

Smoother Road for R&D Spending?

After 2 years of uncertainty, the White House and Congress seem to be moving toward stable funding for science and technology



What a difference a year makes. Last spring, budget projections from both the Republican Congress and the Democratic White House showed federal spending heading steeply downward, and R&D supporters feared they would be among the losers in the frenzy to balance the budget. But last week, when President Clinton presented his budget request for 1998, science and technology came out a relative winner—3% more for the National Institutes of Health (NIH) and the National Science Foundation (NSF), for example, as part of a 2% increase that would raise the overall federal R&D budget to \$75.5 billion. And the accompanying rhetoric from leading figures from both parties suggests that science and technology will fare better in the upcoming budget battles in Congress than anyone predicted less than a year ago.

A budget increase that barely keeps pace with inflation may not seem grounds for celebration—indeed, some groups will be lobbying for more—but, compared with last year's plan, it is a significant achievement. The turnaround also may mark the end of a contentious era in which the White House lobbied hardest for applied research efforts like the Advanced Technology Program (ATP), while Republicans in Congress denounced such programs and focused instead on basic science at agencies like NIH. Clinton hailed medical research in his State of the Union address 2 days before he submitted his budget, and the previous week Senate Republicans proposed doubling all research—not just the basic kind—over the next decade.

What set the new tone? Administration officials cite a host of factors, from good economic indicators that keep the deficit under control, to outside pressure from the scientific community, to Clinton's personal interest in educational technologies like the Internet. Jack Gibbons, Clinton's science adviser, told reporters last week that he and other White House officials are aware of "well-publicized concerns that balancing the budget would make very deep cuts in civilian research," adding that "we've been working hard to make sure that in fact does not come to pass." And the results to date are encouraging, say research advocates. "There's a lot of reason for optimism," says Cornelius Pings, president of the Association of Ameri-

can Universities. "Things are certainly better than a year ago."

The key change is in the so-called "out years." Under the president's current plan, civilian research would inch up by a total of 2% between 1998 and 2002; within that amount, basic research would rise 5%. Last year, the White House proposed a steep decline in R&D—one common estimate was 8.6% by 2000—followed by a gradual upturn in 2001 and 2002. The decline raised a hue and cry among researchers, and the post-2000 bonus was dismissed as a gimmick. Both have been dropped from the 1998 budget. "Unlike last year, we're trying in this budget to put out a profile that we feel will work," says T. J. Glauthier, associate director at the

will argue for an increase."

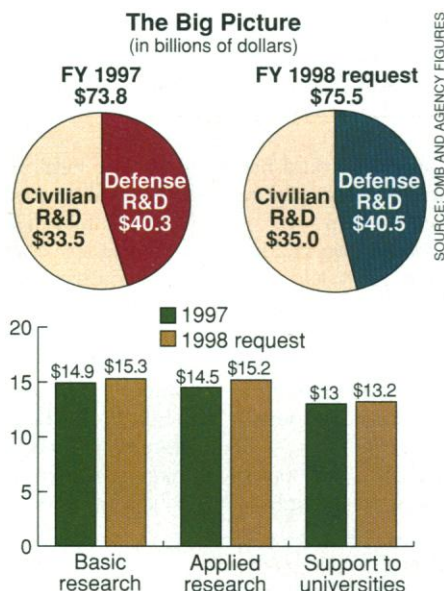
For some agencies, a flat budget would be a big victory. NASA, for example, would plummet from \$13.7 billion this year to \$13.2 billion in 2002 under the plan, although space science would remain stable (see sidebar). And Defense Department (DOD) R&D and testing would drop slightly to \$34 billion in 2002. In contrast, general science and basic research—a \$4.2 billion account that includes many Department of Energy (DOE) research programs as well as NSF—would rise by \$118 million over 5 years, and health research and training would go up \$300 million, to \$13.7 billion.

The White House decision to avoid dramatic cuts in R&D spending dovetails with a recent flurry of science and technology references by the president. Administration officials say that last year's negotiations over the telecommunications bill, the growth of the World Wide Web, and the popularity of putting computers in classrooms raised Clinton's interest in R&D programs in general. "There was a concerted effort to look at science and technology funding as a priority," says one official. "In that time, there was a growing sense of the president playing a personal role in this area."

In his State of the Union list of pet projects, Clinton backed new Mars probes, reiterated his call for an Internet II, and said the United States "must speed [up] the remarkable advances in medical science." New resources, he said, would help NIH end the AIDS threat. Conspicuously absent was any reference to programs like ATP, although it still receives a healthy boost in the president's plan.

Congressional leaders have reacted skeptically to Clinton's overall budget request, but they appear willing to use it as a basic template for creating a bipartisan agreement to balance the budget. Within R&D spending, NIH's supporters in both houses say they will fight for a bigger increase, and Representative Jerry Lewis (R-CA), who chairs the House panel that oversees NSF, NASA, and environmental research spending, says he is not satisfied with the request. "I feel strongly about promoting basic and applied research, and I'll look for more funding for NSF in particular and research in general," Lewis told *Science*. And last week, Senate Majority Leader Trent Lott (R-MS) asked appropriators to protect DOD basic research.

The White House, however, is not rush-



Civil advances. Civilian R&D would take a bigger slice of the 1998 federal pie, with growth in several sectors.

Office of Management and Budget (OMB).

If inflation is factored in, however, the small increase for overall civilian spending takes a nose dive. "Science and technology over the next 4 years will lose as much as 8% of its buying power" as the country moves toward a balanced budget, says Gibbons. That threat energizes agency managers, for whom even level funding is unacceptable. "It's OMB's desire to hold us to a flat budget over the next 4 years," complains NSF director Neal Lane. "And it's our desire not to be flat. So every year, we

Space Scientists Find Fiscal Relief

Although NASA's budget is still headed downward, it's no longer in a tailspin. Indeed, NASA's prospects have brightened enough that advocates of a summit between Administration and congressional leaders to discuss the parlous financial state of the nation's space program now say such a top-level meeting isn't necessary. The reason, say Senator Barbara Mikulski (D-MD) and others, is a successful effort led by Vice President Al Gore to add \$1.6 billion to a White House plan that would have slashed NASA's budget to \$11.6 billion by 2002. The new target—\$13.2 billion in 2000—is still half-a-billion dollars below the 1997 level, but it's big enough to provide space scientists with a host of new tools to explore the origins of life in the universe. "How do you spell relief?" asks Mikulski. "G-O-R-E."

Assuming Congress goes along with the plan, the revised budget request would allow NASA to spend just over \$2 billion a year on space science. That would be \$1 billion more over the next 5 years than was planned just last year. As current projects are completed, the agency would phase in a new round of space missions to examine Mars, the outer planets, and the formation of stars and galaxies—key elements of the so-called Origins effort mapped out late last year (*Science*, 20 December 1996, p. 2003). "Last year, most people were looking for new jobs—the tide had gone out, and we were all stuck in the mud," recalls Ed Weiler, NASA's chief of the Origins program. "Now, morale is great."

Among the programs that can now be squeezed into the lineup are the Keck Interferometer, a ground-based telescope to image large planets around other stars, and the Space Infrared Telescope Facility (SIRTF), a massive spacecraft similar to the Hubble Space Telescope that will be able to see through clouds of dust and gas. NASA hopes to complete the Keck instrument by 2000 and launch SIRTF by the



Looking up. Planned interferometer in orbit.

BUDGET '98

end of 2001, almost a year ahead of schedule. The Jet Propulsion Laboratory in Pasadena, California, also plans to begin work on a space-based interferometer that could be ready for operation in 2004. The cross-shaped spacecraft would use an optical interferometer to determine the angular positions of heavenly bodies with great accuracy. The space agency also wants to begin studying a next-generation Hubble for possible launch late in the next decade.

Mars missions would benefit as well. In 1998 alone, the budget for Mars exploration would rise by half, to \$140 million. NASA intends to send out two Mars probes every 2 years, culminating in a sample-return mission in 2005. More money also will flow into studies of exotic spacecraft that could tunnel through the ice skin of Jupiter's moon Europa or explore possible oceans on Saturn's moon Titan. NASA is also planning a nearly fourfold increase in astrobiology research, to \$36 million.

This renewed interest in space science owes much to last year's findings of possible fossil life in a meteorite from Mars and discoveries of extrasolar planets, which led the vice president to meet in December with scientists, philosophers, and religious leaders. But it also was made possible by tenacious lobbying from Mikulski, whose state is the home of NASA's Goddard Space Flight Center. On 6 February, the day the president submitted his 1998 budget, Mikulski declared victory in a letter to Gore. "A space summit is no longer necessary," she told the vice president.

For Weiler, the outcome is particularly sweet. "When I was put in charge of this program, there was no budget and no new programs," he says. "Now, I'm exceptionally happy. All the boats are going to rise."

—Andrew Lawler

ing to embrace the calls for greater R&D spending until it sees what Congress wants to cut in return. Gibbons says he is "delighted" with Senator Phil Gramm's (R-TX) proposal to double research funding, for example, but that "you do have to get out your pencil and figure out where this comes from."

Policy-makers and lobbyists warn that the brighter picture for R&D spending in the long term could fade if the economy falters or if Clinton and Congress fail to curb the ever-rising costs of Medicare and Social Security. "The message about R&D is beginning to register, but it could vaporize when it comes to actual budgeting," says Pings. And Al Teich, policy chief at the American Association for the Advancement of Science (which publishes *Science*), says that while the ice under R&D spending seems thicker this year, it could still melt away. Gibbons suggests that "you should watch each year," and Mary Good, undersecretary of commerce for technology, issued a call to arms. "It's a never-ending fight," says Good, a chemist and former chair of the National Science Board. "So, unless the [scientific] community keeps up

the effort year after year, there's always the risk of going backward."

Here are highlights from the budgets of various research agencies:

■ **NIH:** About three-quarters of the agency's proposed \$337 million (2.6%) increase would go into extramural science, or "research project grants" that are based on proposals from individual scientists. That increase will raise the total number of such grants from 25,746 to 26,679, including a record number—7112—of new grants. By research topic, the areas that get special attention in the proposed 1998 budget are: HIV-AIDS research (up \$40 million), the biology of brain disorders (up \$37 million), microbe sequencing and new approaches to pathogenesis (up \$35 million), disease prevention (up \$51 million), new therapeutics development (up \$40 million), genetic medicine (up \$41 million), and advanced instrumentation (up \$20 million). At the same time, says NIH director Harold Varmus, current grantees will probably receive only a 2% "cost management" increase next year, not enough to keep up with an expected 3.1% rise in the cost of biomedical supplies and labor.

"We're certainly encouraged when the president talks about the importance of biomedical research in the State of the Union message," says microbiologist John Suttie, president of the Federation of American Societies for Experimental Biology. "But we're less encouraged by his budget numbers." Houston heart surgeon Michael DeBakey, speaking for a 40-member Coalition for Health Funding, appealed for a 9% increase that matches what Varmus said last fall was needed to support NIH's best projects.

NIH's congressional champions are jousting on its behalf. For example, Senator Arlen Specter (R-PA), who chairs the Senate subcommittee that writes the NIH appropriation, has announced that he thinks a boost of 7.5% for NIH is "doable" this year. And Representative John Porter (R-IL), whose House subcommittee will initiate the NIH appropriation, told *Science* that the president's offer is "unacceptable" and "cannot be sustained." Last year, Porter doubled the Administration's request and NIH wound up with a 6.9% raise, and observers predict he will push for a similar increase this year.

NSF Revamps Graduate Training Grants

It has become a truism that science is increasingly multidisciplinary and that job opportunities for new Ph.D.s are brightest for those entering industry. So, why, officials at the National Science Foundation (NSF) wonder, are most U.S. universities still training students to follow in the narrow footsteps of a single academic mentor?

A new NSF program is intended to help break that pattern by encouraging universities to broaden the training of graduate students. The program, known as Integrating Graduate Education and Research Training (IGERT), is part of NSF's 1998 budget proposal unveiled last week (see main text). Combined with an expansion of its CAREER program for young academic faculty members, the activities are part of a continuing effort to help the scientific infrastructure adapt to a changing world. "It's a response to what a graduate education should be like," says acting deputy NSF director Joe Bordogna, who played a lead role in getting IGERT off the ground. "The idea is to enable graduates to pursue a broader range of options. Nobody has the answer, but we think this will help."

Most of NSF's support for graduate students currently comes through its prestigious fellowship program, which gives stipends to 800 students a year to work with a single faculty researcher, or by funding a student slot on an individual research grant. IGERT will expand NSF's role in traineeships, in which the grants go instead to universities. IGERT will merge and augment two existing traineeship programs, one within the biology directorate and the second a foundationwide program run by the education directorate, that together fund nearly a thousand students, most of them in graduate school, at 183 universities. The agency hopes to spend \$20 million on IGERT in 1998, about \$5 million more than it spends on the two programs it will replace.

A committee is still hashing out details of the new program, to be presented next month to NSF's oversight body, the National Science Board. But officials say that IGERT will emphasize inter-

disciplinary training and promote opportunities for students to work with industry, as well as providing money for research equipment.

As a model for what they hope to achieve, NSF officials point to a traineeship program at Arizona State University that focuses on biological diversity. John Lundberg, an evolutionary biologist who directs the program, says it draws on faculty from nine academic units for a truly interdisciplinary approach. A graduate student in ecology, for example, applied family trees of organisms—phylogenies—for a project in neurobiology, providing that faculty with "a different way to look at their world." But Lundberg offers a note of caution: "Most of our graduates want a postdoc and then a university position—I haven't seen too many break the mold."

NSF is also expanding its CAREER program, itself a 1995 merger of several programs for young faculty members. CAREER is an attempt to strike a better balance between teaching and research. Applicants must demonstrate their interest and involvement in improving undergraduate instruction, along with their plans for cutting-edge research. NSF has budgeted a 17% increase in the \$70 million program, which provides grantees with up to \$200,000 over 5 years.

The agency is still feeling its way with all these programs, and it is hoping that an internal review of how different support mechanisms shape the career paths of graduate students will help determine the proper mix of programs. But the results won't be ready for at least a year. In the meantime, says Bennett Bertenthal, assistant director for social and behavioral sciences, who is overseeing the review, the search for answers continues.

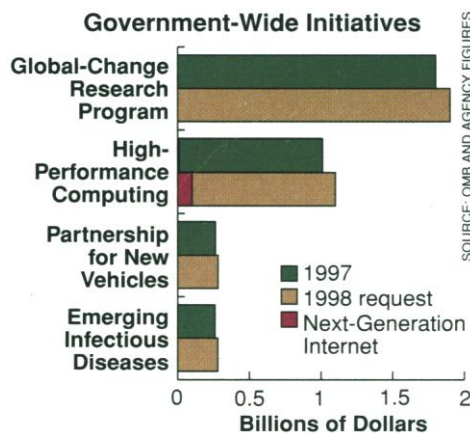
"Everybody recognizes that what we have now is not sufficient—it's too narrow," says Bertenthal, who is on leave from the psychology department at the University of Virginia, which 4 years ago cut its graduate enrollment by 30% in an effort to ease demand on a saturated job market. "IGERT jives with people's intuition of what's needed. But nobody really knows what to do." —Jeffrey Mervis



■ **NSF:** A 3.4% increase in NSF's research account, to \$2.5 billion, is seen by agency officials as a presidential vote of confidence in NSF's basic mission—support for basic academic research. But it doesn't hurt to have something with a bit of pizzazz in the portfolio, too. The biggest single new activity in the proposed 1998 budget is a \$58 million program—Knowledge and Distributed Intelligence—that uses a phrase coined by Vice President Al Gore in describing how new technologies are changing the way people collect information and learn (*Science*, 12 April 1996, p. 177). "We want to take what we already have one level higher," says director Neal Lane about NSF's plan to build on existing programs in computer science and other disciplines to improve software and hardware for manipulating databases and communicating with other users.

NSF has also requested a \$9 million down payment for a \$180 million array of 40 millimeter-wavelength telescopes to explore the early universe and star formation, and \$25 million for a radar observatory in Canada's Northwest

Territory to study the aurora and other phenomena in the upper atmosphere. Although its \$620 million education directorate would grow by only 1%, NSF hopes to combine research and training money in a new approach to supporting graduate education (see <http://www.nsf.gov/bfa/bud/fy1998>).



Holding on. Clinton seeks modest increases in four ongoing multiagency programs.

■ **Energy:** The big-ticket item in DOE's request is more than \$900 million in upfront funding to build the National Ignition Facility at Lawrence Livermore National Laboratory. The laser complex is part of the stockpile-stewardship effort that could prove a boon to fusion researchers and astrophysicists as well. The one-time request for construction would push the budget for nuclear weapons to \$5 billion.

Civilian energy research will remain flat at \$2.5 billion, but "that's fundamentally a good-news budget," says Martha Krebs, DOE energy research chief. The Administration wants \$35 million in 1998—\$20 million more than this year's level—as the U.S. share in building the Large Hadron Collider at CERN in Switzerland, part of a \$394 million request to support construction through 2004. DOE and CERN recently settled on the U.S. role in building the accelerator and its detectors.

DOE also wants \$23 million to study a new spallation neutron source and to upgrade an existing neutron source at Los Alamos National Laboratory. The cost of the

new source, which likely would be built at Oak Ridge National Laboratory, could exceed \$1 billion, but a decision on construction is not likely to be made until next year. Two years ago, the White House killed a proposed Advanced Neutron Source, using reactor technology, planned for Oak Ridge.

■ **NASA:** A proposed \$200 million drop in its current \$13.7 billion budget makes the agency one of the few R&D losers in the president's budget. But given White House threats last year to make even deeper cuts, NASA Administrator Dan Goldin is happy. "Holy mackerel, this is a great program," he told reporters. Some of his enthusiasm is due to a 4% increase in space science, bringing its budget slightly above \$2 billion and giving NASA leeway for a series of activities known as the Origins program.

Life and microgravity sciences and applications did not do so well, however, falling by \$30 million to \$214 million. The largest cut comes to life sciences research, which would decrease 11%, to \$86 million. Mission to Planet Earth would rise slightly, to \$1.4 billion, and its core, a set of Earth-observing satellites, would get a boost of nearly \$100 million to prepare the spacecraft for launch.

■ **Defense:** Funding for basic research has been declining since reaching a 1993 peak of \$1.4 billion, and all categories of research suffered last year when Congress and the Administration diverted \$1 billion from the Pentagon to education programs. DOD research absorbed most of this cut because, says one observer, it has a relatively "weak constituency." But now, the president's budget seeks to reverse the trend, boosting basic research by 8%, to \$1.16 billion, while the Pentagon's \$36.6 billion R&D budget falls by \$600 million. University research initiatives, covering a wide variety of academic projects, would go up 11%, to \$237.8 million, while the Ballistic Missile Defense Office, a congressional favorite, would plunge 23% to \$2.582 billion.

■ **NIST:** Technology officials strongly defended the proposed 22% increase for ATP, to \$275 million, as a necessary step on the way to a \$500 million budget in 2002. But after Congress nearly killed the 5-year-old program last year, they admit that winning any increase for the precompetitive industrial research program will be a tall order and that the president's original plan for a \$1 billion juggernaut is a pipe dream. "This is the only program I know that set up an elaborate evaluation mechanism before any grants were made," says technology undersecretary Mary Good. "And the anecdotal evidence so far is pretty good." Elsewhere in their budget, NIST officials have delayed any request for new construction pending a report later this

year to Congress, which has balked at earlier plans to renovate NIST's facilities in suburban Maryland and Boulder, Colorado.

■ **NOAA:** Oceanic and atmospheric research at the agency would drop 2% to \$248 million in the president's request, but climate and air-quality research would rise by 8%, with increases for forecasting El Niño and monitoring ground-level ozone. Ocean and Great Lakes

■ **USGS:** Faced with a flat budget, the geological survey is trimming programs such as mapping and continental surveying to give other research a boost. Benefiting most is USGS's biological research division—formerly the National Biological Service—which is going up 5.5% to \$145 million to fund work in areas such as invasive weeds and coastal habitat. USGS is also adding \$2 million to water-quality research. "Over-

Name	1997	1998 Request	% Change
National Institutes of Health	\$12.7 billion	\$13.1 billion	+2.6
Research project grants	\$6.9 billion	\$7.1 billion	+3.9
National Science Foundation	\$3.27 billion	\$3.37 billion	+3.0
Education	\$619 million	\$626 million	+1.0
Major research equipment	\$80 million	\$85 million	+6.2
Defense Department			
Advanced Research Projects Agency	\$2.14 billion	\$2.20 billion	+2.8
Basic research	\$1.08 billion	\$1.16 billion	+7.7
NASA	\$13.7 billion	\$13.5 billion	-14.6
Space Infrared Telescope Facility	0	\$81 million	NA
Mars Surveyor	\$90 million	\$140 million	+55.5
Life and microgravity sciences	\$244 million	\$214 million	-12.3
Energy Department	\$16.2 billion	\$16.6 billion	+24.2
Nuclear weapons (incl. stockpile stewardship)	\$3.9 billion	\$5.1 billion	+30.8
Neutron source	\$8 million	\$23 million	+187.0
Large Hadron Collider	\$15 million	\$35 million	+133.0
Agriculture Department			
National Research Initiative	\$94 million	\$130 million	+38.3
Commerce Department			
National Institute of Standards and Technology	\$572 million	\$692 million	+21.0
Advanced Technology Program	\$225 million	\$275 million	+22.2
National Oceanic and Atmospheric Admin.	\$1.91 billion	\$2.0 billion	+4.1
Oceanic and atmospheric research	\$253 million	\$248 million	-2.0
Environmental Protection Agency			
Research and development	\$504 million	\$555 million	+10.1
U.S. Geological Survey	\$739 million	\$745 million	+0.9

SOURCE: OMB AND AGENCY FIGURES

Positive thinking. The president's request gives most research agencies a bit more to work with.

research would drop by 16%, including an 8% reduction in the Sea Grant program. The undersea research program, which was not included in the president's budget last year but received \$12 million, would get \$5.4 million.

■ **EPA:** Administrator Carol Browner pledges to beef up science and technology efforts as part of an overall 12.4% increase in EPA's budget, to \$7.6 billion. Funding for the Office of Research and Development would go up 10% to \$555 million. Most notable is a 21% rise, to \$115 million, for the Science to Achieve Results extramural grants program, which funds research in areas such as ecosystem protection and endocrine disrupters with help from NSF and other agencies. Also targeted for increases are research on global change, children's environmental health, work to support new drinking water and food-quality laws, and the health effects of particulate matter, the last in support of controversial proposed regulations on air quality.

all, it's nothing to cheer about, but I suppose it could have been a lot worse," says USGS director Gordon Eaton.

■ **Agriculture:** Once again, the president has requested a big boost in the department's chronically underfunded competitive grants program for non-USDA scientists. The National Research Initiative would get an increase of \$36 million, to \$130 million, targeting environmental quality and the genetic enhancement of plants. Within the Agricultural Research Service's flat budget of \$800 million is a proposed \$12 million increase for its six human-nutrition centers, divided equally between a study of what children eat and research on dietary requirements.

—Andrew Lawler

With additional reporting by Jocelyn Kaiser, Eliot Marshall, Jeffrey Mervis, Erik Stokstad, and Gretchen Vogel.