state & society

New Federal budget stresses applied science

Spending for physics has gone up slightly in the Administration's budget proposal for fiscal year 1973, and there are some promising programs in R&D, but overall, a boom in physics money will not be coming this year. High-energy physics money has risen for the first time since the mid-1960's, funds have been appropriated for a Very Large Array radio telescope and the Grand Tour of the outer planets has been scrapped. An informed source told PHYSICS TODAY that funds for basic research in physics in the universities will be about $140 million—up about $3 million from FY 1972.

The watchword in this year's science budget appears to be "applied." As Presidential Science Adviser Edward E. David Jr said in his presentation of the FY 1973 R&D budget, "a major objective of the Administration is to increase the contributions of science and technology to domestic problems." In line with this, total R&D funds will rise from $16.4 billion in 1972 to $17.8 billion in the coming fiscal year, stressing such areas as energy, health, education, environment, urban problems and transportation.

The Office of Science and Technology listed as policy "highlights" the following areas:

- A more strategic approach to R&D as exemplified by the Domestic Council's examination of new technological possibilities. This Executive Office study helped identify areas where government efforts could create new jobs, stimulate industrial production and innovation, improve overseas trade and "more directly meet the needs of man and the nation."
- Channeling of the total R&D effort toward civilian needs.
- The strengthening of fundamental research support to maintain "a solid foundation under the nation's applied sciences and high technology."
- Utilization of the capabilities of the "high-technology" agencies such as NASA, the Atomic Energy Commission and the National Bureau of Standards to deal with domestic problems and national long-range goals.
- Experimental incentives programs in the National Science Foundation and the National Bureau of Standards to stimulate industrial R&D and its application.

NSF has requested $653 million, a figure that does not include the $21.7 million held last year by the Office of Management and the Budget. The budget also includes $80 million for Research Applied to National Needs (RANN) (an increase of $24.1 million) and $22 million as part of $40 million to be shared with the National Bureau of Standards for research on ways to increase industrial and other nonfederal investment in R&D and to increase productivity through the application of science and technology. Another program, which would cost $2.5 million, is to study the economic effects of R&D. For Scientific Research Project Support $275.3 million is requested (see table 1).

The budget for physics (see table 2)

continued on page 71

NSF advisers question their role

Is the National Science Foundation leaning too heavily towards applied research? This is a question some members of the National Science Board, the Foundation's "board of directors," are asking. Such concern about the new direction for the NSF has also been expressed to PHYSICS TODAY by some physicists who serve on the advisory committees to individual segments of NSF. These advisers are distressed, too, at their general lack of effectiveness in communicating advice to the Foundation.

LEDERMAN

When the NSF was first established, it was forbidden to support applied research. Then several years ago the Daddario act changed the enabling legislation so that applied-research support was no longer forbidden. At that time the question was raised, "Are you letting the camel into the tent?"

Since the Nixon Administration took office, pressure has been put on the National Science Board and the Foundation, through the Office of Management and Budget and the Office of Science and Technology, to support more and more applied research. Others have faulted the Foundation with bending too strongly to the winds of relevance.

Leon Lederman of Columbia, who is a member of the Mathematics and Physical Sciences Advisory Committee, said that no one is objecting to well-thought-out programs in applied science. "But the philosophy that basic research has to ride on the coattails of applied physics is totally wrong. I think most of the committee believes that, and we've said more or less that in our last report."

Lederman worries that if NSF tends towards immediacy, that in time of a budget contraction, it will act the way a mission agency would—cut down or cut out of basic research. "If you want to exaggerate," he said, "NSF is turning into a quick-fix agency."

Board member Joseph Reynolds (Louisiana State University) told us

PRESS

CARTER

REYNOLDS

that the Board is concerned that basic science not get lost in the shuffle. "Because applied science has a short-range payoff, it's easier to sell." He doesn't believe that such support is improper, "but there are pitfalls, and some of us are aware of them. It's a matter of apprehension. The NSF has put large increases in basic research in the past two budgets. However, when we communicate with the general public, applied research tends to be emphasized." He fears that basic research will suffer, but he does not believe that it has suffered so far in the NSF budget.

Nevertheless, Reynolds feels that physics has suffered greatly because the Foundation's physics budget did not expand enough to take care of the grants that were dropped by other agencies, such as the Defense Department and the AEC. Physics and astronomy are in an especially bad way, he said, and this problem has been discussed in Board meetings. In physics only about one in ten proposals are accepted, even after the less meritorious proposals are weeded out. Astronomy, he said, suffers from another problem—its funding has always been so small that the field operates from a very low base. Recently astronomy has become quite exciting, and there's simply not enough money to respond to the new opportunities."

He said that the physicists on the board (himself, Robert Dicke, William Fowler and geophysicist Frank Press), because they are aware of the pinch being felt in physics and astronomy, are probably more sensitized than other Board members to the problem of the future funding of basic research.

"Our concern is that in the midst of all that is new, we don't forget what our business really is," Reynolds said. "Basic research is the unique responsibility of NSF in the government. Its other responsibilities in applied research, education, and so on, important as they are, are shared with other agencies. It is the duty of the National Science Board to worry about trends, rather than be too concerned with what's happening in a specific program."

Press says he is not worried about the Foundation tackling some of society's problems, provided that it is not done at the expense of basic research. Such fields as physics, chemistry and the earth sciences, when you take into account inflation and the dropouts from other agencies, have suffered in the period since 1968. In particular, he singled out the drop in the support of graduate students, noting that the slack has had to be taken up out of research grants. He would like to see advocates for basic research be as verbal and as influential as the spokesmen for applied research, and he urges scientists involved in basic research to make their case to both Congress and the Executive branch.

Another Board member told us that although the Foundation has been getting more money each year for the past few years, after taking into account the effects of inflation, there has been little or no increase in the support of fundamental research in the universities; the money has been earmarked for other purposes. Again, including the effects of inflation, from 1968 through 1971 there seems to have been an overall *decrease* in the project support of physics in the universities by the NSF. "There is a sense of unhappiness on the part of some Board members with the way things are going without a very good idea what to do about it," he said.

Stever and Carter comment. We asked the new director of the Foundation, H. Guyford Stever, to comment on the trend towards applied research. He said, "We are convinced that science is healthiest when high-quality scientific ideas originating within our scientific community are strongly supported and when the discoveries and knowledge developed through basic research flows smoothly through applied research and development into many activities of our society. This means that appropriate emphasis must be given to both basic and problem-oriented research and that support for one must not be at the expense of the other.

"The National Science Foundation is concentrating on the need to maintain a proper balance in our total science support effort, and I believe we are succeeding. NSF is deeply committed to the task of insuring continued US vitality in basic scientific research. This is clearly reflected in the fact that the largest single increase in the NSF program for fiscal year 1973 is for Scientific Research Project Support, our core program for the support of basic research.

"At the same time NSF is responding to the growing conviction that science must truly serve man. Through our program of Research Applied to National Needs, which comprises 12% of the total NSF budget, we are seeking to provide the scientific base for solution of problems of national concern. I might add that 40% of RANN funds go into fundamental research."

Herbert Carter (University of Arizona), chairman of the National Science Board, when asked to comment on the applied-research trend, told us, "The rise in NSF support for academic basic research during the last three years is, I am happy to say, continued in the President's budget for 1973. The overall NSF program, of course, has been developed with full participation by Board members and represents a balanced program in the net judgment of the Board. For the third straight year, the largest single program increase in the NSF budget is for basic scientific research in the traditional disciplines. I am also happy to point out that the decline in 'real' outlays in Federal support for all of R&D beginning in 1968 has been replaced by a proposed increase of $1.4 billion, or 8% above fiscal year 1972.

"I should also like to call attention to a trend towards increased support for research intended to help alleviate the growing list of serious societal problems. A portion of the NSF budget has again been allocated to this purpose. I believe that this program should be welcomed by the university community as a major opportunity to develop those new research and teaching programs, sometimes called interdisciplinary or problem-oriented, which students, faculty and the general public are beginning to see may be indispensable to the continued viability of our society. These programs should provide expanded opportunities for the best minds trained in the traditional disciplines as well as a heretofore unavailable opportunity for the training of the new 'interdisciplinarians' the nation so badly needs."

Another source of unhappiness among some of the NSF's advisers is the feeling that the Foundation is not adequately responding to their recommendations. Lederman told us that some members of the Mathematics and Physical Sciences Advisory Committee have felt that NSF should re-evaluate its relationship with the scientific com-

munity, giving the community a larger role in Foundation decisions that affect it.

When NSF decided to form its Division of Materials Research, for example, the Physics Advisory Panel was not consulted. Ronald Geballe (University of Washington), who recently retired as chairman, says he is quite uncertain about the fate of the Panel's advice to the Foundation. "Panel members are seldom made aware of the reception and consequences, if any, of their recommendations. And when the Panel is not even consulted before such far-reaching changes as the formation of the new Materials Research Division are made, one realizes even more vividly its impotence. Panel meetings are used by staff members as occasions to exchange information and ideas among themselves, something they don't seem able to manage without this mechanism," he said. "This materials-research affair is just one more example of the frustrating experience of serving on the Advisory Panel. It demonstrates that the internal management of the Foundation doesn't take the Panel, which represents the outside community, seriously, even though they pay us to come to Washington. It feeds us selected issues, absorbs what we say, and nothing much happens as a consequence."

The new chairman of the Physics Advisory Panel, Russell Donnelly (University of Oregon), says he took the chairman's job because he felt how ineffectual they had been during the couple of years he had served on the panel, and he wanted to try to reverse that a bit. He wants the panel to take a much more active role than before.

One Panel member remarked that the definition of its responsibilities and powers are not clearly laid out. "The subject matter is so big and moves so fast that by the time you get caught up with everything that's happened, you've got very little time left to give much intelligent advice. And then when it's given, you don't often know what happened to it."

The outgoing chairman of the Mathematics and Physical Sciences Advisory Committee, George Vineyard (Brookhaven), says he doesn't feel that you can make a blanket statement that his committee is all dissatisfied with the Foundation's response to its recommendations. On the other hand, Lederman told us that some committee members discussed resigning because the committee had not been receiving any response to its pleas for more funds for basic physical science (which he says has not been getting anything like the increase that NSF as a whole has been getting).

A Board member agreed that there is some dissatisfaction among people on the Vineyard committee and admits that there is room for improvement. He notes that the way the NSF functions, with the lead times that are required, it is almost impossible to get advice on a live issue from one of these committees. They can serve as sounding boards, though, getting a feeling from the community of how things are going, and also providing a mechanism for transmitting information back to the scientific community. —GBL

Budget

continued from page 69

is slightly higher. According to an NSF official, the budget, in contrast to FY 1972, contains some support for new thrusts. Although last year's physics budget had its entire increment over FY 1971 allotted for programs that were to be picked up from other agencies, this year's budget has only a small portion set aside for agency dropouts.

An increase of $1.3 million is requested for Elementary Particle Physics. This program's funds will provide for the upgrading of the Cornell Electron Synchrotron, additional costs at Stanford and for users of high-energy accelerators.

In Nuclear Physics, the start of experiments at Columbia University's Nevis Synchrocyclotron will require an increase in money as will the Los Alamos Meson Physics Facility. NSF presently supports about one-third of the university-based experimental nuclear-physics work in the US.

In Atomic, Molecular and Plasma Physics, about one-half of the total research support will go to experimental investigations of simple atomic and molecular systems. About one-fourth of the program goes for basic plasma physics.

The Theoretical Physics program is suffering from withdrawal of funds by mission-oriented agencies. According to NSF, the Theoretical Physics program is "severely impacted by demands on it from the highly talented investigators who can no longer obtain funding."

RANN is requesting funds for work in some areas that will support physics, such as research on energy-conversion technology and particularly solar energy. Earthquake engineering and excavation and tunneling technology as well as extractive metallurgy are also being funded.

Funding for scientific research support in astronomy will be up $0.8 million to $8.8 million.

NSF has requested $3 million for the initial development of the Very Large Array radio telescope, which will consist of 27 antennas, each 82 feet in diameter, distributed along three 13-mile-long arms of a Y-shaped railroad track. According to NSF, the array will give radio astronomers as much resolution as the 200-inch Palomar optical telescope.

Table 1. NSF Scientific Research Project Support

Discipline	FY 1972 (millions of dollars)	FY 1973 (millions of dollars)
Atmospheric sciences	11.6	13.0
Earth sciences	9.2	11.1
Oceanography	12.6	14.0
Biological sciences	53.4	59.9
Physics	32.9	36.0
Chemistry	24.1	26.8
Astronomy	8.0	8.8
Mathematics	13.6	14.4
Social sciences	22.5	24.6
Engineering	25.4	29.3
Materials research	33.3	37.4
Total	246.6	275.3

Table 2. NSF Physics Budget

Program	FY 1972 (millions of dollars)	FY 1973 (millions of dollars)
Atomic, molecular and plasma physics	3.25	3.6
Elementary particle physics	14.2	15.5
National Magnet* Laboratory	2.3	2.6
Nuclear physics	11.3	12.4
Solid-state and low-temperature physics* (includes theory)	9.15	9.8
Other theoretical physics	4.15	4.5
Total	44.35	48.4

* Handled in Division of Materials Research