

IN ITS RUSH TO THE ELECTIONS, CONGRESS SKIMPS ON RESEARCH

In the final hours of the 102nd Congress, which adjourned on 9 October, Senator Bob Dole of Kansas, the minority leader, criticized his colleagues for a session that produced some "doozies." In his farewell remarks to the senators, Majority Leader George J. Mitchell of Maine admitted that his legislative agenda remained largely unfulfilled and that the next Congress, which assembles on 5 January, would need to do what the 102nd failed to do—most particularly to redirect more of the country's defense operations to civilian goals. The end of the cold war and the strain in the economy should have been the metaphors for this Congress. Instead, the metaphors were the unsettling scandals involving overdrafts at the House's own bank and the misuse of postage stamps and franking privileges. Finally, after months of bickering and floundering and under the threat of voter discontent with incumbent politicians, the lawmakers burst into action this summer and completed all 13 appropriation bills for fiscal 1993, then scurried to the exits and their election campaigns. Even though the combined total of the budget bills reached a record high of \$1.5 trillion for 1993, Congress chose to make cuts in programs that support mainly "small science" and to display its generosity for grandiose megaprojects that will be built by major US corporations.

The fact is these are not ordinary times. Worried about the enormous debt and the jobless ranks, Congress and the White House are determined to accelerate the nation's economic growth. Both have been prevented from jump-starting the economy with large new expenditures by the tight spending caps placed on defense and domestic discretionary programs in the 1990 budget agreement between White House economists and Congressional leaders. It is precisely because of this that some lawmakers tried in the last few years to destroy or delay such big-ticket items as Space Station Freedom and the Supercon-

Bottom lines: Research budgets for fiscal 1993

	FY 92 estimate	FY 93 request (millions of dollars)	FY 93 enacted	Percentage gain (loss)
National Science Foundation	2570.5	3027.0	2733.6	6.3
Research and related activities	1872.0	2212.0	1859.0	(0.7)
Major research facilities				
Laser Interferometer Gravitational				
Wave Observatory	15.9	48.0	38.0*	150
Gemini 8-meter telescopes	12.0	17.0	17.0	41.6
National High Magnetic Field				
Laboratory	10.0	14.0	13.0	30
Research facilities modernization	16.5	0.0	37.5	137.7
Academic research instrumentation	16.5	33.0	12.5	(32)
Education and human resources	465.0	479.0	487.5	4.8
Department of Energy				
General science and research	1472.5	1652.7	1417.8	(3.9)
High-energy physics	628.0	630.9	613.4	(2.4)
Superconducting Super Collider	483.7	650.0	517.0	6.9
Fermilab main injector	15.0	30.0	15.0	0
Nuclear physics	354.4	363.5	309.1	(14.6)
Basic energy sciences	764.7	813.9	859.7	12
Magnetic fusion	328.1	350.9	330.9	0.8
Inertial fusion				
(nondefense program)	8.2	8.8	8.8	7.3
Inertial fusion (defense program)	201.6	195.0	212.3	5.3
National Institute of Standards and Technology	246.7	310.7	384.0	55.6
Scientific and technical research and services	183.0	201.9	192.9	5.4
Industrial technology services	63.7	86.1	86.1	35.1
Defense economic conversion technology	0.0	0.0	105.0	
NASA	14348.7	14993.0	14316.1	(0.23)
Space science research and development	2726.8	2985.0	2855.4	5
Physics and astronomy	1046.6	1113.5	1097.0	5
Planetary exploration	534.2	487.2	471.7	(13)
Earth sciences and applications	725.3	868.5	855.4	18
Space Station Freedom	2002.8	2250.0	2100.0	5
Department of Defense				
Army research sciences	190.8	177.0	236.9	24
Navy research sciences	395.2	457.4	447.3	13
Air Force research sciences	214.4	237.0	234.7	9
University research initiatives	98.5	99.9	325.4**	300
Strategic Defense Initiative	4150.0	5312.0	3800.0	(9)
Defense Advanced Research Projects	1635.5	1200.0	1706.0	4.3
Basic research (6.1 category)	112.4	115.0	118.1	5
Sematech	100.0	100.0	100.0	0

* An additional \$5 million will be provided from the gravitational program in NSF's physics division.

** Includes \$176 million in university "pork-barrel" projects added by Congress.

ducting Super Collider. In the end, though, members in both chambers, lobbied by contractors, scientists, some of their own colleagues and even President Bush, came to the rescue of the big projects, not particularly because they represent investments in research but mainly because they offer much needed business capital

and technological opportunities.

Accordingly, the major R&D themes of the fiscal 1993 budget appear to be technology transfer, critical technologies and job openings. It's not surprising then that in the fiscal 1993 budget government support for applied research received pride of place over basic science as a

singular way of improving the nation's industrial competitiveness.

The 102nd Congress opened with a flourish as lawmakers approved the Persian Gulf War—but only after a volatile debate about its Constitutional power to send Americans into battle. The session ended with the Senate's ratification, by a vote of 93 to 6, of the Strategic Arms Reduction Treaty—the only agreement by the US and USSR that actually requires reductions in each side's vast stockpile of strategic nuclear missiles. Despite such historic foreign policy actions, the 102nd bogged down on domestic issues. This Congress may be remembered for overriding only one of President Bush's 36 vetoes—the last, in fact, on reregulating the cable television industry, an issue that was hardly epochal.

Dealing on the SSC

On science and technology, Congress made several uneven decisions: the palpably political deal that resulted in allocating \$517 million to continue building the SSC as the improbable tradeoff for a nine-month moratorium on nuclear weapons testing and a complete test ban beginning on 1 January 1997; the earmarking of \$2 billion in Pentagon appropriations to enable the defense industry and the weapons labs to transform "useful" technologies into commercial products but also the earmarking of more university "pork-barrel" projects in the Defense Department budget than any Congress had dared to do before; the drastic reductions in research, operations and data analysis within NASA's programs in physics and astronomy, planetary exploration and Earth sciences, as well as the budgetary floor set by the House-Senate conference requiring the agency to spend "not less than \$8 billion" on the Mission to Planet Earth program through fiscal 2000.

In fiscal 1993 NASA will receive a total of \$14.3 billion, virtually the same bottom line as in fiscal 1992, thereby maintaining its ranking as the research agency with the biggest budget. In fact, the space agency will get just \$26 000 more in 1993 than it got last year, though the final amount is \$677 million less than the Administration had wanted. Despite attempts by some scientists led by The American Physical Society and the American Geophysical Union to scuttle the space station, it not only won wide support in Congress but its budget was jacked up 3% to \$2.1 billion, which is still \$150 million less than the Administration's request.

The conference report accompany-

ing NASA's appropriation bill expresses the worry of committee members "that a disproportionate share of space station funding is devoted to 'overhead' costs, which currently constitute more than 50% of station resources. Therefore, the conferees direct that NASA should consider alternative management approaches that will reduce these costs. In that connection, the conferees strongly urge that the agency examine the possibility of collapsing the existing contractual arrangement into a single prime contractor with a single lead center in order to strengthen program execution and accountability." Given such a forceful directive from those with the deep pockets, it didn't shock Washington that Daniel S. Goldin, NASA's administrator for the past six months, responded quickly. Three weeks after the report appeared, Goldin named Marty Kress, until two years ago the senior staffer on the Senate appropriations subcommittee that rules NASA's finances, to the post of the space station's deputy program manager for policy and management. To make sure the station stays within budget, Goldin shuffled Tom Campbell, the agency's former controller, into the job of chief financial officer. The station is expected to cost more than \$30 billion to build and \$100 billion more to operate over its expected lifetime of 30 years.

After the payout to the space station, Congress turned frugal with the rest of NASA's programs. Thus, scientists working in NASA's physics and astronomy programs were short-changed so that the station could prosper. Significant reductions were made in the budget requests for the Advanced X-Ray Astrophysics Facility, called AXAF, as well as for physics and astronomy research and for mission operations and data analysis in physics and astronomy, Earth sciences and planetary exploration. Other cuts were made in the agency's renewed search for extraterrestrial intelligence, along with programs in space science and applications research and in materials processing. Congress also killed the Administration's requests for \$80 million to go ahead with the National Aerospace Plane, a Reagan era favorite, and \$31.8 million for the White House Space Council's pet, the space exploration initiative, which was to develop plans for colonizing the Moon and Mars. Still, the Earth Observing System, the Cassini probe to Saturn and ground-based radioastronomy connected with a program to hunt for other planetary systems beyond the

Milky Way will all continue with full or even additional funding.

For its part the National Science Foundation will get somewhat more than 6% over last year—though the Administration had sought an 18% rise, in keeping with promises by Presidents Reagan and Bush to double the NSF budget in five years. Nonetheless, foundation officials are grateful for small favors in this debt-ridden year. The problem with the NSF increase is that none of the increase goes to individual investigators. In fact, the research line of NSF's budget went down by 1%—some \$13 million less than the \$1.87 billion the agency got in 1992. Researchers in the physical sciences are bound to fare badly because Congress has protected some of NSF's big-ticket projects in those fields. These include: \$43 million for the Laser Interferometer Gravitational Wave Observatory, of which \$38 million was specifically allocated and another \$5 million was directed by Congress to be taken from the physics division; \$17 million for two 8-meter Gemini optical telescopes, one to be built in Hawaii, the other in Chile, with funds for both being matched by contributions from Canada, Britain and Chile; and \$13 million for the National High Magnetic Field Laboratory being built at Florida State University. Congress also set aside \$37.5 million for new academic research facilities and \$12.5 million for laboratory equipment.

Lobbying for LIGO

In addition, Congress lopped off \$11 million that NSF had intended to spend on research equipment for mathematical and physical sciences. Senate staffers say this was done to provide funds for LIGO and the Gemini telescopes. Early in the 1993 budget cycle, Rochus E. Vogt of Caltech, director of the \$200 million LIGO project, indicated to NSF officials that the project could get by for one year with about \$16 million. But once the sites of the two detector facilities were designated in Louisiana and in Washington, LIGO became the darling of lawmakers in those states—notably J. Bennett Johnston, the Louisiana Democrat who is the influential chairman of a Senate appropriations subcommittee, and House Speaker Thomas S. Foley, Democrat of Washington. "With those two backing the project," says a source on Capitol Hill, "it's hard to stop the funds from flowing."

Coming on top of a 1% reduction for all research programs, the construction projects are certain to put sharp strains on the mathematical and

physical sciences division this year. On 18 October, NSF Director Walter E. Massey told his physics advisory committee that physics researchers who rely on foundation grants will feel "real pain." After Massey left the advisory group's meeting, Robert A. Eisenstein, the newly appointed head of the physics division, offered the gloomy prediction that his unit was likely to take a 5% hit in 1993. Because as many as 30% of physics proposals were already being turned down, declared Eisenstein, "we must deal with our crisis as intelligently and sensitively as we can."

For the past nine years it has been customary for Congress to give NSF more than it wanted for science and math education. This year is no different. The education and human resources directorate was handed nearly 5% more than last year—a total of \$487.5 million, which is \$8.5 million more than the budget request. The conference committee report provides \$5 million more than the agency wanted for a new "urban systemic initiative" that would put up matching money for science and math schooling in five major US cities. Another \$5 million goes to the Experimental Program to Stimulate Competitive Research, more commonly known as EPSCOR. NSF's graduate traineeship program will receive \$23 million this year.

In a section on NSF the House-Senate conference report modifies the controversial directives contained in the earlier report by the Senate appropriations committee, led by Barbara Mikulski, a Democrat of Maryland. Mikulski had sought to change the foundation's emphasis from basic research performed by individual investigators and their cadre of graduate students to more applied work with ties to industry, so as to advance "technologies deemed to be critical to the nation's future" (PHYSICS TODAY, September, page 53). Leaders of The American Physical Society and other science groups objected that the directives would reduce the amount of academic research supported by the agency and run counter to the foundation's original charter—to be the government's mainstay for basic science and graduate education.

The House-Senate conference report commends Massey and the National Science Board for organizing a high-level commission of academic and industrial scientists and administrators (see accompanying box) to advise on NSF's future mission. It also says the Mikulski directives are "temporarily set aside" pending the outcome of the commission's delibera-

Special Commission on the Future of the NSF

Co-chairmen: William H. Danforth, chancellor of Washington University in St. Louis, and Robert W. Galvin, executive committee chairman of Motorola, Inc and chairman of Sematech in Austin, Texas.

Members: John Armstrong, vice president of research at IBM; Jacqueline K. Barton, chemistry professor at Caltech; Corrine C. ("Lindy") Boggs, former US Representative for the Second District in Louisiana; Lewis M. Branscomb, former senior scientist at IBM and chairman of the National Science Board, now professor of public policy at Harvard's John F. Kennedy School of Government; Peter M. Eisenberger, director of the Princeton Materials Institute; Marye Ann Fox, professor of chemistry at the University of Texas;

C. Peter Magrath, president of the National Association of State Universities and Land-Grant Colleges; Percy A. Pierre, vice president of research and graduate studies at Michigan State University; Frank H. T. Rhodes, president of Cornell University; Earl S. Richardson, president of Morgan State University; Ian M. Ross, president emeritus of AT&T Bell Laboratories; William J. Rutter, chairman of the board at Chiron Corporation; Donna Shalala, chancellor of the University of Wisconsin at Madison.

tions, which are to be reported by the end of November. The lawmakers indicate that they expect to see NSF's report when its operating plan for fiscal 1993 is presented to them on 15 December. Until then, the conferees say, they are "reluctantly" suspending the Senate's funding floors for NSF programs in manufacturing, high-performance computing and interdisciplinary environmental research—all of which were mentioned specifically in Mikulski's plan to redirect the foundation.

That stated, the conferees declared that NSF should devote itself to making up the gap in R&D that the agency claims US industry has abandoned in the past decade. "If the NSF is to help transform this condition, it seems apparent that it must in fact change the fundamental emphasis it places on various research initiatives," the report asserts. The conference committee wants the agency to consider undertaking "a reallocation of expenditures to strengthen certain priority areas: process research and development; engineering research; emerg-

ing and precompetitive technologies; and fundamental research with ties to future industrial interests." According to the report, the Commission on the Future of the NSF "may offer some chance for this transformation to begin—but only if the changes are serious, substantive and broad-based in the foundation's approach to research and development." As for what the foundation should do, the conferees mince no words: NSF had better emphasize a real change in direction rather than "simply the wish" to transform itself in hope of getting larger annual budgets.

Congress gave the Department of Energy "slow down" orders for virtually all of its research programs, with one notable exception—the SSC. The \$8.25 billion project will get \$517 million in 1993, but its political crisis this summer reads like the Perils of Pauline. The cliffhanger began normally enough on 11 June when the House appropriations committee recommended that the SSC should receive \$483.7 million—though the Administration had asked for \$650 million for fiscal 1993. Six days later, piqued over a failed attempt to require a Constitutional amendment for a balanced budget, the full House voted 231 to 182 to jettison the massive accelerator (PHYSICS TODAY, August, page 58). This brush with oblivion set off a lobbying campaign that ultimately involved nearly 100 000 people, including Nobel Prize winners who appeared at a Senate hearing; Texas schoolchildren who wrote letters to members of Congress; Texas Senators Lloyd Bentsen, a Democrat, and Phil Gramm, a Republican, who twisted the arms of just about every potential opponent in their chamber; and President Bush, who phoned eight undecided senators before a critical vote to convince them to endorse the SSC. On 23 July, the Senate approved spending \$550 million for the machine. After more months of nail-biting by particle physicists, on 15 September a House-Senate conference committee agreed to allocate \$517 million. This decision ignited another volatile debate in the House, where SSC opponents angrily accused their negotiators of not representing the will of the majority in the conference committee. On 17 September, however, the House voted to accept the "compromise" figure.

But in the great game of politics, nothing is as it seems. Some SSC adversaries in Congress decided to get even, using an ostensibly unrelated tactic. In August the Senate had voted 68 to 26 to impose a nine-month moratorium on underground nuclear

weapons tests, to place stringent conditions on all subsequent tests and to stop testing completely in late 1996. Sam Nunn, the Georgia Democrat who heads the Senate armed services committee and is certainly no dove, has championed a phaseout of nuclear tests ever since Mikhail Gorbachev declared a moratorium on Soviet tests in 1989; Nunn's objection to testing was strengthened by Boris Yeltsin's declaration to stop all Russian tests unilaterally. Opponents of Nunn's plan included the President, Defense Secretary Dick Cheney and other Administration panjandrum who argued that testing is absolutely essential to US security—to evaluate the safety and reliability of nuclear warheads, if nothing else.

Enlisting the help of Johnston in the Senate and proponents of the test ban in the House, Nunn was able to slip the moratorium provision into the Energy and Water Development bill, which also provided funding for the SSC. In doing this, advocates of the test ban knew they risked a veto by Bush. Still, they figured, Bush wanted the SSC so badly (and believed its construction would help him win Texas in the November election) that he would sign the bill. In the end the ploy worked. On 2 October Bush signed the Energy and Water Development Act (P L 102-377) containing both the test ban and the accelerator.

Speaking two weeks later to an audience at the Corporate Associates meeting of the American Institute of Physics, Will Happer, director of DOE's energy research programs, recalled that a friend on the National Security Council had once said that it had been known for years that the US faced three mighty superpowers: the Soviet Union, China and the high-energy physics community.

Reneging on a promise

In other actions, Congress chopped \$15 million out of the high-energy physics base program and then whacked \$15 million from the proposed upgrade of Fermilab's Tevatron accelerator. DOE's "small science" programs in materials, chemistry and computing also suffered cuts amounting to \$7 million below last year's level. And despite DOE promises to increase the magnetic fusion budget by 5% per year for the next five years, Congress cut \$20 million off last year's tight budget. With a possible touch of irony, the conference committee report directs DOE to make the reduction "in a manner that is cost effective and least disruptive to the mission and priorities" of the fusion program. Nonethe-

less, the conferees expect DOE to fund the engineering design work for the International Thermonuclear Experimental Reactor, which is to be built jointly by the US, Russia, Japan and the European Community at a site still to be chosen by the partners.

Congress also gave the endangered Los Alamos Meson Physics Facility a new lease on life by transferring its funding to DOE's defense programs budget. Like the SSC this year, LAMPF had a melodramatic encounter involving political machinations. The Administration had asked for \$54.5 million for LAMPF in 1993, even though DOE officials have indicated that the machine has outlived its useful life in nuclear physics. Among LAMPF's champions are both of New Mexico's powerful senators, Pete Domenici, a Republican who sits on the appropriations committee, and Jeff Bingaman, a Democrat on the armed services committee. In his quest for Senate support for the SSC, Johnston came up with a scheme to have LAMPF funded from DOE's defense programs, which would free some money in the department's nondefense research programs for the SSC. LAMPF is justified in defense programs, said Johnston, because among its uses it would serve as a test bed for burning excess amounts of plutonium gathered from dismantled US and Russian nuclear warheads and it also would provide a potential way of producing tritium for thermonuclear weapons now that DOE has decided to postpone building a new production reactor. With Domenici and Bingaman behind him, Johnston succeeded in wangling \$54.5 million for LAMPF from DOE defense programs. LAMPF also will get \$10 million from Los Alamos's budget for ongoing neutron weapons research. Another \$15 million is designated for LAMPF from the Defense Nuclear Agency for similar studies.

Full funding was provided for several DOE projects under construction, including the Continuous Electron Beam Accelerator Facility, known as CEBAF, being completed in Newport News, Virginia, the Relativistic Heavy Ion Collider at Brookhaven and the Advanced Photon Source at Argonne.

The National Institute of Standards and Technology posts the highest increase of any R&D agency for fiscal 1993, reflecting, no doubt, Congress's concern with industrial technologies. Its new budget is \$384 million—a 56% boost over last year. The Senate had approved \$109 million for a defense conversion program, which would be funded at NIST out of cutbacks in defense expenditures. But the White

House Office of Management and Budget would have none of it, arguing that such a practice would violate the 1990 deficit reduction agreement that disallowed any funds crossing the "fire wall" between defense and domestic discretionary spending. The Senate tried to do something similar in the NSF appropriation bill, which called for \$55 million to be shipped across the Potomac from the Pentagon for a traineeship program for military engineers. When OMB objected to the plan, the provision was quickly dropped from the final appropriation bill.

Buying cold war weapons

In fact, the 102nd Congress was unable to make any sizable reductions in the Defense Department budget, in large part because this would be likely to cause economic and employment disruptions in an election year. Instead, it approved a \$274.3 billion defense appropriation that includes many weapons and systems designed for the cold war era. DOD's spending bill represents a 9% decline, adjusted for inflation, from the \$291 billion military budget for 1992 but cuts only \$6.5 billion from President Bush's request for 1993. "Congress didn't cancel anything," claims a Senate staffer. "Every program is alive and well." This is true, to be sure, of the Strategic Defense Initiative, which got \$3.8 billion after some bitter wrangling in both houses.

DOD's appropriations act provides more than \$2 billion for various forms of technological conversion, economic reinvestment and human retraining in the transition from the cold war era. In addition, the foreign aid bill authorizes new programs to assist the independent republics of the former USSR in improving their economies and dismantling nuclear weapons. The legislation allocates \$20 million for exchanges of secondary school children and \$30 million for exchanges of undergraduate students, graduate students and farmers. It provides \$400 million for the Former Soviet Union Demilitarization Act, which would go toward dismantling defense industries, cleaning up nuclear waste and strengthening scientific research programs, among its purposes. The legislation authorizes the director of NSF to create a \$25 million non-profit organization that would support joint research projects among scientists and engineers from the US and FSU and set up programs to assist FSU scientists in marketing their discoveries and inventions by creating new businesses.

—IRWIN GOODWIN ■