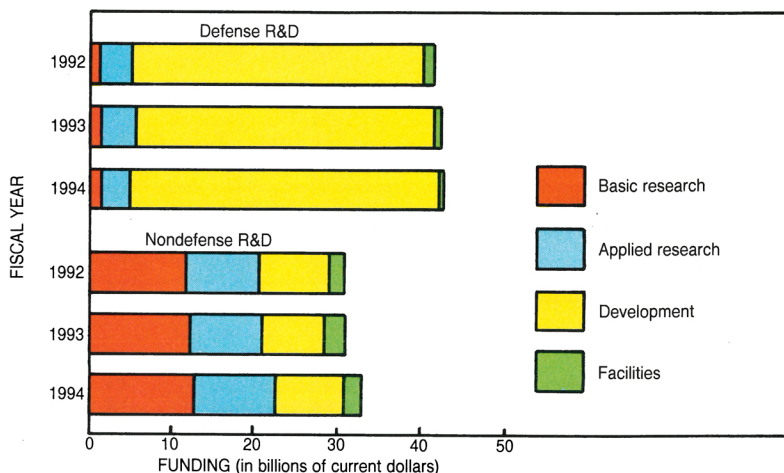


CLINTON'S BUDGET BOOSTS TECHNOLOGY, MAKING RESEARCH SCIENTISTS JITTERY

It's not hard to pinpoint when Clinton's first R&D budget got into trouble. It was on the morning of 20 April when President Clinton succumbed to a Republican filibuster in the Senate and abandoned his \$16.3 billion "emergency" stimulus package containing, among much largess, an additional \$206.7 million for the National Science Foundation in the current fiscal year, \$117 million more for the National Institute of Standards and Technology and \$81 million for the National Oceanic and Atmospheric Administration. Thus, Clinton's first legislative setback was something of a debacle for those scientists who had counted on NSF, NIST and NOAA to spend the unexpected windfall on research and equipment. The stimulus supplement was to be the first tangible evidence of the Clinton Administration's support of investments for the future. Its defeat and the feckless performance of the White House and research agencies in making a case for their programs before Congress during this year's budget cycle, say science policy watchers, portend trouble ahead.

From his economic conference in Little Rock last December to his budget speech to Congress in February, the President appeared to be in control of his economic plan, with its higher-priced science and technology programs. The scientific and corporate communities generally approved of the new Administration's avowed intentions to promote technological advances, to reduce the Federal deficit and to stimulate economic growth. Three months later a chorus of critical voices raised anxiety levels about the outcome of Clinton's R&D budget for fiscal 1994, which starts on 1 October. Some key members of Congress now express uncertainty about the chances of R&D faring well. "Without strong arguments from the directors of the science agencies and departments and from the leaders of the scientific communities," says Representative George E. Brown Jr, the California Democrat who is chairman



Defense and civilian R&D experienced little change in 1992–93. The Clinton budget request for FY 1994 calls for nondefense R&D to increase 6.7% and basic research by 3.3% to \$33 billion, while defense R&D would rise by 0.5% to \$42.5 billion. (Source: OMB.)

of the House Committee on Science, Space and Technology, "a lot of good scientists in research universities and government laboratories will be shortchanged. There are just too many people and programs competing for discretionary dollars in these tough economic times. I fear we'll be apportioning some pain in 1994."

Almost everyone associated with government in Washington foresees problems ahead as Congress grapples with the 1994 budget—all 1478 pages. In a candid moment that became the talk of the town in April, Leon E. Panetta, the former House member from California who now directs the White House Office of Management and Budget, admitted on the occasion of the President's first 100 days in office that Clinton's agenda was in trouble on Capitol Hill.

Throughout their election campaign Clinton and Vice President Al Gore Jr spoke out on the issues of health care, technology policy, precollege education, environmental protection and, almost always, more jobs. They never promised budget in-

creases for science research. Instead, deficit reduction became an evangelical mission, and industrial policy, a term that was banned during the Reagan and Bush years, became a faddish buzzword. The Vice President has met with telephone company executives to discuss cooperating on a new information superhighway, a subject that he introduced to Congress some three years ago, and Administration aides speak to Detroit's automakers about working together with the national laboratories on electric cars. Such priorities have little to do with science research as it is traditionally practiced, and the proposed budget embodies many Clinton-Gore technological departures from previous Administrations.

Issued on 8 April, the fiscal 1994 budget has a bottom line of \$1.5 trillion. It would allot \$76 billion for R&D and facilities—once again a record amount. The R&D request is 3% more than this year's figure and, as such, just matches last year's inflation rate and also equals the inflation predicted for this year. In

Department of Energy physics-related programs

	FY 92 actual	FY 93 request (millions of dollars)	FY 93 current	FY 94 request
High-energy physics				
Physics research	145.3	145.9	145.9	148.6
Technology research, including design and building detectors	68.3	69.4	65.4	59.4
Facilities operations				
Fermilab	136.4	142.7	137.9	140.7
SLAC	90.2	91.5	88.7	80.0
Brookhaven, including Alternating Gradient Synchrotron	43.4	45.0	43.9	42.9
Other including computer networking systems	0.03	2.7	2.5	4.9
Capital equipment	87.7	73.2	67.6	65.1
Construction				
Accelerator improvements and modifications	15.8	15.1	15.1	13.1
General plant (roads, utilities, safety, environmental and security projects)	13.4	12.8	12.8	12.1
Fermilab linac upgrade	6.2	0	0	0
Fermilab main injector	11.7	30.0	15.0	25.0
B-factory	0	0	0	36.0
Total high-energy physics	618.4	630.9	613.4	627.8
Superconducting Super Collider				
R&D, program direction and operations	102.4	116.8	116.8	109.4
Capital equipment	56.3	63.0	38.0	50.0
Construction	323.8	470.2	359.7	480.6
Total SSC	482.6	650.0	514.5	640.0
Nuclear physics				
Low-energy research				
Universities, mainly Texas A&M, Duke and U. of Washington	3.2	3.3	3.3	3.0
National laboratories	3.3	3.2	3.4	2.9
Reactors, including NIST cold neutron beam	1.0	0.9	1.2	1.1
Other research, including solar neutrinos	4.6	5.9	5.3	6.4
Accelerator operations	3.4	3.6	3.6	5.1
Data measurement and evaluation	11.5	9.2	9.1	7.2
Medium energy, including LAMPF, Bates and CEBAF				
Research	38.3	40.8	30.6	33.4
Facilities operations	62.1	70.6	26.9	58.2
Heavy ion, mainly Brookhaven AGS and Texas A&M, Yale and U. of Washington				
Research	36.4	39.4	38.5	40.7
Facilities operations	37.9	28.6	28.7	26.7
Nuclear theory	14.0	14.8	14.7	14.8
Capital equipment for detectors and data acquisition	30.0	32.2	26.2	29.0
Construction				
CEBAF	48.3	33.0	32.0	16.6
Brookhaven Relativistic Heavy Ion Collider	49.4	71.4	70.0	70.0
Accelerator improvements and modifications	4.1	3.2	3.2	3.8
General plant projects	2.1	3.5	3.5	3.6
Total nuclear physics	351.4	363.5	309.1	322.3
Basic energy sciences				
Materials sciences, including solid-state physics				
Research, mainly at Ames, Argonne, Brookhaven, Lawrence Berkeley, Oak Ridge and universities	132.2	169.0	136.4	143.1
Facilities operations, including first full year (1994) of Berkeley 1-2-GeV light source and commissioning components at Argonne 6-7-GeV light source	121.2	121.2	134.8	133.9
Chemical sciences, including atomic and plasma physics				
Research, principally at Oak Ridge	99.6	115.1	105.8	110.4
Facilities operations	56.9	60.3	56.6	58.6
Applied mathematical sciences, including computer sciences research and upgrade of supercomputer center	80.5	91.0	83.2	106.2
Engineering and geosciences	35.2	39.5	36.2	37.9
Advanced energy projects				
Research on novel, high-risk ideas	10.7	11.9	10.9	11.4
Congressionally directed	44.0	0	0	0
Energy biosciences, performed mainly at universities	24.4	27.6	25.3	26.7
Program direction	7.5	8.4	8.4	9.4
Capital equipment and instrumentation	37.0	46.3	44.9	44.9
Construction, mainly Argonne				
6-7-GeV light source	111.0	122.4	109.1	119.5
Congressionally directed projects	0	0	94.8	0
Total basic energy sciences	760.4	813.9	846.4	802.0

continued on page 85

its many parts, the budget emphasizes the Clinton-Gore economic plan as articulated in a campaign document, "Technology for America's Economic Growth," and in their political manifesto, "A Vision of Change for America" (PHYSICS TODAY, April, page 43).

Let Commerce be Commerce

Accordingly, programs and units of the Commerce Department would get the biggest percentage increase of any department. "We believe that the Commerce Department should in fact be an exciting and effective Commerce Department," says John H. Gibbons, the President's top assistant for science and technology. "That means it should assume leadership in organizing collaborative research projects between government and industry. We think of it as the centerpiece of the government's effort to advance the country's manufacturing technology, which is absolutely vital in today's intensely competitive global economy." One of Commerce's oldest components, NIST, which had been known for its first 91 years as the National Bureau of Standards, would be reinvigorated with a larger mission and two outreach programs, the Manufacturing Extension Partnership and the Advanced Technology Program. NIST, along with the Energy Department's laboratories and the Pentagon's Advanced Research Projects Agency, is now under explicit orders to make deals with commercial firms in so-called generic, precompetitive technologies. The concept of joint ventures is hailed by the private Council on Competitiveness as an "important step forward in improving the effectiveness of Federal R&D programs."

Along with this effort, Gibbons told a group of science writers at a dinner in the Rayburn Building of the House of Representatives on 8 April, the 1994 budget continues the shift in the ratio of civilian to defense R&D expenditures that began in the Bush years. Clinton's goal is to change the current lopsided split of 59% military and 41% civilian to a balanced 50-50 split in "a few years," said Gibbons. The division had been more nearly 50-50 in the 1960s.

Most scientists working in basic research would much prefer that the balance of the 1960s be quickly restored. The budget for basic science totals \$14 billion, of which \$11 billion would go to university research. Basic research in civilian and defense programs taken together would go up by 3%, and nondefense applied research would rise 6%.

The budget appeared as bits and

pieces in various ways ever since the stimulus package was released two months ago. It gave another dimension to Clinton's R&D agenda: NSF would receive a 16% increase over the current year; the National Institutes of Health, the darling of Congress for years, would rise by only 3.2%, which includes disproportionately larger increases for three politically sensitive programs—breast cancer research, AIDS research and the human genome project; NASA would get a 6.6% boost, the greatest beneficiary being the long-neglected field of aeronautics research and technology, which would receive 18.8% more than its current allocation; and Energy Department R&D would go up by a paltry 2.3%, though several programs would get big boosts—namely solar research, energy conservation, technology transfer from the national labs, and the Superconducting Super Collider. NIST and NOAA, which had been slated for large funding infusions under the now-defunct stimulus bill, still appear to do well in the budget, with increases of 36% and 7.3% respectively.

Those percentages, however, included the increases requested by the Clinton Administration before Senate Republicans filibustered the stimulus package to death. The demise of the supplemental appropriation poses a dilemma for NSF in particular because the agency's 1994 request now appears disproportionately large, amounting to 16% over the current budget. An increase of that size is a natural target for cost-cutters in Congress. To be sure, Representative Louis Stokes, a Democrat of Ohio, chairman of the House Appropriations subcommittee that funds NSF, has already informed the agency it was highly unlikely to get as much as it seeks.

Hybrids of agony and ecstasy

Hugh Loweth, who had dominated science budgeting at OMB for decades before his retirement in 1990, claims that "every budget is a hybrid of agony and ecstasy." Instances of both abound in the proposed budget. DOE's budget for high-energy physics calls for reductions in the operations account at almost all of its laboratories, including cuts of 10% at SLAC and 2% at Brookhaven. For the first time, the department's total high-energy physics budget of \$627.8 million would be surpassed by the separate SSC account, which amounts to \$640 million. At the Defense Department, Clinton's \$242.6 million request for the University Research Initiative would appear to be substan-

Department of Energy physics-related programs, continued

	FY 92 actual	FY 93 request (millions of dollars)	FY 93 current	FY 94 request
Major user facilities , mainly laboratory light sources	178.1	181.5	191.4	192.5
Advanced Neutron Source to be built at Oak Ridge*	0	0	0	39.0
University and science education				
Laboratory cooperative science centers at DOE labs	25.8	36.6	25.5	35.8
University programs, including museums and EPSCOR**	18.7	9.8	20.8	12.8
University reactor fuel assistance	4.7	3.7	3.7	3.7
University research instrumentation	4.9	5.6	5.6	5.6
Laboratory technology transfer for industry collaboration	10.0	15.1	10.1***	
Fusion energy				
Magnetic confinement systems including upgrades†	180.3	182.8	164.2	157.4
Applied plasma physics, including theory and				
National Energy Research Supercomputer Center	61.8	62.5	61.9	59.8
Development and technology, including ITER design	56.7	67.6	66.4	81.3
Planning and projects	0.3	4.8	4.8	4.9
Inertial fusion energy				
at Berkeley and Livermore	8.2	8.2	6.9	4.0
Program direction	7.5	8.8	8.8	9.2
Capital equipment and instrumentation	13.0	21.0	14.1	16.0
Construction, including tokamak experiment design	4.6	4.2	4.2	15.0
Total fusion energy	332.2	359.7	331.2	347.6
Inertial fusion (DOE weapons R&D)				
Gas laser, including Aurora and Nike	11.8	11.9	16.0	14.4
Glass laser, including Nova and Omega	106.4	117.7	120.3	110.0
Pulsed power, including PBFA II and Hermes III	31.5	30.0	30.0	27.9
Supporting activities, including design of national facility	15.6	15.6	15.0	20.3
Capital equipment, including Omega laser upgrade at U. of Rochester	29.5	20.7	31.0	15.9
Total inertial fusion	194.8	196.9	212.3	188.4
Weapons activities				
Research and development	1412.8	1388.2	1499.9	1285.5
Testing	510.8	473.9	419.4	456.0
Stockpile support—production and surveillance	2497.4	2566.3	2181.2	1892.5
Program direction	128.6	355.8	186.5	284.1
Complex reconfiguration	44.4	26.0	141.1	163.5
Total weapons activities	4435.8	4810.2	4435.4	4124.6
New production reactors	333.8	153.8	121.2	0
Nuclear materials production and enrichment	1906.3	1776.7	1455.5	1137.2
Verification and control technology	185.9	241.7	339.8	368.8
Nuclear safeguards and security	80.6	104.2	98.7	90.3
Defense complex cleanup, restoration and waste management	4283.2	5000.0	4964.9	5515.9

*ANS was in the basic energy sciences budget in FY 1992 for \$24.1 million and in FY 1993 for \$21.4 million.

**University programs totaling \$14.3 million in FY 1993 and \$11.4 million in FY 1994 are part of the FCCSET education initiatives. In addition all laboratory cooperative science centers are part of the FCCSET education initiative.

***President Clinton's stimulus package, which was defeated in the Senate in April, had proposed to add nearly \$47 million to the FY 1993 program for 64 new technology transfer projects.

†The Princeton Beta Experiment and the Oak Ridge Advanced Toroidal Facility will both shut down in FY 1994.

tially less than the \$317 million the program received from Congress this year, but the fact is that the current account includes \$176 million worth of "pork-barrel" earmarks made by lawmakers for projects for colleges and universities back home without benefit of either peer review or floor debate. In addition, the URI budget line is said to include a proposal to renew a university instrumentation program similar to one DOD ran in the mid-1980s; it would get \$50 million in 1994. Then, too, the Pentagon

budget lists \$29.5 million for so-called focused research initiatives, which are those high-technology and education programs that are the special themes identified by the interagency Federal Coordinating Council on Science, Engineering and Technology and the White House Office of Science and Technology Policy.

Clinton's budget asks for \$12.5 billion to cover the cost of six FCCSET initiatives—on advanced materials and processing, high-performance computing and communications, glo-

National Science Foundation physics-related programs

	FY 92 actual	FY 93 request (millions of dollars)	FY 93 current	FY 94 request
Mathematical and physical sciences				
Physics research				
Elementary particles	44.7	48.4	40.5	45.8
Nuclear sciences	44.8	48.4	40.3	43.7
Atomic, molecular and optical	17.8	19.0	18.5	20.9
Theoretical	20.3	20.8	18.7	20.9
Gravitational	10.6	11.9	10.3	11.3
Total physics	138.1	148.6	128.2	142.6
Materials research				
Condensed matter physics	23.0	29.1	24.6	28.6
Solid-state chemistry and polymers	20.8	24.7	22.1	24.1
Metals, ceramics and electronic materials	21.8	27.8	23.2	25.2
Materials theory	12.2	14.8	13.0	14.6
National facilities and instrumentation	17.7	19.7	18.4	22.1
Materials research centers and groups	48.1	51.4	49.5	56.4
Total materials research	143.5	167.5	150.7	171.0
Chemistry, including physical chemistry	112.1	126.0	112.2	130.9
Mathematical sciences	78.4	85.0	77.6	88.0
Astronomical sciences				
Solar system, stellar evolution and galactic studies	38.0	41.6	36.1	40.8
National Astronomy and Ionosphere Center*	10.5	11.1	9.8	9.1
National Optical Astronomy Observatories, including Kitt Peak and Cerro Tololo	28.5	29.5	27.6	31.2
National Radio Astronomy Observatory, including enhanced operation of VLBA	35.3	37.8	29.9	32.9
Major research facilities				
National High Magnetic Field Laboratory**	10.0	14.0	14.0	12.0
Laser Interferometer Gravitational Wave Observatory	15.9	48.0	20.0	43.0
Gemini 8-meter optical-infrared telescopes	12.0	17.0	14.0	17.0
Geosciences				
Atmospheric sciences research, including global climate studies	68.5	79.3	69.5	81.9
National Center for Atmospheric Research	51.4	64.7	50.2	59.2
Upper atmospheric facilities	6.6	7.9	6.7	7.9
Earth sciences, including geophysics, earthquake prediction and nuclear waste disposal	75.9	88.1	75.8	89.7
Ocean sciences, including global climate processes	90.0	109.2	93.3	112.6
Oceanographic centers and facilities	51.2	59.3	48.1	56.8
Ocean drilling program	36.2	37.8	36.3	40.5
Total geosciences	379.8	446.4	379.8	448.6
Computer and information science and engineering				
Theory and research	34.8	43.0	34.8	46.1
Information, robotics and intelligent systems	26.9	36.8	27.0	40.6
Microelectronic information processing systems	21.4	30.4	21.5	32.8
Advanced scientific computing, mainly at NSF's four supercomputing research centers	69.4	86.7	69.5	91.3
Networking (NSFNet) and communications research	35.4	48.1	40.0	54.9
Cross-disciplinary activities, including demonstration projects in education and teacher training	22.4	27.1	22.5	30.3
Total computer and information science and engineering	210.4	272.2	215.2	296.0
Academic research facilities and instrumentation				
Research facilities renovation and modernization	16.5	0	35.0	27.5
Research instrumentation	16.8	33.0	15.0	27.5
Critical Technologies Institute***				
	0	1.0	1.0	1.0
Education and human resources				
Systemic reform, including Statewide Systemic Initiatives, instructional materials and EPSCOR	44.5	76.0	85.7	103.0
Elementary and secondary education	198.1	191.4	188.5	198.0
Undergraduate education	60.7	63.0	61.7	74.8
Graduate education and research development	55.6	57.9	62.5	66.5
Human resource development	46.3	50.1	48.9	65.9
Research, evaluation and dissemination	36.3	41.2	40.3	48.0
Total education and human resources	441.4	479.5	487.5	556.1

*Upgrade of the 305-meter radio-radar telescope at Arecibo, Puerto Rico, is cost-shared with NASA.

**Full operation of the laboratory is scheduled for 1994, following total expenditure of \$140 million, more than half provided by the State of Florida.

***This institute, created by Congress in the Department of Defense Authorization Act of 1992, provides analytic support to the White House Office of Science and Technology Policy and collects data for the Federal Coordinating Council on Science, Engineering and Technology. While the institute is funded in the NSF budget, it is operated by the Rand Corp.

bal climate change, manufacturing technology and science, biotechnology research and science, and math and engineering education. These six programs, says Gibbons, who chairs FCCSET in his capacity as director of OSTP, are "a dynamic list of topics." All were inherited from the Bush Administration, with the blessing of Gibbons's predecessor, D. Allan Bromley. It was Bromley who argued that the government could carry out no more than five or six of these high profile programs because of the time and resources required to coordinate the initiatives among as many as a dozen departments or agencies.

During the Bush years, FCCSET programs were known as Presidential Initiatives. Whether bearing that title or the new name of strategic initiatives, the programs are unpopular with many academic scientists and with some agency officials who would prefer that the money go to the normal channels of allocation—that is, to investigator-initiated research. Advocates of the FCCSET initiatives argue that the initiatives benefit traditional research programs because by allocating most of the money to applied objectives neither Congress nor the agencies are likely to raid basic science funds.

Object lesson in funding

The crux of the problem for funding basic research is how it is perceived by most members of Congress. Basic research has a relatively small and dispersed constituency that carries little weight and contributes few dollars for lawmakers. What happened to Clinton's stimulus package is a case in point: After weeks of stalemate, on 26 May the House passed a \$931.5 million supplementary appropriations bill instead of the Administration's \$16.3 billion package. The House version had none of the funds for NSF, NIST or NOAA that Clinton had sought. Instead, the House made sure that the bill covered summer jobs for inner-city youths and public works projects for favored districts, as well as increased funds to states and cities for community police service and to Amtrak. To offset the new expenditures, House members cut the current budgets for NOAA (to delay building a semitropical research station at Key Largo, Florida), for NASA (to stretch out several construction projects), from Federal prison improvements and from Department of Education programs in student financial assistance, library services and the Excellence in Mathematics, Science and Engineering Education project. In the debate on the House floor over

this spending bill, several lawmakers warned that the cuts would have adverse effects on needy college students, higher education programs and scientific research. Their forebodings were ignored.

In postmortems of such actions on Capitol Hill, it is frequently observed that "the devil is in the details." The 1994 budget allocations to the 13 House Appropriations subcommittees are another case in point. In the budget sent to the Hill, the Administration asked for at least \$6.8 billion more in direct spending than the ceiling set by Congress in its budget resolution. It happens that Clinton's so-called investment initiatives almost equal the entire overrun. To lawmakers the consequence is clear: Discretionary spending needs to be trimmed below the Clinton budget request for all 13 appropriations bills. To that end Pentagon outlays for next year would be held to \$255.6 billion, which is \$2.3 billion below the amount the Administration proposed. Energy and water, which includes the DOE budget, would get to spend \$21.7 billion, down \$163 million from Clinton's request and just about even with the current spending allotment. The outlay available to agencies and departments operating in the VA, HUD and independent agencies budget would be nearly \$70 billion, a boost of 8.6% over the current year but 1.2% below Clinton's budget. Within this spending plan, NSF's request for research funds would be chopped from an 18% increase to one of 10%—an increase that raises some doubts about how this would be allocated, considering the prominence of the FCCSER initiatives and several large construction projects in the foundation's portfolio.

Here are some highlights of the fiscal 1994 budget by agency:

National Science Foundation. Amid the many budgets that are nearly flat after inflation, NSF's stands out. Clinton's proposed \$446.7 million (or 16%) increase for the agency, of which \$345.8 million would go to research programs (an increase of 18%), was cheered by individual investigators, but its chances of passage as it stands now appear unrealistic. It also isn't exactly certain if core research would benefit from any additional dollars or if the money would be used to foster closer ties between industrial scientists and university researchers—a conundrum that still seems to perplex the National Science Board, the agency's policy-making body, ever since the Commission on the Future of NSF issued its report (see PHYSICS

Department of Defense basic research funding (6.1 budget category)

	FY 92 actual	FY 93 request (millions of dollars)	FY 93 current	FY 94 request
Army				
Research sciences, including physics and materials	186.6	166.6	202.0	203.7
In-house laboratories, independent research	8.8	6.7	11.7	11.0
Electromagnetics and hypervelocity physics	2.9	3.9	3.7	3.7
Navy				
Research sciences, including physics and materials	377.0	457.4	408.8	416.9
In-house laboratories, independent research	14.0	16.2	16.7	17.0
Air Force				
Research sciences, including physics and materials	201.3	237.4	235.8	241.3
In-house laboratories, independent research	6.0	9.8	4.7	5.2
Geophysics	36.9	42.5	39.1	40.0
Advanced Research Projects Agency				
Research sciences, including physics and materials	115.8	126.1	109.6	79.7
Materials and electronics sciences	71.0	71.8	60.5	46.0
Materials and electronics technology	198.4	255.4	255.1	198.5
Information sciences	44.8	49.5	49.2	33.7
Office of Secretary of Defense				
Research sciences	0	0	0	2.0
In-house laboratories, independent research	0	0	0	3.4
Universities research initiatives*	219.6	99.9	317.1	242.6
Focused research initiatives	0	0	0	29.5
Ballistic Missile Defense Organization**	3906.9	5400.0	3724.8	3637.1

*Includes \$116 million for Congressional earmarks, also known as "pork-barrel" allocations in FY 1992 spending and \$176 million for pork projects at universities in FY 1993.

**Renamed from Strategic Defense Initiative Organization.

NOAA physics-related programs

	FY 92 actual	FY 93 request (millions of dollars)	FY 93 current	FY 94 request
Oceanic and atmospheric research				
Interannual and seasonal climate, including studies of El Nino-Southern Oscillation	8.2	8.3	7.9	7.9
Long-term climate and air quality, including high-performance computing and high-performance computing and high-speed networking	25.5	27.7	25.0	31.1
Climate and global change	47.0	78.3	47.0	69.9
Weather research, including numerical models and forecasting techniques	35.8	35.1	33.7	36.7
Solar-terrestrial research and monitoring services	5.4	5.6	4.9	5.4
Marine prediction, including numerical modeling	16.1	13.7	16.4	17.2
National Undersea Research Program	15.2	0	16.0	2.0
	153.2	168.7	150.9	170.3

National Institute of Standards and Technology physics-related budget

	FY 92 actual	FY 93 request (millions of dollars)	FY 93 current	FY 94 request
Scientific and technical research and services				
Physics	25.5	28.2	26.4	26.9
Materials science and engineering	27.7	38.6	35.6	47.2
Chemical science and technology	18.5	20.9	19.3	23.1
Applied mathematics and scientific computing	6.5	6.8	6.8	7.0
Computer systems	11.8	12.2	12.1	37.1
Electronics and electrical measurements	25.0	29.3	26.5	30.7
Industrial technology services				
Advanced Technology Program	49.9	67.9	67.9	199.5
Manufacturing Extension Partnership	16.9	17.8	18.2	30.2
Quality improvement program	0	0	0	2.8

NASA physics-related programs

	FY 92 actual	FY 93 request (millions of dollars)	FY 93 current	FY 94 request
Physics and astronomy				
Advanced X-Ray Astrophysics Facility development	150.7	174.0	168.3	260.3
Global geospace science: Solar-terrestrial program	75.3	60.1	72.6	13.3
Gravity Probe-B development	0	0	1.9	40.0
Shuttle-Spacelab payload support	78.8	101.1	94.0	0 *
Payload and instrument development**	118.3	78.2	99.3	53.4
Explorer missions development	109.1	112.5	115.8	123.3
Mission operations and data analysis				
Hubble Space Telescope operations and servicing	207.7	214.2	216.7	222.2
Hubble Space Telescope data analysis	36.0	42.3	42.4	38.5
Astrophysics mission operations and data	85.3	100.5	88.3	84.5
AXAF mission operations and data	3.3	14.9	14.9	11.6
Space physics mission operations and data	42.9	69.0	53.2	59.4
Supporting research, analysis and new concepts	69.9	81.4	71.6	72.2
Suborbital programs				
Sounding rockets	34.2	37.3	36.4	39.5
Airborne science and applications	12.0	12.6	13.0	13.6
Balloon program	13.9	15.4	15.4	16.4
Information systems, including advanced computing applications, data management and networking	0	0	0	26.5
Total physics and astronomy	1036.7	1113.5	1103.9	1074.7
Planetary exploration				
Mars Observer development	85.0	0	0	0
Mars balloon relay for Russia's Mars '94 mission	1.2	0	0	0
Mars '94 lander instruments	0	0	3.5	3.5
Cassini development	210.7	210.0	204.9	206.6
Mission operations and data analysis				
Galileo operations	57.7	63.0	59.4	57.6
Magellan operations	45.1	7.0	7.0	5.1
Mars Observer operations	0	45.6	40.5	34.3
Pioneer mission operations	10.6	0	0	0
Voyager-Neptune data analysis	4.3	6.0	5.0	5.7
Planetary flight support	43.0	48.7	51.5	58.0
Supporting research, analysis and new concepts	76.0	106.9	101.7	126.4
Total planetary exploration	534.2	487.2	473.6	557.2
Mission to Planet Earth				
Earth Observing System (EOS)	176.4	308.4	263.8	322.7
Earth Observing System data information operations	77.7	82.6	130.7	182.7
Earth probes, including Scatterometer and				
Total Ozone Mapping Spectrometer	77.8	88.9	99.4	97.3
Advanced Communications Technology Satellite	18.7	3.6	4.0	3.0
Ocean Topography Experiment/Poseidon	65.0	0	0	0
Payload and instrument development	37.9	49.4	35.5	22.9
Mission operations and data analysis	100.6	142.1	147.6	160.8
Interdisciplinary research	2.3	2.6	4.5	5.0
Modeling and data analysis	45.8	45.0	42.6	45.0
Process studies				
Radiation dynamics and hydrology	33.2	34.0	31.6	34.7
Ecosystems dynamics and biochemical cycles	23.3	23.1	23.7	26.8
Atmospheric chemistry	29.9	30.3	28.1	32.0
Solid Earth science	25.9	30.2	27.7	28.7
Laser research facilities for crystal deformation studies	9.3	9.0	8.2	9.3
Airborne science and applications	20.3	22.9	20.7	25.2
Mission to Planet Earth information systems	0	0	0	11.8
Research operations support	83.9	98.0	70.1	67.0
Total Mission to Planet Earth	828.0	970.1	937.9	1074.9
Academic programs				
Graduate student researchers	7.0	8.2	7.0	7.6
Summer faculty fellowships at NASA centers	4.0	4.0	3.9	4.1
Innovative research at universities and colleges	2.9	3.1	2.9	3.0
Mission to Planet Earth joint ventures with faculty	2.8	2.8	2.6	2.7
Aerospace education services	6.1	7.0	6.5	6.9
Innovative education at pre-college levels	5.5	7.6	5.3	6.0
Educational technology, including software	1.5	1.0	4.2	1.5
Special projects	0	0	19.4	0
EPSCOR	0	0	5.0	5.0
Minority university research and education	22.0	22.7	22.7	23.2
Space grant colleges and fellowships	15.0	15.0	13.4	14.5
Total academic programs	66.8	71.4	92.9	74.5
Space Station Freedom and new technology	2002.7	2250.0	2122.5	2300.0

*The Shuttle-Spacelab mission management and payloads program will be transferred to the Life and Microgravity Sciences and Applications program starting in FY 1994.

**This includes design and testing for a variety of instruments, including quartz gyroscopes for Gravity Probe-B, ground stations to support Japan's Very Long Baseline Interferometry Space Observatory (planned for 1995) and Russia's Radioastron program (1997), as well as the stellar x-ray polarimeter for Russia's Spectrum-x-Gamma mission (1995) and the ultraviolet spectrometer and spectrograph for the German-US Shuttle Pallet Satellite (1993).

TODAY, December 1992, page 70).

NSF has been under pressure from researchers to increase the size of grants, now averaging about \$50 000, and from lawmakers to provide more grants, now about 21 000. Before leaving the foundation at the end of April, Walter E. Massey, then its director, told Congress the first priority was to augment existing grants to offset the rising cost of scientific equipment, to support graduate students and postdocs, and to allow researchers to complete the work they planned.

The budget request includes \$6.5 million for new environmental research, including \$1 million to launch the National Center for Ecological Synthesis and Analysis. NSF planned to start the center this year, but Congress failed to appropriate the funds. By adding \$44 million to its High-Performance Computing and Communications program, the agency would spend \$305 million in 1994 on Vice President Gore's pet plan to create a national data superhighway. The foundation's program for mathematics and science education would continue to rise by leaps and bounds, to \$622 million. The budget also calls for \$17 million to proceed in building two Gemini 8-meter optical-infrared telescopes (one in Hawaii, the second in Chile) and \$43 million for the Laser Interferometer Gravitational Wave Observatory (one in Louisiana, the other in the state of Washington). LIGO has been an acrimonious topic among astronomers and physicists almost from the day it was proposed seven years ago as an \$80 million project to detect the elusive gravitational waves predicted by Einstein's theory of general relativity. It now has a \$250 million price tag, which some believe will cause big dents in NSF's budgets for years.

Department of Energy. The proposed \$19.6 billion budget for DOE reflects the Clinton Administration's aim of creating clean sources of energy, improving energy efficiency, protecting the environment and using the national labs to support technological advances, create new jobs and reduce chances for nuclear proliferation. Energy Secretary Hazel R. O'Leary boasts of "reinventing" the department and "substantially redirecting" its R&D priorities. That means eliminating many projects on advanced nuclear power reactors and reducing nuclear weapons activities. DOE's budget for defense programs would drop from \$7.2 billion to \$5.9 billion. Meanwhile, environmental restoration and waste management, which includes cleaning up the de-

crepit nuclear weapons complex, would increase from \$5.5 billion to \$6.5 billion.

Emphasizing Clinton's—or perhaps Gore's—"green" views, the big winners at DOE would be solar and other renewable energy sources (up 27% to \$327 million) and biological and environmental research (up 17% to \$416 million). Losers include nuclear energy research, whose current \$345 million budget is to be lopped in half, as well as basic energy sciences, which would fall about 2% from its 1993 figure of \$814 million. In particle and

nuclear physics and in fusion research, the bottom lines show small gains in most instances, but even there the increases go for construction, leaving the core science programs with little more than cost-of-living gains of around 3%. The budget seeks \$20 million to start work on the Tokamak Physics Experiment at the Princeton Plasma Physics Laboratory, \$26 million to begin the Advanced Neutron Source at Oak Ridge National Laboratory and \$36 million to create an asymmetric "B-factory"—an accelerator producing B

mesons—which would go up at either SLAC or Cornell University. Fermilab, which wanted \$100 million to hasten the upgrade of its main injector, may have to settle for the \$25 million in DOE's budget, and the SSC under Clinton's plan would get not the \$860 million called for in the building program but \$640 million and a stretch-out of three years. Worse, the venerable Los Alamos Meson Physics Facility is to be scuppered, with just \$1.5 million allowed for closing it down.

—IRWIN GOODWIN

HAPPER LEAVES DOE UNDER OZONE CLOUD FOR VIOLATING POLITICAL CORRECTNESS

These are turbulent times in Washington for science. Consider the case of William Happer, who was dismissed from his post as director of energy research at the Department of Energy after opposing the prevailing views of Vice President Al Gore Jr and his environmental aides on the harmful effects of ozone depletion and greenhouse gases on the Earth's environment and on human health. Happer's dispute with Gore's people is the first instance of the Clinton Administration enforcing its version of "political correctness" on scientists in its midst. The sacking of Happer, a former Princeton University physics professor with impressive credentials, raises questions about whether the Administration will be able to recruit scientists for sensitive positions when science conflicts with politics.

As a holdover from the Bush Administration, Happer was not expected to stay on in the Clinton Administration. The White House could easily have dumped him in favor of its own choice for top scientist at DOE. Instead, after President Clinton's inauguration, Happer was asked to remain at his post until a successor could be appointed. Energy Secretary Hazel R. O'Leary, a former electric utility lawyer and energy regulator in the Ford and Carter Administrations, as well as John H. Gibbons, the President's science adviser, had received enthusiastic messages about Happer from scientist members of the Clinton transition team, from DOE lab directors and from lawmakers in Congress. They called for Happer to be kept on. O'Leary agreed to hold on to Happer, and so did Gibbons, but Gore and his teammates thought otherwise. As George Brown Jr, the California Democrat who heads the House Committee on Science, Space

and Technology, observed: "Happer marches to a different drummer than Al Gore. Will is a pure scientist. Al Gore is a politician."

Widely regarded as a leading authority on laser spectroscopy and optical pumping of spin-polarized nuclei, Happer was plucked from Princeton by the Bush White House in May 1991 to serve at DOE (PHYSICS TODAY, September 1991, page 65). He was confirmed easily by the Senate in August of that year. Even so, the job was not expected to be easy—and as it turned out, it wasn't. Sidney Drell, deputy director of SLAC, had it exactly right when he forecast that Happer was "stepping into a caldron" at DOE. One of Happer's first assignments was to get the nuclear and particle physics communities to agree on scientific priorities in the face of severe budget restraints. He was distressed to find he couldn't obtain consensus.

Opposing an apocalyptic vision

Signs of Happer's heterodoxy on prevailing environmentalist positions first appeared at a meeting of the Federal Coordinating Council on Science, Engineering and Technology more than a year ago, during the Bush Administration. On that occasion he opposed the apocalyptic vision of an environmentally ravaged Earth, the theme of Gore's best-selling book, *Earth in the Balance: Ecology and the Human Spirit* (Houghton Mifflin, 1992). At the meeting Robert T. Watson, then chief scientist for NASA's Mission to Planet Earth (which uses satellites to study global climate change), delivered a scary account of increases in greenhouse gas emissions that could cause global warming and of exposure to cancer-causing ultraviolet radiation resulting from atmospheric ozone depletion. When Wat-

son spoke of an "ozone hole over Kennnebunkport," President Bush's summer retreat, Happer, visibly angry according to eye witnesses, interrupted the discourse, calling the concept rubbish, only using a more colorful epithet.

Happer argued that knowledge of the interactions controlling climate and understanding of abrupt atmospheric perturbations are incomplete and inexact. For starters, he urged FCCSET to endorse setting up a network of instruments to monitor the "discrepancy" between predicted levels of uv-B, normally blocked by stratospheric ozone, and the actual levels of uv-B measured at the Earth's surface. Happer explained that most of the ground measurements of uv-B are now made at airports, where chemical pollutants in the ambient air are apt to upset the readings.

The FCCSET incident quickly became a cause célèbre among Washington environmentalists. The staff of the Senate Subcommittee on Science, Technology and Space, which Gore headed at that time, characterized Happer's doubts about the extent of a greenhouse effect as "the Bush White House effect."

After Clinton's election, Happer continued to press for new and better placed instrumentation to measure uv-B. Among those who reviewed Happer's ideas on this subject was Watson, who is rumored to be in line for a top job at the White House Office of Science and Technology Policy. It also was looked at by Kathleen McGinty, who served as legislative assistant for energy and environmental issues for Gore in his last years in the Senate and is now director of the newly formed White House Office of Environmental Policy, created at Gore's insistence. The response, not