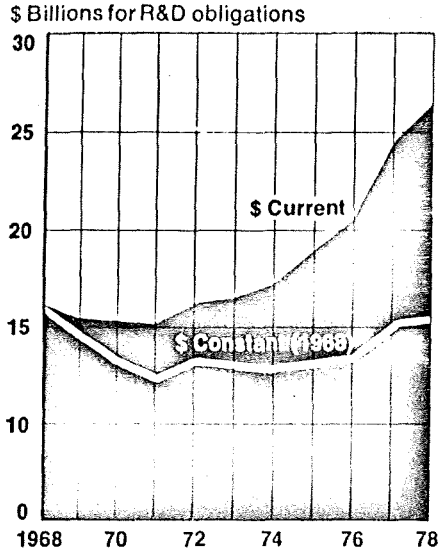
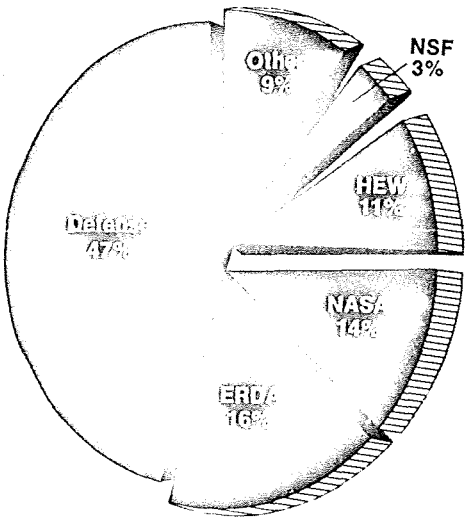
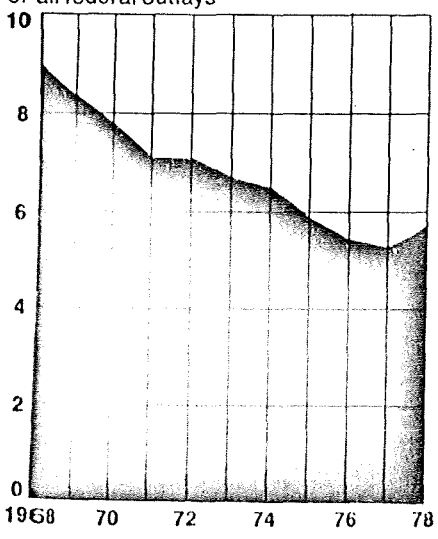
R&D funds will rise by slim margin in constant terms . . .

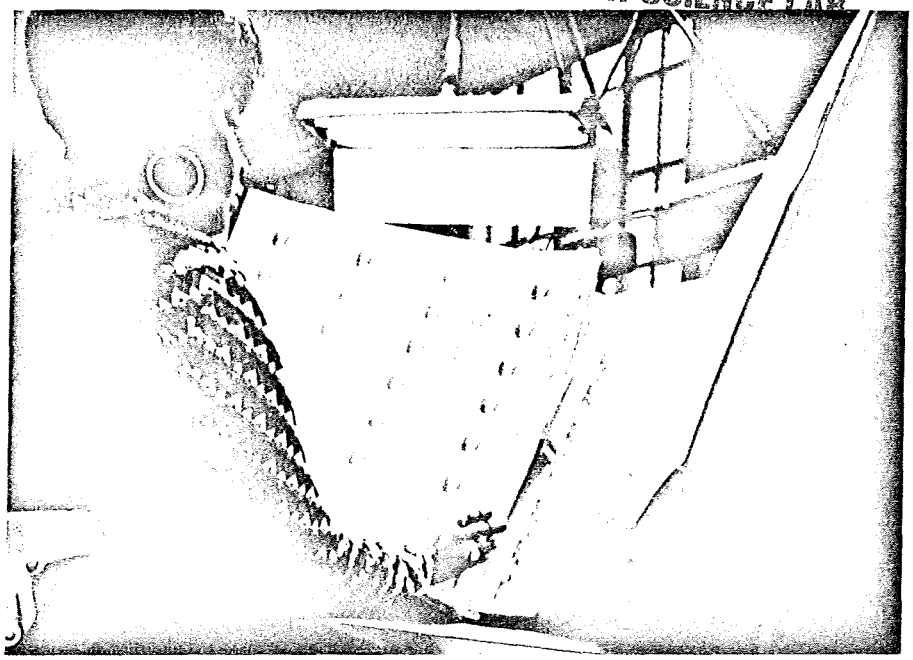


. . . as defense continues to get largest share . . .



. . . and total R&D funds remain at 6% of budget





Federal R&D funding seems set for moderate growth

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C&EN, Washington

Shortly before the end of his term, President Ford sent to Congress his proposed federal budget for fiscal year 1978. It proposes outlays of $440 billion in fiscal 1978, up 6.5% over 1977 levels, and estimates receipts at $393 billion, for a deficit of $47 billion. It also proposes increasing funding 8% for federal R&D programs to $26.3 billion. Ford's budget again places strong emphasis on basic research, with funding for this area slated to rise 9.2% to $3.04 billion.

These 1978 figures are far from firm. Final funding figures for fiscal 1978 will reflect changes recommended by the Carter Administration and the actions of Congress, which has long been known for its unwillingness to accept Presidential budget figures without some, in many cases drastic, changes. The new Administration must submit its proposed budget changes to Congress by about the first of March. So it is unlikely that the new Administration will be able to make major changes in many portions of the budget. Most likely areas for action are tax cuts, job programs, and energy programs. But it probably won't be until President Carter submits the fiscal 1979 budget that his proposals can be fully implemented.

The federal R&D budget for fiscal 1978 would be particularly hard to change. As former Presidential science adviser H. Guyford Stever notes, the federal R&D budget is not an integrated entity. It is the sum of bits and pieces of decisions made in the course of reviewing the budgets of various federal agencies involved in R&D. In addition, Stever points out that the Ford budget was put together with substantial input from people, both inside and outside government, working in the field. Thus, Carter probably would get the same advice Ford did on where the money should go.

More than likely, the new White House Office of Science & Technology Policy, which Stever headed, played an active role in shaping the R&D budget. Representatives of OSTP participated in most meetings between the agencies and the Office of Management & Budget, which has the final word on how much money is spent where, to determine R&D funding priorities and levels. In addition, Stever says, OSTP was in contact with Carter's transition people explaining, in as much detail as possible in the time allowed, judgments made in arriving at final R&D budget figures.

Carter's representatives apparently agreed with three major R&D initiatives included in Ford's proposed budget. These are a 35% increase, to $54 million, as the first stage of a multiyear program directed at earthquake prediction and monitoring; $27.6 million earmarked for

beginning a new competitive grant program in basic agricultural research; and a 58% increase to $313 million in nuclear fuel cycle R&D.

The Defense Department, according to figures from OMB, still accounts for the major portion, 46.8% or $13.1 billion, of the federal R&D budget. This represents a 10% increase over fiscal 1977 funding levels. Obligations for space R&D would increase only 3.2%, well below OMB's estimated 6% inflation rate, to $3.2 billion. And obligations for civilian R&D (other than space) would increase 5.3% to $10 billion. Ford also proposed increasing funding for federal support of research at colleges and universities 7.1% to $3.2 billion, and increasing funding for research facility construction and renovation 12.4% to $1.64 billion.

The Energy Research & Development Administration gets the largest chunk of the civilian R&D money. Obligations for fiscal 1978 would be set at $5.08 billion, a rise of 18.3% over fiscal 1977 levels and of 74.4% over fiscal 1976. Of this total, $427 million would be obligated for basic research, $531 million for applied research, $4.1 billion for development, and $1.0 billion for R&D facilities. ERDA's outlays (actual money spent or paid out) are forecast to total $4.4 billion in fiscal 1978.

About $2.1 billion of ERDA's budget will go for nuclear work. For example, funding for the liquid-metal fast breeder reactor program would be increased $176.5 million to support initiation of major construction activities on the Clinch River breeder reactor and activation of the fast-flux test facility. Funding for fusion research would increase 23% to $512.9 million, including $94 million for initiation of a magnetic mirror experiment at Lawrence Livermore Laboratory.

In the nonnuclear area, a major increase in obligations is scheduled for fossil fuel energy R&D, up 29% to $614.4 million. Major initiatives will include small-scale multiple parallel demonstrations on direct combustion and gasification of coal, implementation of carbon dioxide gas injection to enhance oil and gas recovery, and cost-shared activities to recover oil from shale. And somewhat optimistically, considering two previous defeats in the House, ERDA again is requesting $295 million for federal loan guarantees and price supports for synthetic fuels commercial demonstration projects. Proposed funding for solar research is up 5% to $305 million, conservation up 5% to $161 million, and geothermal up 61% to $88 million.

For the National Science Foundation, President Ford's budget obligates $885 million, about $87 million—or 11%—over fiscal 1977 program levels. According to Dr. Richard C. Atkinson, acting director of NSF, more than $20 million, or about 24%, of the $87 million increase will be used to investigate fundamental laws, processes, and phenomena, including such things as synthesis and reaction mechanisms and catalysis. Nearly $28 million will be used for the purchase of modern scientific equipment and to upgrade instrumentation. About $40.6 million of the increase is for research in the general area of environment and resources, including $10.4 million for studies of the atmosphere and the oceans related to weather and the impact of pollution, and $9.6 million to accelerate research on earthquake engineering. And about $2.5 million of the proposed increase will be devoted to basic and applied research on chemical processing techniques and various aspects of materials science.

In contrast to the past fiscal year, all of NSF's major program areas are scheduled for increased funding in fiscal 1978. Largest increases include obligations for the directorate of mathematical and physical science and engineering (which includes chemistry), up $26.6 million; astronomical, atmospheric, earth, and ocean sciences, up $24.7 million; and biological, behavioral, and social science, up $18.3 million.

The biggest new item in the agricultural area is the Department of Agriculture's ambitious five-year, $150 million proposal for competitive basic research grants to universities, private laboratories, and other government agencies. Intended to boost crop yields through research into photosynthesis, nitrogen fixation, genetic engineering, and plant protection (pest control), $27.6 million has been built into the Agricultural Research Service allotment to kick off the program in fiscal 1978. Although funds for this new program largely account for the roughly 13% hike from ARS's 1977 budget of $290.1 million, the money represents a more than 10-fold increase in spending for crop improvement over the past fiscal year. The idea, of course, is to get more from the land already in use, since, as OMB points out, increased acreage is unlikely to contribute much to additional U.S. food production.

However, a number of agencies' R&D programs did not fare quite so well under Ford's proposed budget. For example, increases for the National Aeronautics & Space Administration just about kept abreast of anticipated inflation. For fiscal 1978 Ford proposes increasing NASA's obligation $296 million, or 7.9%, to $4.0 billion. More than half of that increase ($152 million) is for procurement and production of five space shuttles. Whether NASA would have gotten even that much of an increase except for President Ford is hard to tell. According to Stever, Ford himself decided that NASA should be allowed to proceed on schedule with production of the first two space shuttles and to continue work on three others. The NASA budget also includes funding for a space telescope to be launched by the space shuttle in 1983, initial funding for a five-year $280 million program on Jupiter probes, and initial funding for a $182 million, six-year program to develop a new LANDSAT D satellite.

Other major program increases at NASA are for materials processing in space, up 74% to $15.5 million; life sciences, up 50.5% to $33.3 million; space communications, up 47% to $22.8 million; and earth resources detection and monitoring, up 42.2% to $92.0 million. These increases, however, are offset by decreases in other areas. For example, funding for lunar and planetary exploration, down

Funding for basic research shows solid gain in 1978

$ Millions	1977[a]	1978[a]	Increase 1977–78
HEW	$744	$796	7.0%
NSF	612	688	12.4
ERDA	389	427	9.8
NASA	352	365	3.7
Defense	274	314	14.6
Agriculture	193	215	11.4
All other	221	236	6.8
TOTAL	$2785	$3041	9.2%

a Estimates. Note: Obligations for fiscal years ending Sept. 30, except for 1976, which ended June 30.

Glossary of budget terms

Authorization. Basic substantive legislation (as opposed to appropriations) enacted by Congress that sets up a federal program or agency either indefinitely or for a given period of time. Such legislation sometimes sets limits on the amount that subsequently can be appropriated, but does not usually provide budget authority.

Deferral. Any executive branch action or inaction that delays the availability of budget authority for obligation. Deferrals may not extend beyond the end of the fiscal year and may be overturned at any time by either house of Congress.

Fiscal year. Year running from July 1 to June 30 for fiscal year 1976. All subsequent fiscal years will begin Oct. 1 and end Sept. 30. The fiscal year is designated by the calendar year in which it ends.

Obligations. Commitments made by federal agencies to pay out money for products, services, or other purposes, as distinct from the actual payments. Obligations incurred may not be larger than the budget authority.

Outlays. Checks issued, interest accrued on the public debt, or other payments made, net of refunds and reimbursements.

Rescission. Enacted legislation canceling budget authority previously granted by Congress. Rescissions proposed by the President must be approved by Congress within 45 days in order to become effective.

The total federal R&D package

Federal R&D money breaks down by agency like this

$ Millions	Obligations			Outlays		
	1975[a]	1976[b]	1977[b]	1975[a]	1976[b]	1977[b]
Defense	$9,592	$11,132	$12,317	$9,329	$10,391	$11,919
NASA	3,488	3,800	3,833	3,521	3,557	3,745
ERDA	2,499	3,610	4,064	2,225	3,168	3,735
HEW	2,543	2,910	2,976	2,566	2,532	2,799
NSF	617	693	766	623	650	724
USDA	467	530	579	460	544	573
Interior	322	349	355	315	342	351
DOT	274	367	359	303	337	336
EPA	221	311	266	251	313	277
Commerce	228	247	250	224	243	258
NRC	94	122	148	81	114	138
VA	103	116	118	97	108	112
HUD	61	55	60	54	59	60
Other	185	219	231	184	216	224
TOTAL	$20,694	$24,461	$26,322	$20,233	$22,574	$25,251

a Actual. b Estimates. **Note:** Fiscal years ending Sept. 30, except for 1976, which ended June 30.

5% of outlays goes for new R&D facilities

$ Millions	Obligations			Outlays		
	1976[a]	1977[b]	1978[b]	1976[a]	1977[b]	1978[b]
ERDA	$412	$681	$1014	$370	$473	$670
Defense	141	468	347	141	166	311
NASA	94	146	161	120	125	133
NSF	52	39	47	50	37	45
DOT	14	25	22	12	20	19
USDA	16	23	15	9	35	23
HEW	28	25	15	45	31	21
Commerce	7	7	7	8	6	5
EPA	6	7	2	7	5	5
Other	31	34	6	22	36	16
TOTAL	$801	$1455	$1636	$784	$934	$1248

a Actual. b Estimates. **Note:** Fiscal years ending Sept. 30, except for 1976, which ended June 30.

11% will support research in colleges and universities

$ Millions	Obligations			Outlays		
	1976[a]	1977[b]	1978[b]	1976[a]	1977[b]	1978[b]
HEW	$1423	$1577	$1600	$1459	$1287	$1415
NSF	445	497	562	446	463	521
Defense	291	312	339	282	312	353
ERDA	144	170	223	129	152	200
USDA	125	141	169	115	145	156
NASA	119	117	120	111	116	119
EPA	33	42	38	31	31	34
Other	110	124	141	111	113	132
TOTAL	$2690	$2980	$3192	$2675	$2621	$2927

a Actual. b Estimates. **Note:** Fiscal years ending Sept. 30, except for 1976, which ended June 30.

13% to $148.2 million; weather and climate observation and forecasting, down 19.5% to $30.7 million; and ocean condition monitoring and forecasting, down 60% to $19.2 million.

EPA's proposed R&D budget of $261.3 million is a bare $1.8 million, or less than 1%, ahead of last year. It is part of a total agency budget that former administrator Russell E. Train has called "inadequate." Yet the agency says that by "redirecting" funds (cutting money from some programs and adding to others) new R&D emphasis would be put on improving water quality in line with recommendations from the National Academy of Sciences, finding out how environmental carcinogens contribute to U.S. cancer incidence, and looking into the health effects of pollutants produced by coal gasification and liquefication projects. At the same time, EPA says that solid waste research also would be expanded to try to live up to the Resource Conservation & Recovery Act of 1976. The agency, though, would have to set about all these good things with fewer people under the Ford Administration budget, which would cut 134 R&D staff positions from the fiscal 1977 level of 1800.

The biggest increase in R&D dollars in EPA's proposed 1978 budget is in solid waste research, jumping from $4.1 million to $7.7 million, up about 53%. Funding of most other R&D programs remains essentially flat (and in many cases actually decreases when inflation is figured in). Toxic substances R&D remains unchanged at $1.4 million from year to year, but funds for enforcement (not counted in R&D) are up a hefty $7.2 million, or 46%, from $15.5 million in 1977. R&D staff in the toxic substances program would remain unchanged, also at six positions, but permanent positions for administration of the act would increase a whopping 273 in fiscal 1978 from 43 last year.

Health research fares little better than environmental R&D in the budget proposals. When funds for buildings and facilities are excluded, NIH in fiscal 1978 would get about $40 million more, or $2.505 billion for health and related research. That's only about 1.6% more than the $2.465 billion provided in 1977, and it does not keep up with inflation. Of this total, the National Cancer Institute would get only $4 million more than the $815 million it did in fiscal 1977 for research, whereas the National Heart & Lung Institute at $404 million for 1978 would do a bit better with $7 million more than last year. All other NIH research would increase $30 million to $1.282 billion, up about 2.4%.

Despite these slender funding increases, NIH says, $4 million more would go to NCI for research into occupational carcinogenesis, part of a joint program with EPA. About $40 million also would go for basic research in immunology, virology, cell biology, and genetics in the form of grant funds. Under budget proposals, NIH also would look deeper into technology for safe recombinant DNA

How the agencies fare

NSF budget is set for a 14% hike following a 7% rise in 1977 . . .

$ Millions	1976[a]	1977[b]	1978[b]
Mathematical and physical sciences and engineering	$192.3	$222.6	$249.2
Astronomical, atmospheric, earth, and ocean sciences	171.0	188.7	213.4
Biological, behavioral, and social sciences	109.0	126.5	144.8
Research Applied to National Needs	72.0	63.9	78.0
Science education programs	62.5	59.0	75.7
Program development and management	42.2	45.5	47.8
U.S. Antarctic program	48.6	45.3	47.5
Scientific, technological, and international affairs	22.4	20.0	22.6
Special foreign currency program	4.4	4.6	6.0
TOTAL	**$724.4**	**$776.1**	**$885.0**

a Actual. b Estimates. **Note:** Obligations for fiscal years ending Sept. 30, except for 1976, which ended June 30.

. . . with funding of chemical research also up 14% to about $44 million

$ Millions	1976[a]	1977[b]	1978[b]	Increase 1977–78
Materials research	$46.1	$51.6	$60.6	17.4%
Physics	45.1	55.4	59.4	7.2
Ocean sciences	47.1	56.5	58.9	4.2
Physical, cellular, and molecular biology	43.7	51.1	58.9	15.3
Astronomical sciences	48.6	52.3	58.0	10.9
Atmospheric sciences	44.5	51.4	55.9	8.7
Engineering	35.8	42.6	46.1	8.2
Chemistry	34.7	40.2	44.3	10.2
Earth sciences	27.1	32.2	34.8	8.1
Environmental biology	26.8	30.6	33.6	9.8
Behavioral and neural sciences	19.7	23.6	28.3	19.9
Social sciences	18.8	21.4	24.0	12.1
Mathematical sciences	17.3	19.9	21.8	9.5
Computer research	13.2	15.5	17.0	9.7
TOTAL	**$468.6**	**$544.3**	**$601.6**	**10.5%**

a Actual. b Estimates. **Note:** Obligations for fiscal years ending Sept. 30, except for 1976, which ended June 30.

At EPA, energy, water, and air continue to account for bulk of R&D support

$ Millions	1976[a]	1977[b]	1978[b]
Energy	$83.0	$96.4	$96.4
Water quality	35.3	44.2	44.8
Air	35.8	44.0	39.6
Interdisciplinary	23.0	26.3	25.8
Water supplies	8.5	13.2	15.2
Pesticides	8.3	10.7	10.8
Solid waste	2.8	4.1	7.7
Toxic substances	0.8	1.4	1.4
Radiation	1.5	0.8	0.8
TOTAL	**$199.0**	**$241.1**	**$242.5**

a Actual. b Estimates. **Note:** Obligations for fiscal years ending Sept. 30, except for 1976, which ended June 30.

NASA budget will climb 8%

$ Millions	1976[a]	1977[b]	1978[b]
Conduct of R&D	**$2677**	**$2761**	**$3011**
Space shuttle	1206	1288	1349
Tracking and data acquisition	241	255	282
Space flight operations	189	202	268
Aeronautical research and technology	175	190	231
Space applications	178	198	229
Physics and astronomy	159	166	224
Lunar and planetary exploration	254	192	148
Expendable launch vehicles	166	151	137
Space research and technology	75	82	98
Life sciences	21	22	33
Technology utilization	8	8	8
Energy technology application	6	6	5
Research and program management	**792**	**845**	**847**
Construction of facilities	**82**	**118**	**162**
TOTAL	**$3552**	**$3723**	**$4021**

a Actual. b Estimates. **Note:** Obligations for fiscal years ending Sept. 30, except for 1976, which ended June 30.

NIH funding will move up only 1.5%

$ Millions	1976[a]	1977[b]	1978[b]
National institutes			
Cancer	$761	$815	$819
Heart and lung	369	397	404
General medical sciences	187	205	220
Arthritis, metabolism, and digestive diseases	175	209	217
Neurological and communicative disorders and stroke	140	156	161
Allergy and infectious diseases	126	141	153
Child health and human development	136	146	151
Eye	50	64	65
Environmental health sciences	37	49	58
Dental research	51	56	58
Aging	19	30	34
Research resources	130	138	102
Research facilities	8	67	66
National Library of Medicine	27	35	37
Office of the director	18	16	18
John E. Fogarty Center	6	8	8
TOTAL	**$2240**	**$2532**	**$2571**

a Actual. b Estimates. **Note:** Obligations for fiscal years ending Sept. 30, except for 1976, which ended June 30.

Most of ERDA's civilian R&D budget still goes for reactor work

$ Millions	Authorities[a] 1977	Authorities[a] 1978	Outlays[a] 1977	Outlays[a] 1978
FISSION REACTOR DEVELOPMENT	**$826.0**	**$1002.5**	**$711.8**	**$870.9**
Liquid-metal fast breeder reactor	685.7	854.7	594.2	736.0
Other fission	140.3	147.8	117.6	134.9
FOSSIL ENERGY	**475.9**	**614.4**	**443.9**	**494.4**
Coal	362.0	443.6	358.0	369.4
Liquefaction	73.0	107.4	85.0	110.0
Direct combustion	51.9	49.4	56.8	55.0
Demonstration plants	100.3	99.9	68.1	50.2
Low-Btu gasification	33.1	69.4	39.9	45.0
High-Btu gasification	44.1	51.5	58.8	43.0
Advanced research and supporting technology	37.1	40.3	36.6	42.2
Advanced power systems	22.5	25.7	12.8	24.0
Petroleum and natural gas	43.0	53.1	36.5	52.6
Gas and oil extraction	38.8	50.1	33.1	49.2
Supporting research	4.2	3.0	3.4	3.4
Magnetohydrodynamics	40.0	50.5	29.0	37.3
In-situ technology	30.9	41.5	20.4	35.1
Oil shale	22.7	28.9	13.7	22.1
In-situ coal gasification	8.2	12.6	6.7	13.0
NUCLEAR FUEL CYCLE AND SAFEGUARDS	**357.7**	**636.3**	**299.6**	**490.9**
FUSION POWER DEVELOPMENT	**415.9**	**512.9**	**322.2**	**431.0**
HIGH-ENERGY PHYSICS	**223.8**	**269.3**	**199.8**	**237.4**
SOLAR ENERGY	**290.4**	**305.0**	**183.1**	**234.6**
Solar electric applications	171.9	223.8	104.3	150.2
Heating and cooling	86.5	44.9	60.9	61.2
Fuels from biomass	12.7	17.0	5.7	9.6
Agricultural, process heat	7.8	10.3	5.0	7.6
Technology support	11.5	9.0	7.2	6.0
ENVIRONMENTAL RESEARCH	**180.9**	**209.8**	**175.1**	**198.1**
BASIC ENERGY SCIENCES	**153.9**	**172.8**	**134.9**	**159.9**
Material sciences	74.8	77.5	60.1	71.5
Molecular, mathematical, and geosciences	50.7	65.4	47.6	56.1
Nuclear sciences	28.4	26.7	27.2	29.3
Advanced energy projects	—	3.2	—	3.0
BASIC RESEARCH AND TECHNOLOGY DEVELOPMENT	**149.1**	**161.0**	**140.7**	**151.7**
Nuclear physics	80.8	85.8	75.5	84.1
Life sciences and biomedical applications	44.4	39.1	41.6	37.7
Space nuclear systems	22.6	35.1	22.6	28.9
Nuclear explosives applications	1.3	1.0	1.0	1.0
CONSERVATION	**153.4**	**161.0**	**118.9**	**140.0**
Transportation energy	27.7	36.5	24.0	31.4
Improved conversion efficiency	23.7	32.6	12.7	29.2
Energy storage systems	33.5	32.6	27.5	28.7
Electric energy systems	26.5	25.3	20.7	21.8
Buildings, community systems	26.6	21.6	22.6	18.7
Industrial energy	15.4	12.4	11.4	10.2
GEOTHERMAL	**54.7**	**88.0**	**49.0**	**68.0**
Hydrothermal technology applications	14.4	20.6	11.1	16.3
Resource exploration, assessment	9.3	18.1	8.8	16.2
Engineering R&D	13.9	16.2	12.8	14.3
Advanced technology applications	12.2	12.9	11.4	10.5
Environmental control, institutional studies	4.9	8.2	4.9	7.2
Utilization experiments	—	12.0	—	3.5
TOTAL	**$2865.8**	**$3620.1**	**$2456.8**	**$3045.9**

a Estimates. **Note:** Fiscal year ending Sept. 30.

research and expand its efforts to evaluate environmental chemicals for their carcinogenic properties. And according to budget documents, NIH also would begin a program to "identify behavioral measures that will provide advance warning of toxic effects of noxious environmental agents," which apparently means studying early warning symptoms of toxicity.

If all these new ventures appear to add up to more than the $40 million increase on NIH's budget drawing board—they do. But the institute is counting on cuts elsewhere in its budget proposal to make things come out even. For example, NIH's Research Resources programs will be cut $36 million from the 1977 figure of $138 million.

Research funds for another of HEW's operations, the Alcohol, Drug Abuse & Mental Health Administration, also would be cut from $154 million in fiscal 1977 to $146 million in fiscal 1978, or about 5%. Yet HEW says that research would be expanded (apparently with economies elsewhere) into nonmedical drug abuse; epidemiological studies on addiction in women and infants; the effects of drug abuse on impaired performance; and determining the most effective drug abuse therapies.

Although not highly visible in federal R&D, the Commerce Department is authorized to spend $78.5 million in fiscal 1978 for what the department calls "science and technical research," and this amount is up nearly $6 million from fiscal 1977, or about 8%. But $5.5 million of this increase is not real, it is due to a bookkeeping change for Commerce's Office of Telecommunications. Increased funds would go for expansion of the National Bureau of Standards' nondestructive testing program ($300,000); expansion of the bureau's National Voluntary Laboratory Accreditation Program ($800,000); laboratory renovation; and new equipment purchases. But between budget additions and cuts in some programs, NBS would only come out about $240,000 ahead of last year's $70.1 million. The National Technical Information Service also would benefit modestly from increased spending.

The Patent & Trademark Office is slated to receive about $300,000 less in 1978 than it did in 1977, but its $89.6 million budget includes a $1.7 million savings due to reduced printing costs, leaving about $1.3 million for added patent examiners and for purchase of a new computer to speed things along.

The big winner at the Commerce Department, though, is the National Oceanic & Atmospheric Administration, whose budget of $801.4 million is a sizable $69 million, or 9.4%, higher than last fiscal year. Among other activities, NOAA's 1978 budget would provide for additional funds for climate research, including studies into changes in the stratosphere, setting up a climate "diagnostics center," and forecasting the effects of climate change on world food supplies. □