Clinton's R&D Budget Defers Pain to Unkindest Cuts By Republicans

On his first day as chairman of the House Appropriations Committee, Robert L. Livingston, a tall and courtly Louisiana Republican, arrived at a meeting in the Capitol bearing a machete, a bowie knife and, to make his point even more emphatically, an alligator skinning knife. A former trial lawyer and criminal prosecutor and a member of the House of Representatives for 18 years, Bob Livingston claims that the new Republican majority can come to grips with the Federal deficit by making significant cuts in spending. "We have made a commitment to the American people to make the cuts, even in some favorite programs," he told an interviewer, "so that we can make this country healthy and wealthy for a long time to come."

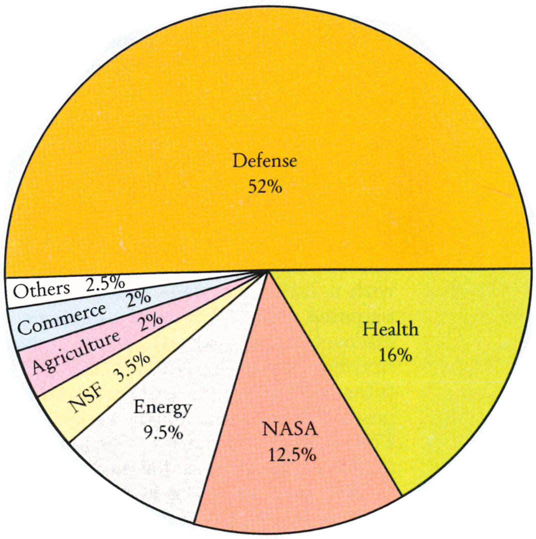
The object of his sharp-edged remarks was dropped on his desk on 6 February in the form of President Clinton's 233-page budget request for fiscal 1996, which begins on 1 October. The proposed budget calls for outlays of $1.6 trillion, a 4.8% increase over fiscal 1995. Of this amount, R&D would be essentially frozen, increasing by only $170 million to $72.8 billion, or just 0.2% more than this year's estimated spending. However, once inflation is taken into account, R&D would be lower than this year's spending level by about 3%. The President's budget would shift more than $900 million from military to civilian research programs, in keeping with his promise to restore the R&D balance to 50–50 during his presidency. Accordingly, civilian R&D is increased by $1.1 billion, or 3.5%, to $34.9 billion, while defense R&D is cut $918 million, or 2.4%, to $37.9 billion. With 52% of the total, military R&D is still dominant. As recently as 1993, though, defense spending accounted for 58% of the Federal R&D allocation.

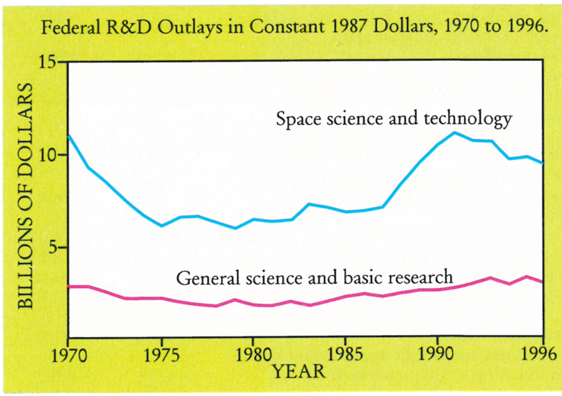
Despite the stringent fiscal restraints on the government, the proposed budget emphasizes basic research over applied research and development. Basic research would get an increase of $493 million, or 3.5%, to a total of $14.5 billion. Applied research would also rise, but only slightly, by $117 million, or 0.8%, to $14.7 billion. This would enable the President to stand by his plans to support the technology transfer programs he favors, including the Advanced Technology Program at the National Institute of Standards and Technology, the Partnership for a New Generation of Vehicles (see page 73) and the Defense Department's Technology Reinvestment Project.

In making his case for the budget at a news conference in the Old Executive Office Building on 6 February, John H. Gibbons, the President's science adviser and director of the Office of Science and Technology Policy, stated: "Even in the best of economic climates, Federal investment is essential in helping foster development of critical technologies where private investment is inadequate, as when risks are high and no single company can capture enough of the benefits. The Federal government always has played a key role in developing new technology in areas such as agriculture, aerospace, medicine and electronics—areas that have served as basic building blocks for economic development. Today, tough international competition is putting unprecedented pressures on American industry, and many firms have cut back on critical long-term research—research that is more vital than ever to the nation's economic future. This is no time to waver in our traditional commitment to public support for applied research."

Gibbons often calls the area between basic research and technology development "the valley of death." The expression is meant to suggest that many good ideas never get developed

Percentage of R&D Outlays (including Facilities) in the Proposed FY 1996 Budget





A GRAPHIC DIFFERENCE is apparent in terms of real dollars (based on the worth of US dollars in 1987) spent since 1970 for general science and basic research compared with space science and technology. Basic research expenditures in fiscal 1996 would not be changed much in value from 1970. The dip occurred in the Nixon and Ford presidencies, while basic science support began doing better in the Reagan and Bush era. Outlays for space plummeted after the Moon landing and headed up with the Hubble telescope and space station.

Department of Energy physics-related programs

	FY 94 actual	FY 95 request	FY 95 current	FY 96 request
		(millions of dollars)		
High-energy physics				
Physics research	144.7	139.9	139.9	147.2
Facilities operations				
Fermilab	138.2	134.3	141.6	146.4
SLAC	78.4	73.9	78.2	80.8
Brookhaven	41.8	41.6	43.1	45.5
Other operations, including computer networking	4.1	4.6	13.6	7.4
Technology research, on existing and proposed accelerators, colliders and detectors, including Large Hadron Collider	56.7	58.2	58.2	67.4
Capital equipment				
Fermilab, including detector improvements	27.0	26.6	26.7	29.6
SLAC, including detector and end station development	11.7	11.2	12.5	15.7
Brookhaven, including muon-2 and beamline development	8.4	5.2	5.3	2.2
Brookhaven general purpose equipment	3.9	3.9	3.9	3.9
Universities and other laboratories	9.1	10.8	9.3	11.8
Construction				
Brookhaven	8.4	8.2	8.2	7.6
Fermilab main injector	34.9	43.0	52.7	62.4
SLAC B-factory	42.9	44.0	48.8	57.6
Total high-energy physics	610.2	605.4	642.1	685.6
Nuclear physics				
Low-energy research				
Universities, mainly Triangle Universities Nuclear Lab, U. of Washington and Solar Neutrino Observatory	3.7	3.1	3.0	4.3
National laboratories, mainly Oak Ridge and Lawrence Berkeley	2.8	3.2	3.2	3.1
Reactors, mainly at NIST, Oak Ridge and Brookhaven	1.1	0.8	0.8	0.2
Other research, including GALLEX and SAGE experiments	3.7	5.7	5.6	7.1
Accelerator operations at Oak Ridge and universities	5.3	6.0	5.9	7.6
Data compilation and evaluation	7.0	6.0	6.0	4.8
Medium-energy research, mainly CEBAF, MIT Bates Lab and Brookhaven	41.2	44.8	43.3	42.5
Facilities operations, mainly CEBAF, Bates Lab and LAMPF	67.1	48.9	81.7	61.4
Heavy-ion research, mainly Brookhaven AGS and Lawrence Berkeley	39.1	40.1	40.0	39.2
Facilities operations	25.7	21.4	21.2	27.6
Nuclear theory	14.7	14.7	14.7	15.5
Capital equipment, mainly for CEBAF	32.0	28.0	28.0	28.0
Construction				
Brookhaven Relativistic Heavy Ion Collider	79.3	70.0	71.3	71.3
CEBAF	16.6	1.0	1.3	3.4
Accelerator improvements and modifications	6.1	7.1	5.4	5.0
Total nuclear physics	345.3	300.8	331.5	321.1
Superconducting Super Collider	640.0	0	0	0
Basic energy sciences				
Materials sciences, including solid-state physics, metallurgy and ceramics research				
Research, mainly at Argonne, Brookhaven, Lawrence Berkeley, Oak Ridge and universities	135.8	138.3	138.4	169.6
Facilities operations	123.8	135.9	134.0	178.7
Chemical sciences, including atomic physics research, mainly at Oak Ridge and universities	104.1	106.9	105.8	118.3
Facilities operations	54.8	55.1	53.8	63.3
Applied mathematical sciences, including computer and communications research and advanced software	99.1	109.4	108.1	108.7
Engineering and geosciences, including environmental geophysics and geophysical imaging	35.5	36.8	35.8	40.0
Advanced energy projects*	10.7	11.1	10.8	12.0
Energy biosciences, mainly at universities	25.5	26.0	27.9	29.5
Program direction	9.1	9.9	9.9	10.0
Capital equipment and instrumentation**	43.5	41.5	39.1	57.0
Construction, mainly Argonne's 6–7 GeV light source	115.9	70.4	70.4	24.4
Total basic energy sciences	757.8	741.3	733.9	811.4
Major user facilities, mainly light sources at Brookhaven, Argonne, Oak Ridge and Lawrence Berkeley	178.6	191.0	187.7	242.0
Advanced Neutron Source* **	15.9	40.0	21.0	0
Energy research analysis†	3.5	3.5	3.4	3.5
University and science education				
Cooperative science centers at DOE laboratories	34.2	30.8	30.3	30.0
University programs, including postdoc research	16.9	17.4	27.1	17.4
University research instrumentation	0.6	5.6	5.6	5.6
University reactor fuel assistance††	3.6	3.7	3.6	—
Program direction and pre-college and undergraduate education	0	2.9	2.9	2.4
Total university and science education	55.3	60.4	69.5	55.4

continued on page 67

for want of technology transfer from the bench scientists or research laboratories to the corporate world. ATP and TRP, as well as the Energy Department's Cooperative Research and Development Agreements between the national labs and commercial companies, are Federal programs that the new Republican majority in the House fiercely opposes on ideological grounds. The Clinton Administration would increase spending on ATP by 14% to $491 million next year and boost another NIST program, the Manufacturing Extension Partnerships, by 62% to $147 million. In addition, the Pentagon's TRP program, within the Advanced Research Projects Agency, would receive a 13% funding rise to $500 million in fiscal 1996. Though House Republicans are already moving to make recisions in these programs from the current year's budget and say they will oppose the programs in next year's budget, the Administration has made no attempt to reach common ground with Congress by trimming those activities.

Republicans have taken a wholly different tack on academic R&D. At an hour-long briefing for Washington science writers on 8 March, House Speaker Newt Gingrich of Georgia and Representative Robert S. Walker of Pennsylvania, chairman of the House Science Committee, expressed firm support of basic science and academic research. Both fiercely criticized technology transfer as being government efforts to interfere with Adam Smith's ideal market by picking winners and losers. Both characterized the Administration's technology programs as "subsidies for mainly large companies."

At his budget briefing on 6 February, Gibbons extolled the Administration's increased support for academic R&D, which would go up by $863 million, for a total of $12.5 billion. Gingrich and Walker would most likely applaud what Gibbons said on the occasion: "Investment at universities yields a particularly high return, in part because the investment adds both to the knowledge base and to training the next generation of scientists and engineers."

But after praising the Administration for singling out academic support with a 7.4% increase—"twice the anticipated rate of inflation"—Gibbons discovered the next day, to his embarrassment, that the National Institutes of Health had overstated its proposed funding for academic research by $750 million. This error wiped out virtually all the increase for universities.

At a time when the Federal government is awash in red ink and the dollar is plunging to new lows against

Department of Energy physics-related programs, continued

	FY 94 actual	FY 95 request	FY 95 current	FY 96 request
		(millions of dollars)		
Laboratory technology transfer for collaborations with industry and small business	36.7	53.5	57.2	56.6
Technology partnerships program to promote industrial collaboration	0	0	0	3.2
Advisory and oversight program direction†††	13.4	12.5	12.5	9.8
Fusion energy				
Magnetic confinement, including costs of PBX shutdown and TFTR decommissioning	163.2	150.5	187.9	131.5
Applied plasma physics, including studies of tokamaks and other concepts and operations of computer networks	57.3	54.3	54.3	48.8
Development and technology, including design of ITER	77.9	89.0	89.0	100.4
Planning and projects†	0.04	5.9	7.4	6.1
Inertial confinement (nondefense)	3.9	6.0	8.0	3.1
Program direction	8.9	9.6	9.6	9.6
Capital equipment and instrumentation, mainly for C-MOD and DIII-D and for heavy-ion accelerator	15.5	10.3	10.3	12.5
Construction, mainly for TPX	1.9	47.0	2.0	54.1
Total fusion energy (nondefense)	328.6	372.6	368.4	366.0
Weapons activities				
Inertial fusion (defense program)				
Indirect drive with glass laser—NOVA and Trident	95.0	103.5	93.4	102.5
Direct drive with glass laser—Omega	15.8	13.0	18.3	18.2
KrF laser—Nike	9.6	8.0	8.1	8.0
Light ion beams—PBFA II and NOVA	25.2	25.6	25.5	26.8
Capsule fabrication and development	14.1	14.6	13.1	13.5
National Ignition Facility—design and development	6.0	2.1	6.0	23.6
National Ignition Facility—construction	0	0	0	37.4
University and users programs	3.6	2.4	2.4	2.8
Capital equipment, mainly for Omega upgrade	15.9	9.7	9.7	7.9
Total inertial fusion (defense)	185.1	178.9	176.5	240.7
Research and development††††	1250.0	1263.9	1249.2	0
Testing	394.3	362.4	190.7	0
Stockpile stewardship	1590.6	1399.0	1384.3	1585.1
Stockpile management and support	1524.1	1710.5	1707.5	1848.4
Nonproliferation, verification and arms control	353.9	358.1	339.6	430.8
Nuclear safeguards and security	89.8	85.8	88.8	89.5
Environmental restoration and waste management (nondefense)	693.0	713.0	731.7	713.0
Environmental restoration and waste management (defense)	6065.0	5234.9	5605.0	6008.0

*This program evaluates novel, high-risk, exploratory energy concepts, typically at a level of $300 000 per year for a period of three years.

**In addition to funding general purpose equipment in the Basic Energy Sciences program, state-of-the-art instruments and additional beam lines are provided at DOE laboratories and university centers. High performance computing and communications activities also are supported.

***Concerns about the high projected cost of the ANS and its use of 93% enriched uranium led DOE to withdraw the project from the FY 1996 budget request. Funds in FY 1995 for the ANS will go instead to support research and design work on a spallation neutron source in the program.

†This program supports staff and peer reviews of projects and programs to judge the quality of research and the impact on DOE's mission.

††In FY 1996 this activity will be transferred to DOE's Office of Nuclear Energy.

†††This program provides staff advice and analysis on programs and policies, though under the 1993 department realignment some activities will be transferred in 1996 to other offices, including technology partnerships and university and science education.

††††This line includes inertial confinement fusion within defense programs for FY 1994 and FY 1995, but in FY 1996 this R&D line, including inertial fusion for weapons, appears in the science based stockpile stewardship program.

such strong currencies as Japan's yen and Germany's mark, the Administration itself is paring some politically popular programs and proposing major spending cuts to make room for increased funding for the research "initiatives" Clinton favors and to contribute to deficit reduction. The President's cuts include a $23 billion savings over the next five years derived from management reorganization and program reductions at three Cabinet departments—Energy, Transportation, and Housing and Urban Development—and two smaller agencies—the General Services Administration and the Office of Personnel Management. The Energy Department also has dropped plans to build the Advanced Neutron Source at Oak Ridge National Laboratory and has chopped $300 million from the amount the Defense Department allocates to academic research. Gibbons told reporters at his budget session that "no program is going to escape careful scrutiny"—a remark that may haunt him during the appropriations cycle that will go into high gear after the House and Senate budget committees issue their numbers on 15 April for the discretionary spending portions of the budget.

For their part, Livingston and Walker contend that Clinton's budget is "a good starting point" for making appropriations. But other Republicans are more assertive. Representative Dana Rohrabacher of California, who heads the energy and environment subcommittee of the House Science Committee, began a hearing on 13 February with a feisty declaration: "Not only are we not going to approve budget increases, we plan to cut from 1995 levels." While Congress won't get its discretionary funding targets until 15 April, he said, "it's clear we will probably be faced with a total of more than $1 billion in cuts off this request. . . . For 40 years Congress has been at the Christmas dinner table, gorging itself without regard to the consequences. It's time to push away those tempting bonbons and put government on Slim-Fast."

A few weeks after his hearing, Rohrabacher was advised by House budget leaders that he will need to take at least $1.4 billion from the DOE and the Environmental Protection Agency allotments proposed in Clinton's budget. Indeed, if that figure prevails, DOE's research programs are sure to be whacked, possibly by as much as $1.2 billion. The most likely candidates for the chopping block: environmental cleanup and rehabilitation, magnetic fusion, renewable energy sources and high-energy physics. "No one should be surprised," says a Rohrabacher aide. "Remember what Willie Sutton said when he was asked why he always robbed banks: 'That's where the money is.' "

Those Democrats known for their unshakable support of research are wary about R&D funding at Clinton's proposed levels out of today's pinched Federal purse. Representative George E. Brown Jr, the California Democrat who had chaired the House Committee on Science, Space and Technology (as it was known before the Republican takeover) told members of the American Association for the Advancement of Science at its annual meeting in Atlanta in February that government spending on R&D is likely to be reduced by as much as 25% over the next five years, "with some areas suffering even more." The message was not what scientists

National Science Foundation physics-related programs

	FY 94 actual	FY 95 request	FY 95 current	FY 96 request
		(millions of dollars)		
Mathematical and physical sciences				
Physics research				
Atomic, molecular, optical and plasma	19.1	20.0	19.3	20.1
Elementary particle	40.9	44.6	43.0	47.8
Gravitational, including LIGO R&D	10.5	11.0	10.7	11.0
Nuclear	38.5	40.3	38.8	43.9
Theoretical	18.4	19.3	18.6	19.4
Total physics research	127.4	135.1	130.3	142.2
Materials research				
Condensed matter physics	23.3	24.2	24.2	27.0
Solid-state chemistry and polymers	21.4	22.8	22.1	23.2
Metals, ceramics and electronics materials	23.4	24.0	23.7	24.8
Materials theory	12.1	12.8	13.1	14.0
Facilities and instrumentation	32.9	33.7	33.4	39.6
Materials research science and engineering centers	55.1	59.4	58.9	62.3
Total materials research	167.2	176.8	175.4	190.9
Chemistry research				
Chemistry, including physical chemistry and interdisciplinary materials chemistry	97.0	105.8	105.1	112.9
Instrumentation and infrastructure	17.9	18.1	17.9	20.7
Total chemistry	114.9	123.9	123.0	133.6
Mathematical sciences				
Mathematical research	62.0	66.0	65.2	70.3
Infrastructure	16.0	18.6	18.4	19.6
Total mathematics	78.0	84.6	83.6	89.9
Astronomical sciences				
Astronomy research	39.0	40.5	38.8	40.0
National Astronomy and Ionospheric Center	8.3	8.2	7.8	8.6
National Optical Astronomy Observatories, including Kitt Peak and Cerro Tololo	26.5	27.9	26.7	29.2
National Radio Astronomy Observatory, including VLBA and R&D for a large large mm-wavelength array	27.8	30.2	28.9	32.6
Total astronomical sciences	101.5	106.7	102.2	110.4
Multidisciplinary research activities*	28.8	30.6	30.0	31.3
Major research facilities				
Laser Interferometer Gravitational Wave Observatory	0.03	50.0	85.0	70.0
National High Magnetic Field Laboratory	12.0	12.0	12.0	15.0
Gemini 8-meter telescopes	17.0	40.0	41.0	0
Geosciences				
Atmospheric sciences research	82.0	91.4	85.4	91.0
National Center for Atmospheric Research	52.5	56.5	58.4	64.8
Earth sciences research, including geophysics	52.9	57.7	54.5	58.6
Continental dynamics	7.2	7.9	7.4	9.3
Instrumentation and facilities in Earth sciences	20.6	21.8	20.4	22.2
Ocean sciences research, including global climate processes	99.2	114.0	102.9	110.3
Oceanographic centers and facilities	51.1	54.0	50.6	54.2
Ocean drilling program	38.7	40.0	39.9	41.1
Total geosciences	404.2	443.1	419.5	451.5
Computer and information science and engineering				
Theory and research, including system software	39.1	41.9	40.3	42.9
Information, robotics and intelligent systems	29.6	34.7	32.3	35.1
Microelectronic information processing systems	23.5	27.6	25.8	28.1
Advanced scientific computing, including operations of four state-of-the-art supercomputing centers	74.6	85.2	79.2	84.1
Networking and communications research and infrastructure, mainly NSFNet operations	49.9	58.3	56.5	59.6
Cross-disciplinary activities, including improving undergraduate research use and infrastructure	22.8	25.9	24.2	25.8
Total computer and information science and engineering	239.5	273.5	258.3	275.6
Academic research facilities and infrastructure**				
Academic research facilities (about 70 awards)	53.0	27.5	59.1	50.0
Academic research instrumentation (about 185 awards)	52.3	27.5	59.0	50.0
Education and human resources	569.0	586.0	614.0	599.0

*This program was created in FY 1994 to support innovative research across disciplinary fields and rapidly emerging opportunities. While most participants are in fields covered by the mathematical and physical sciences directorate, investigators can come from other disciplines as well. Examples of each are nanosciences and data analysis of the Comet Shoemaker–Levy collision with Jupiter in 1994.

**Congress appropriated $118.1 million for this program in FY 1995 and an additional $131.9 million for academic infrastructure to be administered by NSF for several agencies. The release of funds for the interagency infrastructure program was contingent on the Clinton Administration organizing the activity and requesting additional money for FY 1996. The Administration chose not to initiate the program and proposed instead to rescind the $131.9 million.

were prepared to hear. Often called "Mr. Science" for his understanding and appreciation of R&D, Brown warned that "it is naive to think that research, [whether] basic or applied, will not be linked to the conservative Republican social and political agenda."

Possibly the most resolute budget-cutter in Congress is Representative John R. Kasich of Ohio, chairman of the House Budget Committee. He promises to craft a plan to balance the budget by 2002, to match the promise made in the "Contract with America" that the new House leaders would make balancing the budget their first legislative priority. The way Republicans do this is most likely to be a massive "reconciliation bill" that matches tax and spending changes dollar for dollar. That would impose discipline on Congress and keep tax cuts from swelling the deficit.

In January the Congressional Budget Office released figures showing the deficit will head back up in 1996, topping $200 billion. It will then reach $220 billion in 1997 and 1998. Caps on discretionary spending expire in 1998, and by the year 2000 the deficit could leap to $284 billion. This is why the "out-year problem" vexes the R&D agencies. Though there are few new starts in next year's budget, the programs and facilities now in place and under construction require increasingly larger amounts of money to operate in each of the next few years, to account for inflation if nothing else. In moving toward a balanced budget, the chances for larger allocations for discretionary funds, from which both civilian and defense R&D allocations come, are nil. The obvious consequence: R&D will be downsized.

The more horrendous problem of course is the monstrous debt. Sometime this summer or fall Congress will need to raise the statutory limit on the national debt from the current $4.9 trillion. Moreover, three years from now, according to estimates by CBO, the national debt may hit $6 trillion. The killer is the interest payment on the debt—$235 billion this year, $260 billion next year. Such whopping payments exceed the nation's annual deficits.

Here are some highlights of President Clinton's proposed R&D budget:

National Science Foundation. For the past three years NSF has emphasized its commitment to "research in strategic areas" that are associated with national needs. This year, however, the emphasis is on individual investigators and small groups—a return to the original purpose in setting up NSF in 1950. "If you want to solve a problem in basic research, the idea is going to come from the community," says NSF Director Neal Lane. "It's sure not going to come from somebody in Washington." Lane's dictum would seem to turn on end the directions the agency has received in recent years from Democrats on the Senate Appropriations Committee. Now Lane has the backing of Republican leaders in the House to pursue NSF's traditional ways.

The agency's budget request calls for an overall increase of 3%, to $3.36 billion, in 1996—the lowest rate proposed by any Administration since before 1987, when President Reagan ordered NSF's budget doubled in five years. Now, by cutting back on education programs and facilities construction, the agency plans to boost its research activities by 7.6%, to $2.45 billion. Percentage increases within the research directorates are fairly even: biological sciences up 7.6% to $324 million; computer and information science and engineering up 6.7% to $275.6 million; engineering up 7.7% to $344.2 million; geosciences up 7.6% to $451.5 million; mathematics and physical sciences up 8.3% to $698.3 million; and social, behavioral and economic sciences up 8% to $122.9 million.

The request for a program called Academic Research Infrastructure is $100 million, a decrease of $18 million, or 15.3%, from the current year. The cut is actually much greater. The Administration seeks a recision of $131.9 million from the program's current operating budget, which Republicans are only too happy to accept. Last year's appropriations bill had provided $250 million for academic research facilities but specified that nearly half of the amount was subject to recision unless the Administration asked for at least $250 million for facilities in fiscal 1996. While aware of the need for new research facilities and equipment on campuses—estimated as far back as 1986 at $10 billion—the agency did not submit a request for the funds. Lane has said that doing so would have necessitated a reduction in research funding elsewhere and that this would "greatly distort our priorities."

Even so, some of NSF's own facilities would receive funding increases. The Cornell Electron Storage Ring is marked for a small 2.1% rise of $500 000—for a total of $23.9 million next year—to improve its luminosity for particle physics experiments. Funding for the National High Magnetic Field Laboratory at Florida State University would increase by 25% to $15 million as it enters its second five-year phase to develop the next generation of magnet systems. The Laser Inter-

Department of Defense basic research funding (6.1 budget category)

	FY 94 actual	FY 95 request	FY 95 current	FY 96 request
		(millions of dollars)		
Army				
Research sciences, including physics and materials	183.1	195.3	201.7	127.6
In-house laboratories, independent research	10.8	13.7	13.7	14.3
University and industry research centers	5.6		8.6	62.7
Navy				
Research sciences, including physics and materials	385.7	408.0	400.9	385.9
In-house laboratories, independent research	16.7	17.1	17.1	16.1
Air Force				
Research sciences, including physics and materials	224.8	235.8	239.7	239.9
In-house laboratory, independent research	0.7	0	0	0
Geophysics technology	35.1	29.9	0	0
Materials	69.4	68.9	68.8	74.5
Advanced Research Projects Agency				
Research sciences, including physics and materials	85.9	87.7	87.6	89.7
Computing systems and communications technology	321.2	419.6	389.0	403.9
Materials and electronics technology	261.2	224.8	274.1	226.0
Office of the Secretary of Defense				
In-house laboratories, independent research	2.3	0	2.3	3.5
University research initiatives	240.2	232.5	249.7	236.2
Focused research initiatives	11.5	20.0	5.9	14.0
Medical free electron laser	20.4	23.0	23.4	13.3
Historically black colleges and universities	0	0	22.5	14.8
Ballistic Missile Defense Organization	2605.1	2979.9	2467.6	2442.2

NOAA physics-related programs

	FY 94 actual	FY 95 request	FY 95 current	FY 96 request
		(millions of dollars)		
Oceanic and atmospheric research				
Interannual and seasonal climate, including studies of the El Niño–Southern Oscillation	7.9	8.0	7.9	8.3
Long-term climate and air quality, including high-performance computing program	31.1	47.0	33.7	54.7
Climate and global change (NOAA wide)	69.9	84.0	70.8	89.5
Weather research, including numerical modeling and forecasting techniques	36.7	33.9	41.5	39.1
Solar–terrestrial research	5.4	5.6	5.6	7.8
Marine prediction, including numerical modeling	17.2	14.3	14.3	14.9
Undersea Research Program*	2.0	0	17.9	0
Total oceanic and atmospheric research	170.2	192.8	191.6	214.3

*For the third successive year the agency proposes to cancel this program. Since the program began in FY 1981 it has been the source of support for six regional research centers, including those in the Caribbean, Hawaii and Alaska. Despite NOAA's plan, though, Congress has allocated funds to the program.

National Institute of Standards and Technology physics-related budget

	FY 94 actual	FY 95 request	FY 95 current	FY 96 request
		(millions of dollars)		
NIST laboratory programs:				
Scientific and technical research and services				
Physics	26.7	27.5	27.5	28.1
Materials science and engineering	43.3	61.7	49.8	54.3
Chemical science and technology	22.2	32.8	32.5	39.1
Electronics and electrical engineering	29.5	30.0	35.4	45.1
Computer systems	28.9	68.5	37.1	46.7
Applied mathematics and scientific computing	7.0	7.3	7.3	11.0
Industrial technology services				
Advanced Technology Program	199.1	451.0	430.1	490.9
Manufacturing Extension Partnership	30.2	61.1	90.6	146.6
Malcolm Baldrige National Quality Award	3.2	6.9	3.4	4.9

NASA physics-related programs

	FY 94 actual	FY 95 request	FY 95 current	FY 96 request
		(millions of dollars)		
Physics and astronomy				
Advanced X-Ray Astrophysics Facility development (AXAF)	239.3	234.3	234.3	237.6
Gravity Probe B development*	42.4	50.0	50.0	51.5
Offsetting reduction	—	—	—	−51.5
Global geospace science (International Solar-Terrestrial Physics)	27.6	40.0	40.0	5.4
Payload and instrument development				
Collaborative solar–terrestrial research	32.8	23.2	23.2	3.8
Tethered satellite system	2.4	3.8	3.8	5.7
International astrophysics payloads, including Japan's Astro-E and Russia's RADIOASTRON program	24.3	20.9	26.9	23.6
Explorer series development				
X-Ray Timing Explorer	36.5	36.7	32.6	0
Advanced Composition Explorer	33.2	44.1	39.6	36.0
Small explorers and planning for others	53.6	83.7	48.2	93.2
Mission operations and data analysis				
Hubble Space Telescope operations and servicing	215.2	226.7	236.7	182.7
Hubble Space Telescope data analysis	38.5	42.7	42.7	43.5
AXAF mission operations and data analysis	11.6	18.9	18.9	40.4
Astrophysics mission operations and data analysis	84.5	89.0	84.7	79.6
Space physics mission operations and data analysis	55.4	64.4	49.4	82.4
Research and analysis				
Space physics supporting research and technology	35.7	35.7	35.7	35.7
Astrophysics supporting research and technology	35.4	35.4	39.7	39.7
Space Infrared Telescope Facility definition (SIRTF)	0	0	0	15.0
Suborbital programs				
Kuiper Airborne Observatory**	13.6	13.2	13.2	3.4
Stratospheric Observatory for Infrared Astronomy (SOFIA)	0	0	0	48.7
Sounding rockets	39.5	38.0	38.0	38.6
Balloon program	16.4	16.0	16.0	16.0
Information systems	26.5	26.1	26.1	25.9
Launch services	84.6	95.2	95.8	74.2
Total physics and astronomy	1149.0	1238.0	1195.5	1131.0
Planetary exploration				
Cassini development	266.6	255.0	255.0	191.5
Discovery program				
Mars Pathfinder	60.8	77.5	77.5	35.9
Near Earth Asteroid Rendezvous (NEAR)	66.6	52.2	52.2	31.3
Future missions	0	0	0	36.6
Mars Surveyor program	14.6	59.4	59.4	108.5
Mars instruments	4.4	2.1	2.1	1.4
New Millennium spacecraft***	0	0	10.5	30.0
Mission operations and data analysis				
Galileo operations	59.4	70.7	70.7	75.1
Magellan operations	11.8	0	0	0
Voyager–Neptune data analysis	4.3	0	0	0
Near Earth Asteroid operations	0	0	0	3.3
Planetary flight support	55.2	57.0	46.5	49.4
Research and analysis	107.6	115.1	108.4	109.1
Launch services	120.6	134.8	134.8	155.7
Total planetary exploration	771.9	823.8	817.1	827.8
Mission to Planet Earth				
Earth Observing System (EOS), including Landsat-7	392.9	455.1	591.1	591.1
EOS Data Information System (EOSDIS)	188.2	284.9	230.6	289.8
Earth probes development, including Total Ozone Mapper	96.4	82.0	81.6	36.9
Payload and instrument development				
Atmospheric payloads	12.1	7.6	7.6	1.1
Solid Earth payloads	13.8	11.9	11.9	3.8
Applied research and data analysis				
Mission to Planet Earth research	200.1	227.8	227.8	209.9
Mission operations, data retrieval and storage, including Consortium for International Earth Sciences and computing	117.0	116.5	116.5	98.5
Global Observations to Benefit the Environment (GLOBE)	0	5.0	5.0	5.0
Advanced Communications Technology Satellite (ACTS)†	3.0	2.3	2.3	0
Launch Services	26.5	48.7	48.7	88.0
Facilities construction at Goddard and Langley	18.0	17.0	17.0	17.0
Total Mission to Planet Earth	1068.0	1258.8	1340.1	1341.1
Space access and technology††	562.4	NA	642.4	705.6
Academic programs				
Education programs, including undergraduate and graduate opportunities to work in research at NASA centers	54.3	56.3	56.3	61.4
Minority university research and education	31.2	40.9	45.9	57.3
Space station development and operations	1939.2	1889.6	1889.6	1833.6
US-Russian cooperative program, including Mir support	170.8	150.1	150.1	129.2

*Though the spacecraft is in development, its operation depends on the outcome of a review of its scientific merit conducted by the National Research Council

**The Kuiper Observatory, a 0.91m infrared telescope flown on a modified C-141, will be grounded in FY 1996 and replaced, if approved, by the Stratospheric Observatory for Infrared Astronomy (SOFIA),a 2.5m telescope provided by the German Space Agency and on board a rehabilitated Boeing 747.

***An aggressive program to develop and demonstrate smaller, cheaper spacecraft and instruments.

†NASA is phasing out of this technology as commercial organizations are building new systems—particularly Iridium (by Motorola), a videophone system (Hughes) and a home video network (Norris Communications).

††This program is intended to develop with industry lower cost aerospace technologies for global sales.

ferometer Gravitational Wave Observatory would get $70 million in 1996 to continue construction toward its full operation in the year 2001. The National Superconducting Cyclotron Laboratory at Michigan State University is included in the budget for a 31.8% jump to $12.4 million to complete a high-resolution spectrometer dedicated for studies of unstable nuclei.

The budget request contains $31 million for the NSF mathematical and physical sciences directorate to support innovative proposals that cross traditional disciplinary borders. Directorate staffers have identified four areas for multidisciplinary advances—namely, optics in communications and instrumentation; nanoscience on the atomic scale; molecular biology involving chemistry, mathematics and physics; and research infrastructure, ranging from accelerators and telescopes to workstations and lasers.

NSF continues to support seven so-called strategic research initiatives directly related to national priorities. In the President's budget, environment and global change would receive a 16.9% hike from $329 million to $355 million, and high performance computing and communications would get a 7.4% rise to $313.6 million in 1996.

Department of Energy. Just when the department is under political and managerial siege, it is requesting $17.8 billion in fiscal 1996, an increase of $337.4 million from its current budget. Despite calls from Republicans in Congress to abolish the department, the White House considers the increase a temporary measure to cover short-term expenses while DOE is restructured. Still, the President's budget would require the department to chop a total of $14.1 billion over the next five years, of which $5.7 billion would come from selling such assets as the Naval Petroleum Reserve at Elk Hills and Teapot Dome in California. The precipitous fall in DOE's budget through the end of the century is almost certain to cause the department's research programs to stumble along the way.

The budget squeeze has already forced the Administration to abandon the Advanced Neutron Source, which would have been built at Oak Ridge and was designed to benefit both basic science and industrial research. At an estimated cost of $2.9 billion, the ANS was considered too expensive to build, and with its fuel consisting of 93% enriched uranium, it was held to be a risk to the Administration's nuclear non-proliferation agenda. Instead, DOE officials are now looking at a spallation neutron facility, a cheaper alternative that would use an accelerator rather than a reactor to create neutrons and could possibly be adapted to produce tritium for the nuclear weapons arsenal.

The high-energy physics program would receive $685.6 million, up $43.5 million or 6.8%—just about enough, says the department's budget document, to accommodate the recommendations of the Drell Panel review of the program (see PHYSICS TODAY, June 1994, page 51). Energy Secretary Hazel O'Leary says the increase "would put high-energy physics back on course" after the cancellation of the Superconducting Super Collider in 1993. The budget also proposes $52 million to continue the upgrade of Fermilab's main injector and another $52 million for SLAC's B Factory.

At $321.1 million, nuclear physics would be reduced $10.4 million or 3.1%. The total would include $70 million to operate the completed Continuous Electron Beam Accelerator Facility at Newport News, Virginia, and to continue construction of the Relativistic Heavy Ion Collider at Brookhaven. By contrast with nuclear physics, basic energy sciences, which has been short-changed in recent years, would go up 10.6% to $811.4 million.

The DOE budget request contains $100 million for a Scientific Facilities Initiative, with most of the money going to programs in basic energy sciences. If approved by Congress, the funds would be spent for new beam lines, instrumentation and electricity rates at a wide range of synchrotrons, light sources and other big machines at DOE labs to provide greater access for academic and industrial researchers. Lab directors have been telling members of Congress for years that they have been unable to operate their facilities for long enough periods to satisfy user demands because of funding shortages to pay for equipment and power.

The magnetic fusion program has escaped the draconian cuts so far, but some members of Congress from both sides of the aisle are now stalking it with battle-axes. The budget calls for $366 million, down $2.4 million, but the fate of the $740 million Tokamak Physics Experiment, which would demonstrate ignition and burning of deuterium–tritium fuel, is in grave doubt. The President's Committee of Advisers on Science and Technology will recommend this summer what action to take on the fusion program. PCAST also will review US participation in the International Thermonuclear Experimental Reactor, now in the engineering design stage.

National Aeronautics and Space Administration. Rumors of reductions for NASA were circulating for months before the budget was released. So the 1.4% cut in the agency's budget, down $203.7 million to $14.26 billion for 1996, was not unexpected. The agency also will need to absorb a $5 billion decrease over the next five years to help pay for the President's middle-class tax cut. By the end of the century the annual NASA budget may drop to $13 billion. "Make no mistake," NASA Administrator Daniel Goldin warned at his budget briefing, "when this is over, NASA will be profoundly different. We're going to restructure the agency."

Funding cuts and flat budgets have already shrunk the agency by 30% in the past five years. Almost all of its science programs have been or are being reviewed and reorganized. Although specific recommendations on how the agency intends to achieve its budget and program objectives will not be ready until 17 May, Goldin says "everything is on the table," including eliminating facilities and centers and combining operations with the Defense Department at some military bases. Like DOE and DOD, NASA has a task force examining all its labs and centers. The findings of these panels will be reviewed by PCAST, which has been asked to advise the President on closings and consolidations.

Within NASA's budget request, funding for the space station would decrease about 3% in fiscal 1996 to $1.83 billion, though as in previous years additional money for it is included in the life and microgravity sciences program, bringing the total to $2.1 billion. Three modest new initiatives are presented in the NASA budget: $15 million for mission studies of the Space Infrared Telescope Facility, known as SIRTF; $48.7 million to begin the Stratospheric Observatory for Infrared Astronomy, or SOFIA; and $30 million for what Goldin calls the "revolutionary" New Millenium spacecraft, which would herald reductions in both the cost and weight of today's science spacecraft by a factor of 10. The first mission would probably fly a miniaturized science payload to a nearby asteroid. It could be launched as early as 1997, and if it completes its mission successfully, Goldin will be Congress's golden boy. As it is, Gingrich praises Goldin as "one of the most innovative and entrepreneurial managers in the Federal government."

The Discovery line of small planetary missions would get $36.6 million for at least one spacecraft to follow the Mars Pathfinder and Near Earth Asteroid Rendezvous missions already in development. But other Discovery operations would be pared down. Funding for Mission to Planet Earth, at $1.34 billion in 1996, would remain essentially flat; included in that figure is $591 million for the Earth Observing System—exactly the same amount as in fiscal 1995.

The NASA budget also includes $50 million to develop a second spacecraft in the Mars Surveyor series, to be launched in 1998. Pending favorable review by a panel of the National Research Council, whose report is expected by summer, Gravity Probe B would be funded at $51.5 million. Since the budget request contains an identical figure designated as an offsetting reduction for the space agency, Goldin was questioned at his budget briefing about where he would find the funds if the panel recommends proceeding. Goldin replied that NASA "will make the resources available" from other parts of the budget.

Department of Commerce. NIST continues to be the favored child of the Clinton Administration, with a 20% boost that would raise its budget from $854 million to $1.02 billion. Mindful of Republican opposition to industrial technology programs, however, NIST has lowered its sights. ATP would receive a 14% increase, which is half the growth rate the Administration had advocated last year, when the program was given a thumping 116% boost. In addition, the Manufacturing Extension Partnership program would receive a 62% increase, to $147 million. NIST director Arati Prabhakar says it will be hard to reach the Administration's goal for ATP of $750 million by 1997. Likewise, getting the 1996 request for both programs through Congress will be difficult, if not impossible.

Department of Defense. While the Pentagon's total R&D budget would be lowered by more than $900 million, the proposed funding for basic research is reduced only slightly, by $13 million, or 1.1%, to $1.21 billion. The DOD basic research programs that support university science—namely defense research sciences, the university research initiatives and the focused research initiatives—would be reduced collectively by only $37 million from last year's $1.19 billion figure. As expected, the President is persisting in the push to increase technology transfer programs. The budget seeks a 13% rise in ARPA's military and civilian dual-use technology program, the Technology Reinvestment Project, which would bring it up to $500 million next year. But Congress is certain to have other ideas. IRWIN GOODWIN ■