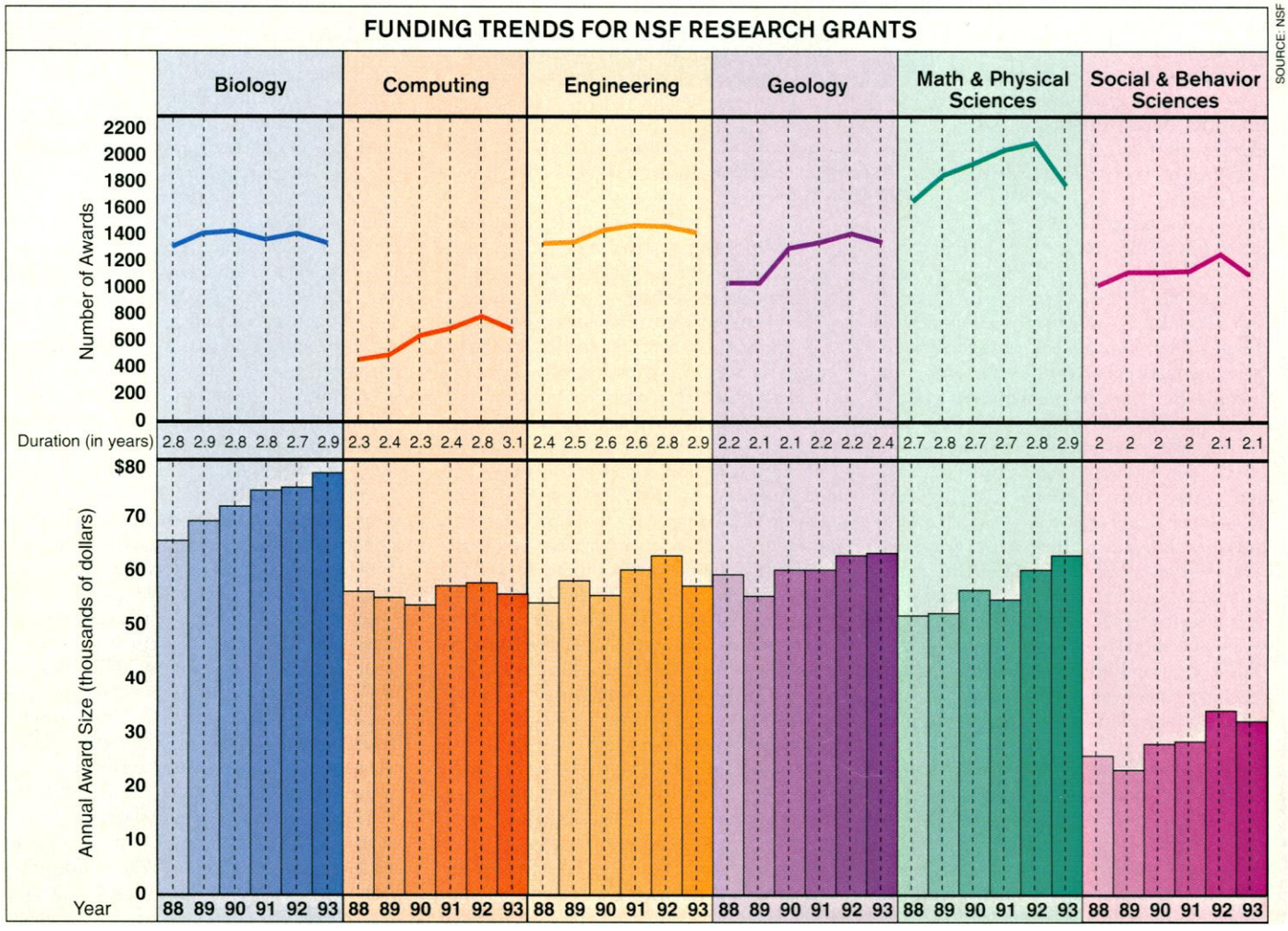
"If one thought that one was in a temporary period of transition, then there would be sentiment to hold onto the present system and wait for a better day," says Eisenberger. "But the pressures on the NSF budget are rising, and that better day may never arrive."

Struggling with new math

That reality has forced NSF officials to seek ways to carry out their new philosophy without a large infusion of cash. None is painless, however. "It's an illusion that one will find a scheme that works," says Bob Zimmer, chairman of the mathematics department at the University of Chicago. "What Fred [Wan, director of NSF's division of mathematics] is left with is damage control. And that means funding the best people. It's like what happens when you're freezing: You support your trunk, and you hope the limbs find some way to survive."

Zimmer is referring to a controversial attempt last year to change the way NSF awards grants—a cautionary tale for those trying to carry out NSF's pledge to "enable researchers." It grows out of a plan to give large awards to a handful of top mathematicians and subsistence grants to everybody else.

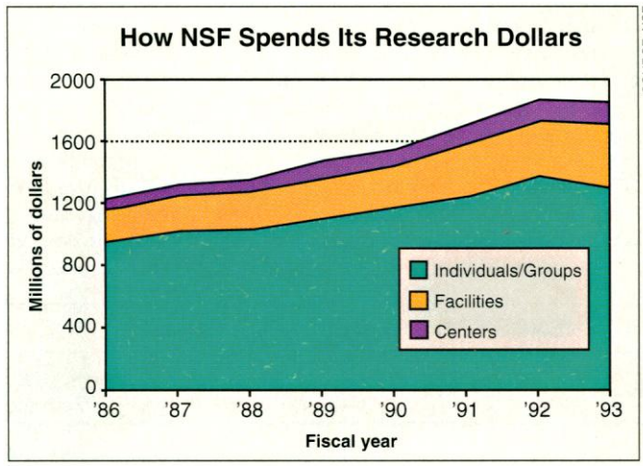
As the chief source of federal support for academic mathematicians, NSF's actions touch on the entire community. And while university scientists and administrators agreed in principle with what NSF was trying to accomplish, they sharply attacked such details as a lower rate of indirect costs and curbs on summer salaries. Although NSF beat a hasty retreat, the crisis has, if anything, gotten worse: A flat budget in 1993



The portfolio. NSF's six research directorates go their own ways in terms of size, duration, and number of grants awarded.

forced the division to make fewer awards and trim the size of the grants it did fund. In response, program officials have come up with a revised plan giving "high-impact" researchers (those who score in the top 10% to 15% of applicants) what they need, setting aside 25% for outstanding young investigators, and telling the rest of its grantees to expect a lot less than they have requested.

The fallout is already being felt by people like Frank Sottile, who is finishing up a doctoral program in mathematics at the University of Chicago. The department pools its grants money for graduate students, with the aim of allowing students to remain on campus during the summer to continue their research. Last spring, however, Sottile found out that there wouldn't be enough to go around; although he managed to snare another summer job on campus, it was full-time work unrelated to his studies. "I thought for a while that I might have to drop out of the program and leave math altogether," he says. "And it's not over. This spring I'll be graduating and the next step is a postdoc. And that means finding another grant."



Market share. The proportion of NSF's research budget going to individual investigators has held steady.

Sottile's experience is not unusual. The bulk of the money a researcher receives from NSF in a grant goes to pay people—the investigator, a graduate student, and, for experimental fields, a postdoc or technician (see p. 1636). "We think in units of a pair of hands," says biology's Henkart about funding requests. Because those expenses come in discrete sizes, big cuts are achieved only by removing a person from a grant or by eliminating an investigator's summer salary. That's what has happened in the math division, where the traditional 2 months' summer salary is being replaced by smaller awards and where officials are now debating the wisdom of eliminating all salary support, on the assumption that most grantees will find some other way to pay their bills. "Of course, you'd save some money that way," says Zimmer. "But if you stop paying people, you're telling them that their work has no value. And that's not a good signal to send to the community."

Lowering the demand

The biology directorate has been the most aggressive in the past few years in trying to increase grant sizes and duration. "It's a priority for us," says James Edwards, a systematic biologist who serves as executive officer, "but we are doing it in the context of giving a researcher what he or she needs rather than by aiming for a specific dollar amount." Not surprisingly, the increase has come at the expense of fewer awards.

Edwards says the biology directorate has tried to cushion the impact on the most vulnerable researchers by giving 30% of its money to first-time investigators and favoring a new investigator over a senior scientist if the two proposals are of equal quality. It also continues to support the foundation-wide Research for Undergraduate Institutions (RUI) program, in which the importance of teaching undergraduates is taken into consideration in judging the merit of a proposal. Judy Owen, chair of the biology department at Haverford College, has had three such grants, and she says that any reduction in RUI funds to finance larger and longer grants to investigators at major research institutions "would kill entire biology programs."

Still, Edwards accepts the fact that larger grants increase the already long odds of obtaining a grant. One way to ease that pressure is to reduce the number of applications. For the biology directorate, that has meant emphasizing work not supported by other federal agencies. In 1992, for example, it decided to ban applications that have been submitted to another federal agency (primarily NIH). In response, the number of applications has dropped 12% in the past 2 fiscal years, and speculation is that many researchers who work with animal models are placing their bets with NIH. (Inexplicably to NSF, the number of applications has also dropped in fields such as systemic biology in which NIH is not a major player.)

The decline in submissions has allowed the biology directorate to hold its success rate steady, at about 27%, while increasing grant size by 4% last year in spite of a flat budget. But the policy has also increased the risk of failure for investigators who do not have time to prepare a different application to a second agency. Steve McLoon, a neuroscientist at the University of Minnesota who recently spent a year as an NSF program manager in cell biology, sees problems with both the restriction and the move toward larger, longer grants.

"My goal was to spread the money as thinly as possible because I don't trust our system to be able to discriminate very well among good proposals," he says about his stint at NSF. As for whether the awards given out were sufficient to complete the work they described, McLoon notes that "people always have the choice of saying no to a grant, but nobody ever said that to me." He thinks the policy of no duplicate submissions is "absurd" because it reduces the number of good proposals and thus robs NSF of an opportunity to tell Congress that it needs more money to meet a growing demand.

A sizeable problem

In spite of assurances from NSF officials that they are sensitive to the needs of those not at the most prestigious institutions, some researchers remain worried about the impact of the new trends. University of Washington paleontologist Peter Ward, who has been funded by NSF since 1976, says an attempt by NSF to move toward 3-year grants in his field "is killing" young investigators by making it nearly impossible for them to break into the field. While he applauds the intent of the new policy—"the rationale [for longer grants] is good: It's less paperwork"—the down side is also fresh in his mind. Ward just missed the cutoff in a competition that resulted in funding only eight of 50 applications, a reminder of how stiff the competition remains. "Paleontologists don't need big grants," he says, "but everybody needs something."

Geochemist Stan Hart, whose laboratory at the Woods Hole Oceanographic Institution operates on several concurrent NSF grants, takes a different view. He says continued support for those not at the cutting-edge isn't doing anybody a favor. "We need to recognize that there is a limit to how many people NSF can support," he says. "I hate to sound elitist, but once you've given someone a chance to succeed, we need to weed out those who are not top-notch and tell them to find another profession."

Regardless of where they stand on the issue of grant size, researchers continue to argue for a substantial increase in the NSF budget. Most analysts think that's not going to happen, however, given the $250 billion federal deficit and a 1990 budget agreement that allows almost no increase in domestic discretionary spending. So where does that leave NSF? The answer: in a quandary. "We have to make our case to Congress in building up our budget," says Henkart. "But I don't expect a big increase. So I guess we'll just have to do the best we can with what we've got."

–Jeffrey Mervis