

between \$23 billion and \$30 billion.

The Stever committee believes that NASA's base program ought to cost about \$10 billion per year to cover top priorities, including a well-balanced portfolio of space science and Earth observational programs. In addition, NASA should get \$3 billion to \$4 billion each year for special initiatives, such as a space station, a moon base, a Mars odyssey, a multisatellite observational network known as "Mission to Planet Earth" and a major solar system exploration. Increasingly, says the committee, NASA is finding it hard to find and keep talented scientists and technicians. NASA should consider liberating its field staff from civil service limits by "privatizing" its centers the way the Department of Energy operates its laboratories—through universities and industrial companies. The only center run that way now is the Jet Propulsion Laboratory, managed by Caltech.

If the space program doesn't give Bush a headache, the problems raised by the global environment are almost certain to require Excedrin. "We believe that global environmental change may well be the most pressing international issue of the next century," declares a paper prepared by an ad hoc committee under Cornelius J. Pings, provost of the University of Southern California. In a letter accompanying the paper, the President is told "the problem of environmental change is now widely recognized as one of growing urgency that will require responses by your Administration. Embedded in the diverse manifestations of this problem—global warming, ozone deple-

tion, tropical deforestation and acid deposition—are enormous challenges to science and engineering, to your Administration and to the world community of nations." Although the "full long-term implications of alterations to the Earth's environment by human actions are still uncertain," says the Pings paper, "there is a growing perception that the future welfare of human society is to an unknown degree at risk." The paper urges the new President to adopt measures to slow the inexorable changes through prudent policies. These would include reducing the burning of coal and oil, increasing the use of such "clean" fossil fuels as natural gas and developing energy sources that do not produce carbon dioxide, such as geothermal, wind, solar and the modular high-temperature gas reactor, the so-called safe nuclear reactor (PHYSICS TODAY, September, page 47). The paper also calls for even deeper cuts in the production of chlorofluorocarbons than those agreed to by 31 nations in the 1987 Montreal Protocol, which requires that world consumption of CFCs be reduced by 50% by 1999.

A 'long-distance race'

Possibly the most highly placed advice came from the Committee to Advise the President on High Temperature Superconductivity. This panel, appointed in 1987 by President Reagan, who referred to them as the "wise men," is made up of distinguished scientists and industrialists and headed by Ralph E. Gomory, IBM's senior vice president for science and technology. Its report, which had languished at OSTP for

three months before its release on 3 January, recommends setting up several consortiums of research universities, commercial companies and government laboratories to develop high- T_c superconductors. The purpose of such cooperative groups is to keep R&D at a consistent level for the decade or more that it will take before the new technology pays off. The trouble now is, as the Gomory Report says, "While there is a high level of activity in US industry today, much of it is scattered . . . and unlikely to survive in what we believe will be a long-distance race."

The panel proposes four to six superconducting consortiums, funded by its industrial members; the government would pay the tab of the universities and national labs. The panel estimates the annual cost of the program might come to \$25 million to \$30 million more than current Federal outlays for all high-temperature superconductivity, which was about \$96 million in 1988. The commission also recommends that the National Science Foundation allocate an extra few million dollars per year on principal investigator grants for superconductivity researchers—a sore point among scientists in the field who have complained about the dearth of NSF funding the past two years.

Notwithstanding all the R&D problems the experts call on Bush to deal with, perhaps the biggest he faces is whether he can deliver on the great expectations he has promised for science and science education in the next four years. In the meantime, the science community is exhilarated by Bush's rhetoric on the issues.

—IRWIN GOODWIN

UNIVERSITIES REACH INTO PORK BARREL WITH HELP FROM FRIENDS IN CONGRESS

The 100th Congress adjourned at the end of October after passing all 13 appropriations bills—something that hasn't happened for nearly a decade. It also managed to attach scores of special "earmarks" to those bills for projects at universities and colleges—something that's been done so frequently in recent years that the practice is ridiculed by critics who use the term "academic pork." Though pork projects once were almost entirely restricted to highways, harbors, post offices and military bases, in more recent years academic institutions have acquired classrooms, laboratories and hospitals with a little help from their friends in Congress.

In the fiscal decade through 1989, a new study shows, more than \$900 million has been set aside in Federal appropriations for some 300 academic buildings and research projects. These data were compiled by James Savage, principal Federal relations analyst at the University of California System in Berkeley. His report, released on 7 March, calls academic pork "perhaps the most divisive issue in higher education."

The habit of reaching into the pork barrel has increased in recent years, as the cost of new facilities has risen and contributions from donors have become harder to raise. The pile of pork for academic projects in this

year's budget totals about \$290 million, according to a compilation done by *The Chronicle of Higher Education* in February. This is just short of the \$291 million in the fiscal 1988 budget—a sum *The Chronicle* considers a record for special-interest projects on US campuses.

Congressional purveyors of academic pork proclaim it is necessary to counter the tendency of the scientific and medical communities to play the "old boy" game. Competitive merit review by professional peers, the argument runs, is unfairly biased toward the favored and famous universities. The agencies that are charged with providing the money have little

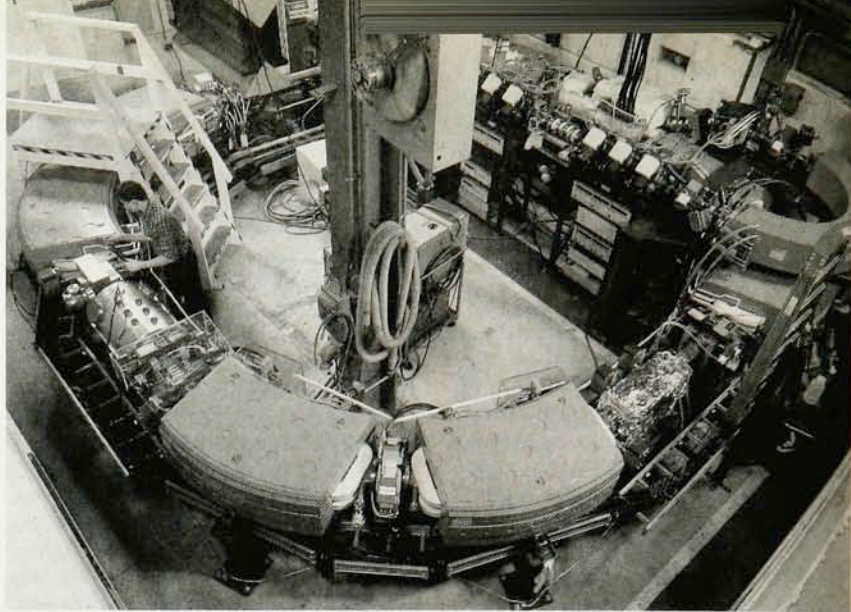
or no chance to examine the merit of the projects or to fit them into their programs. In recent years, university wheelers and Congressional dealers have been promoting their special interests as a great way to improve the nation's cutting-edge technologies and to augment technology transfer from the laboratory to the marketplace—the same arguments, ironically, that government agencies use to support their budget requests.

To be sure, some universities assert their lobbying strategy is to get funds for a broad or fuzzy subject, such as materials science or superconductors, thus enabling their scientists to compete for research grants in the field. Michael M. Crow, director of science policy at Iowa State University, calls this "generic" appropriations. Iowa State attempted to do this by lobbying for a new center specializing in manufacturing technologies. Congress took this literally and awarded \$7.5 million to the university, indicating exactly what would be done by spelling out in legislation the Center for Integrated Design, Non-Destructive Evaluation and Manufacturing. In addition, Iowa State was able to coax \$3.3 million from the Commerce Department for a new materials research center and more than \$5 million from the Agriculture Department for various studies on food, nutrition and water quality.

Agriculture is a traditional source for pork, but in recent years the Departments of Energy and Defense have been hit hard for special interest projects—mainly because these two have research programs that cover many forefront scientific projects, but also because those departments sometimes need votes in Congress for controversial programs and procurements. Still, most agencies end up scrounging from established programs to pay for Congressional earmarks. DOE's Basic Energy Sciences program needs to "eat" some \$20 million of its 1989 appropriations to make up the difference between the money Congress gave for requested projects and the amount it added for pork.

Academic 'double-dipping'

While many members of Congress argue that the customary practice of earmarking money for specific campuses is the best way to enlarge the geographic distribution of Federal funds for science and technology, a new study concludes that this is not so. Savage claims that Congressional earmarking has resulted in concentrating funds in much the same way as the peer review process.



Proton Therapy Accelerator was designed and constructed at Fermilab to treat cancer patients at the Loma Linda University Medical Center near Los Angeles. The machine was first suggested for cancer therapy in 1946 by Robert R. Wilson, later Fermilab's director.

Pork High on the 1989 Funding Menu

The earmarks in DOE's 1989 energy research budget (in millions of dollars):

Arizona State University Barry Goldwater Center for Science and Engineering*	10.0
Brandeis University Energy and Natural Resources Center	3.0
Drexel University (Pennsylvania) Center for Automated Technology*	5.5
Georgetown University (Washington, DC) for fuel cell research	2.6
Loma Linda University Medical Center (California) for proton beam cancer treatment*	11.1
Louisiana State University Microstructures and Devices Center*	13.0
University of Nevada at Las Vegas for radioactive waste management	6.0
University of North Dakota Energy and Materials Research Center	5.5
Northwestern University for materials science research*	10.0
University of Oklahoma Energy Research Center*	3.5
Medical University of South Carolina Cancer Research Center*	8.0
West Virginia University Coal and Energy Research Center	9.2
University of Wyoming for energy research	5.5

DOD is required by Congress to fund the following:

Florida State University for advanced semiconductor materials	20.0
University of Central Florida for management training	5.0
University of Mississippi to plan a physical acoustics center	1.0
University of North Dakota Aerospace Medical Research Center	1.0
Tulane and Xavier Universities for joint biomedical research	16.5

The National Institute of Standards and Technology will provide money for:

University of Arkansas's Southwest Radiation Calibration Center	0.3
Iowa State University Center for Integrated Design, Non-Destructive Evaluation and Manufacturing*	7.5

The Commerce Department is required to foot the bill for:

Arkansas State University at Jonesville to plan a university center	0.1
Iowa State University for a new materials research center*	3.3
University of Kentucky Advanced Science and Technology Commercialization Center*	4.5
Marshall University (West Virginia) for a manufacturing proposal	0.2
Oklahoma State University Center for International Trade	0.3
Wheeling Jesuit College (West Virginia) to plan a software development center	0.2

*Obligated for construction

He asserts that "a handful of states and institutions receive these funds and many already are major recipients of Federal research dollars.... I call that double-dipping."

According to Savage's analysis, just five states have received nearly 42% of all the money that Congress set aside for specific universities and colleges from fiscal 1980 through fiscal 1989. Three of the five—Massachusetts, New York and Illinois—are also among the top ten in overall Federal R&D support. Most of the money for campus projects in those states comes through the traditional competitive review system.

About two-thirds of the pork for universities and colleges went to ten states. Of these, only West Virginia ranks among the bottom ten for total R&D support. Savage's statistics show that those ten states are able to collect only 8% of the money earmarked by Congress for specific campus projects. Ironically, some of the most prestigious research universities consume about 30% of all the pork barrel in the last decade. In 1987, after agreeing to a moratorium on pork, the Association of American Universities was unable to prevent some of its 56 member institutions from dipping into the barrel. Discouraged by the actions of some of its elite members, the AAU is now silent on the subject.

Savage does not claim that his analysis includes every last dollar that Congresses have forked out. Identifying the projects is often difficult, because of the dexterity of members of Congress in concealing

pork in spending bills, sometimes as "midnight riders" attached to continuing resolutions and omnibus appropriations.

The tables Savage has assembled show a remarkable correlation between leaders in both houses of Congress and chairmen of appropriations committees with the academic institutions that have reaped the most pork. It is not surprising that Oregon Health Sciences University leads the list with \$52.4 million in the decade, given that Mark Hatfield and Bob Packwood are ranking minority members on the Senate appropriations and finance committees, respectively. West Virginia University is third with \$34 million, which isn't surprising because the state boasts Robert Byrd, the Senate's president pro tempore, who gave up the majority leadership this year for the equally powerful post of chairman of the Senate appropriations committee. The University of Alabama is right behind with almost \$34 million, notwithstanding that Tom Bevill is chairman of the House appropriations committee.

"The only thing that earmarking tests is the political muscle of the earmarker," says Representative Sherwood L. Boehlert, a New York Republican and member of the House Committee on Science, Space and Technology. New York State, having collected nearly \$83 million in academic pork in the past decade, ranks only behind Massachusetts, which has collected \$94 million worth of pork projects in the past decade.

—IRWIN GOODWIN

two Research Council boards concentrating on mathematics and by the Committee on Mathematical Sciences in the Year 2000, cautions against introducing the "top-down" approach, common in most other countries, that prescribes a national curriculum. Such an approach is deemed incompatible with US cultural diversity and political demography. Instead, the report endorses a strategy of national standards and local implementation. Beyond that, its overall vision is short on specifics: how mathematical abilities can be nurtured through classwork in some 16 000 school systems remains to be addressed.

More detailed recommendations for improving math teaching came on 21 March from the National Council of Teachers of Mathematics. Their 272-page report includes 54 standards for teaching math in elementary and secondary schools and for evaluating how well students are learning. Like the mathematics experts who wrote the Research Council report, the teachers departed from tradition by emphasizing reasoning over rote as the best way to develop mathematically literate Americans.

Both reports are multiples of a common factor: Dick and Jane can't add. But *Everybody Counts* goes much further than the council of teachers report. It suggests the time has come for a new approach to curriculum reform, backed by "appropriate national expectations based upon broad public support among parents, teachers, and taxpayers." National consensus is essential for developing high-quality mathematics education, says the report, and "our national goal must be to make US mathematics education the best in the world."

A gloomier view of US education appeared on 31 January with the release of *A World of Differences*, an international comparison of 24 000 13-year-olds in the US, Ireland, Spain, South Korea, the United Kingdom and four Canadian provinces. US students placed last in mathematics and almost last in science, while Korean youths ranked first in math and tied for first in science with Canadian students in British Columbia. The depressing results for US students only confirm the low grades they have received in similar international assessments (PHYSICS TODAY, June 1988, page 50). Approximately 40% of the tested Koreans were able to solve problems involving geometric concepts—a task only 9% of the Americans could accomplish. The disparity in science was nearly as great.

—COREY S. POWELL ■

THREE REPORTS ON MATHEMATICS EMPHASIZE REASONING OVER ROTE

If any additional documentation were needed about the sad state of mathematics and science in US public education, it came in two recent reports.

The first, issued on 26 January by the National Research Council, bears the reassuring title *Everybody Counts*. What the Research Council's report describes, however, is quite the contrary: too few people seem really able to count. The glossy 114-page report calls for a thorough redirection of US mathematics education. Math should be studied by every student each year from grades 1 through 12, the report urges. Calculators and computers should be more widely used in the early grades, with less emphasis on paper-and-pencil

techniques and rote memorization, which tend to discourage student interest. After making the conventional prophecies about the impending shortage of workers and teachers with the mathematics skills necessary to function in the modern world, the report suggests that US schools must overcome cultural barriers. "We are at risk of becoming a divided nation in which knowledge of mathematics supports a productive, technologically powerful elite, while a dependent, semiliterate majority, disproportionately Hispanic and black, find economic and political power beyond reach," the report warns. "Unless corrected, innumeracy and illiteracy will drive America apart."

The report, prepared by members of