

Fiscal 1997 Budget Request for the National Science Foundation

Last March the Clinton administration was in the unenviable position of having to announce a budget request for fiscal year 1997 before a budget for fiscal 1996 had been passed. It was not easy to know what to make of the requested increase of 3% for the National Science Foundation and of 2% for federal science funding overall; presumably one ought to know what a quantity is before one can calculate an increase in it. On the other hand, the request was just one more confusing message in the cloudy haze that has characterized the budget battle of fiscal 1996.

It was only after fiscal 1996 started on October 1, 1995, that the two houses of Congress agreed on a "conference bill" which contained appropriations for the NSF for fiscal 1996. President Clinton vetoed the bill, which was just one volley in a war with Congress that at its worst moments resulted in government shutdowns and at its best moments left government offices to do their jobs without knowing what their budgets were. A compromise was finally reached seven months into the fiscal year, leaving the NSF with the amount set for it in the conference bill plus an add-back of \$40 million, for a total of \$3.2 billion. This represents a cut of 1.3% over the previous year. The request for fiscal 1997 would raise next year's NSF budget to \$3.3 billion, but whether or not that request will become a reality is anyone's guess.

Last summer the scientific community became alarmed over rumblings about possibly deep cuts in science research funding. Nobel laureates were assembled to speak against the putative cuts, and industrialists weighed in with their support for science. The AMS, after the Council passed a resolution against cutting sci-

ence funding, made it into the lead in a *Science* news story about the reaction of the scientific community. "Mathematicians are the last people you'd think of as haunting Washington's corridors of power," the story began, implying that if the mathematicians were worried, things must be *really* bad.

In June of last year the American Association for the Advancement of Science (AAAS) assembled a meeting of representatives of more than one hundred of its affiliate societies to discuss how to head off the cuts before they were signed into an appropriations bill. Worries intensified in the fall when the AAAS released a forecast predicting a decline of one-third in the science budget over the next seven years.

If worries over the science budget appeared to die down over the winter, it was only because the lurching, uncertain quality of the budget process was so difficult to follow; it doesn't mean that the outlook is more secure. According to Lisa Thompson, Congressional liaison for the Joint Policy Board for Mathematics, the AAAS forecast may have overstated the severity of the problem, because it was based only on numbers in the budget resolution, not the appropriations bills. The budget resolution—a nonbinding agreement between the House and the Senate that does not require the president's signature—contains theoretical budgets for seven years out, but in reality those numbers get revised during each year's appropriations process. Already fiscal 1997 looks better than expected, with the administration's budget request asking for increases for fiscal 1997, with cuts to come in fiscal 1998. Nevertheless, Thompson says, "the underlying message is true": discretionary spending, which includes the NSF and all research and

development programs, will continue to decline. Support for research may not drop as precipitously as the AAAS projected, she notes, but there will be a noticeable decline between now and the year 2002, when the budget is supposed to be balanced. However, the stage is clearly set for reductions in science spending.

Indeed, signs of the erosion can be seen in the abolition last year of the Office of Technology Assessment, the Bureau of Mines, and the National Biological Service. There were even proposals to dismantle the Department of Energy, and several of its programs have been cut deeply. Congress has also set its sights on eliminating the Department of Commerce, though President Clinton has fought hard to keep the department, even to the point of requesting a 16% increase for it for fiscal 1997. Closer to home, signs of the decline can also be seen in the budget for the NSF's Division of Mathematical Sciences (DMS). "We are already starting to see, if you look closely at the budget for the DMS, some stagnation in the numbers," Thompson points out. "And I don't see any change in that."

Uncertainties in the DMS Budget

The 7.6% requested increase for the DMS for fiscal 1997 looks good, but it does not mean there will be 7.6% more money for principal investigator (PI) grants. First of all, the budget request is not an appropriation of money to spend; it is simply a statement of what the administration would like to see spent on what. At this point, the Congress and the administration are so far apart on so many issues that it is not at all clear what will happen as the two branches attempt to compromise. The two are not as far apart on the NSF as they are on many other issues, so it is unlikely that the NSF will be the target of policy-driven cuts. More likely, it will be the victim of the "everybody must suffer" cuts, and it is unclear how deep those cuts will run. In addition, close to half of the increase for the DMS comes from funds for the NSF's Academic Research Infrastructure program. The NSF is attempting to dismantle this program, originally put in place by Congress, and to redistribute the funds to the divisions to support instrumentation. It is not at all clear that Congress will okay the redistribution. And if it does, the funds can only be spent on instrumentation; the DMS cannot use them to increase funding for PI grants.

One of the difficulties in trying to increase NSF funding for mathematics is that political realities sometimes conflict with the expectations of the mathematical community. For example, the response to a new DMS program called Group Infrastructure Grants (GIG) has been uneven. The GIG program is designed to develop new mechanisms, other than traditional PI

grants, for supporting mathematical sciences research (GIG was described in "New Funding Opportunity at the NSF", *Notices*, November 1995, pages 1311-1312). According to one DMS staffer, there were some strong proposals among the ninety submitted, but "far too many [proposers] responded by stapling together old ideas" that might have been funded under old DMS programs.

The idea for GIG was discussed and endorsed by the AMS Committee on Science Policy as something that the community very much needs. So why didn't the DMS get more strong proposals? According to Ronald J. Stern of the University of California, Irvine, GIG is not a "winner" for pure mathematicians like him. "The bottom line is, mathematical research is a deep-thinking activity," he says. "It requires a large block of time to really pursue. Thus the type of support I seek from NSF is the standard 'summer salary' grant to provide this large block of time." The kinds of activities that could be supported by a GIG simply interfere with researchers' attempts to find time for research, he says. "People are not paying attention to [GIG] because it doesn't fit in with what they do."

DMS director D. J. Lewis agrees that the GIG program is not for those who just want to "sit and do research." In establishing GIG, the DMS was trying to prepare for the future. "We didn't see the budget growing, and we thought we might have to go in the long run to a European or Canadian" model of funding mathematics research, which would not include summer salaries, Lewis says. "We wanted to throw it open to the mathematical community to suggest some of the things they need other than summer salary." Another important factor is that GIG fits well into the directions in which the NSF is moving. Increased funding for PI grants, spread liberally across all of mathematics, is an ideal for many, but that scenario just will not fly in the present and prospective budget climate at the NSF.

Interdisciplinary Areas a Focus

Lewis reports mathematicians have done "very well" in competing for grants from the Office of Multidisciplinary Activities, which was set up

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Table 1: National Science Foundation

millions of dollars

	1993 Actual	Change	1994 Actual	Change	1995 Actual	Change	1996 Plan	Change	1997 Request
(1) Mathematical Sciences Research Support	\$75.6	0.4%	\$75.9	0.5%	\$83.1	-0.1%	\$83.0	7.6%	\$89.3
(2) Other Research Support (Note a)	2003.0	7.7%	2157.3	10.4%	2381.8	-5.3%	2304.0	4.8%	2414.7
(3) Education and Human Resources (Note b)	505.1	12.7%	569.0	7.5%	611.9	-1.7%	601.2	5.0%	619.0
(4) Salaries and Expenses (Note c)	114.5	11.3%	127.4	4.8%	133.5	2.6%	137.0	1.5%	139.0
(5) Science and Technology Centers	51.5	11.3%	57.6	4.2%	60.0	1.7%	61.0	5.3%	63.0
(6) Totals	\$2749.7	8.6%	\$2987.2	9.5%	\$3270.3	-2.6%	\$3186.2	4.4%	\$3325.0
(7) (1) as % of the sum of (1) and (2)	3.64%		3.40%		3.37%		3.46%		3.57%
(8) (1) as % of (6)	2.75%		2.54%		2.54%		2.60%		2.69%

Note a: Support for research and related activities in areas other than the mathematical sciences. Includes scientific research facilities and instrumentation, analytic programs, and certain research centers. Excludes Science and Technology Centers. Note b: This program in this category provides support in all fields, including the mathematical sciences.
 Note c: Administrative expenses of operating the Foundation, including the Office of Inspector General.

Table 2: Directorate for Mathematical and Physical Sciences

millions of dollars

DIVISION	1993 Actual	% of Total	1994 Actual	% of Total	1995 Actual	% of Total	1996 Plan	% of Total	1997 Request	% of Total
(1) Mathematical Sciences	\$75.6	(12.3%)	\$75.9	(12.3%)	\$83.1	(12.3%)	\$83.0	(12.6%)	\$89.3	(12.6%)
(2) Astronomical Sciences	100.8	(17.2%)	99.0	(16.0%)	100.0	(15.5%)	103.7	(15.3%)	114.5	(16.2%)
(3) Physics	126.2	(21.5%)	125.1	(20.2%)	127.7	(19.6%)	128.1	(19.7%)	139.5	(19.7%)
(4) Chemistry	108.3	(18.5%)	110.8	(17.3%)	118.6	(18.4%)	119.1	(18.3%)	129.9	(18.3%)
(5) Materials Research	151.6	(25.3%)	154.0	(24.3%)	160.3	(24.8%)	161.7	(24.8%)	176.8	(25.0%)
(6) Science and Technology Centers	29.5	(4.0%)	24.3	(5.3%)	26.0	(4.0%)	25.4	(5.3%)	26.6	(5.6%)
(7) Office of Multidisciplinary Activities	—		28.8	(4.7%)	29.5	(4.6%)	30.0	(4.6%)	31.5	(4.5%)
(8) Totals	\$615.9		\$617.9		\$645.2		\$651.0		\$708.0	

Table 3: Compilation of the NSF Budget, 1992-1997

millions of dollars

	1992 Actual	1993 Actual	1994 Actual	1995 Actual	1996 Plan	1997 Request	1992-1995 Increase	1992-1997 Increase
(1) Mathematical Sciences Research Support	\$76.5	\$75.6	\$75.9	\$85.1	\$83.0	\$89.5	8.6%	16.7%
Constant Dollars	54.5	52.5	57.2	54.5			0.0%	
(2) Other Research Support	1868.3	2005.0	2157.3	2381.8	2304.0	2414.7	27.5%	29.2%
Constant Dollars	1397.7	1586.2	1455.7	1562.9			17.4%	
(3) Education and Human Resources	441.4	505.1	569.0	611.9	601.2	619.0	38.6%	40.2%
Constant Dollars	374.6	349.6	388.9	407.5			27.6%	
(4) Salaries and Expenses	113.9	114.5	127.4	133.5	137.0	139.0	17.2%	22.0%
Constant Dollars	87.2	79.2	86.0	97.6			7.9%	
(5) Science and Technology Centers	47.1	51.5	57.6	60.0	61.0	63.0	27.4%	35.6%
Constant Dollars	33.6	35.6	38.9	39.4			17.3%	
(6) Totals	\$2547.1	\$2749.7	\$2987.2	\$3270.3	\$3186.2	\$3325.0	28.4%	30.5%
Constant Dollars	1875.5	1902.9	2075.7	2145.9			18.2%	

Current dollars are converted to constant dollars using the Consumer Price Index (based on prices during 1982-1984)

last year in the MPS directorate. With the fiscal 1997 request, funding for this office is slated to rise 5%. The enthusiasm of mathematical scientists for interdisciplinary work may also be tested with a possible new initiative in machinery for predictability, which involves modeling, simulation, mining of large data sets, and related questions. The ultimate goal is to develop generic methodologies to address any kind of prediction problems, be it from economics or the weather or basic scientific and engineering research. This initiative will likely be included in the NSF director's "opportunity fund" for fiscal 1997. This fund was established to support cross-disciplinary research that did not fit easily into other discipline-based programs at the NSF.

The DMS is also working with the NSF's Division of Computer Science on a communications initiative that will address a wide variety of problems, from security to networking. This year the DMS launched a new collaborative program with the Applied and Computational Mathematics Program at the Advanced Research Projects Agency, focusing on modeling and simulation of advanced materials processing (see "Mathematics Program at ARPA", *Notices*, November 1995, pages 1297-1298). Other DMS emphases include mathematical biology and mathematical physics, including the mathematics of string theory, the Seiberg-Witten equations, and related work in topology and differential geometry. The DMS will also continue to participate in an MPS program to connect academic researchers with industry. This program started in DMS a couple of years ago and was so successful that it was expanded to all of the MPS divisions. Its main components are postdocs, sabbatical positions for senior researchers, and new graduate programs involving internships in industry.

Forming Alliances

"In a tight, and possibly declining budget situation, to grow funding for mathematics it is necessary to form alliances and partnerships with other agencies and other disciplines," Lewis explains. "This is liable to tip our portfolio a bit from the so-called 'pure' curiosity-driven research chosen by an individual mathematician to one that is more interdisciplinary." However, he also notes that among the various interdisciplinary programs, mathematicians in every area—geometry, number theory, topology, analysis, etc.—can find ways to participate. And, he adds, there is strong evidence that from interdisciplinary work will come new and challenging problems of interest to the pure mathematician.

Programs like GIG and the interdisciplinary initiatives are "the only way in the present funding climate to increase the budget," Lewis main-

tains. "It's not particularly being done because we're trying to direct where mathematics should go or what mathematicians should be doing. It's taking advantage of the opportunities present in the NSF at this point in time. Also, by having some mathematicians help other scientists advance their research agendas, which in and of itself can be intellectually challenging, it may be possible because of that work to make the case that mathematics as a whole is such an important player in the advancement of science that overall funding for mathematics can be increased."

Even so, many mathematicians continue to hold the view that the DMS should concentrate on traditional PI grants in core mathematical areas. But if the DMS is moving in directions the community does not like, the flip side is that the community has not responded to requests for advice from the DMS about support for mathematics. For example, Stern notes that the DMS has asked the community to recommend an appropriate number of PIs to support. "The community could take some responsibility for putting down some hard numbers," but it hasn't, he says. The DMS has also asked for advice on setting priorities for funding among the various branches of mathematics, but for the most part the community has demurred here as well. The reason for avoiding priority-setting, says Stern, is that "it's not in our nature, we are too egalitarian." It would also take a lot of "courage" to set such priorities, he notes, because any proposal to emphasize one mathematical area over another would elicit howls of protest from the areas not emphasized.

Would the DMS be in a better position to argue for increased funding for mathematics if it and the community were more unified on what the priorities are for support of mathematics research? Perhaps. But in the end the more important problem may be the potential for declines in the overall federal science budget. If mathematicians can help argue against the decline, they will be doing their own discipline a lot of good.

—Allyn Jackson

Note: In previous years the *Notices* reporting on the NSF budget request included material prepared by the DMS staff about the request. For fiscal year 1997, this material is available on the NSF home page at the URL http://www.nsf.gov/mps/budget97/97_dms.html.