1973 Budget: Administration Bets on Applied Science

President Nixon unveiled an election-year budget this week that holds out the prospect of a bumper year for technology and applied research. For basic science, the new budget proposes much more modest gains.

One constant theme weaves through the budget figures, and it is simply this: that the Nixon Administration means to intensify its efforts of the past 2 years to channel new money for research and development into "problem-related" areas where the possibilities lie for reaping tangible benefits to the nation's economy, security, and physical well-being. The catchphrase for this effort, and one that crops up again and again in the voluminous budget documents, is "science and technology in the service of man." And the guiding philosophy behind it, as Nixon expressed it in his State of the Union address on 20 January, is that new monies for R & D are to be "focused on projects where an extra effort is likely to produce a breakthrough, and where the breakthrough is most likely to make a difference in our lives."

Despite constraints on spending, the Administration is asking for sizable amounts of new money for R & D, much of which would go to directed medical research, to nuclear reactor and space shuttle development, to strategic and tactical weapons work, and to a huge package of applied science initiatives aimed at domestic problems.

The new budget, of course, represents a request to Congress for funds, not money safely in the bank. Nevertheless, it does reflect roughly how the federal government will be spending its money on R & D in the coming academic year.

Overall, the Administration is seeking to spend a record amount of $246 billion in fiscal year 1973, an increase of 4 percent, or $10 billion, over the current year. Like the previous two budgets, this one is described as "expansionary" but "not inflationary." But it is more of a gambling budget than the Nixon Administration has previously proposed—one that bets a $26 billion deficit that it will succeed as a Keynesian prod to the economy where the others fell short. To the benefit of the scientific community, part of this gamble involves an elevated hope that R & D will contribute to this prodding effect by opening new markets, alleviating unemployment, and shoring up the sagging U.S. position in world trade.

How this warmth toward R & D translates into dollars varies according to how one does the bookkeeping. In a press briefing held a few days before the budget was released, presidential science adviser Edward E. David, Jr., dwelled on new *obligations* budgeted for R & D, although not all new obligations are spent in the same year. In FY 1973, obligations for R & D would rise by 9 percent, from $16.4 billion to $17.8 billion. This increase of $1.4 billion would be composed of $760 million for military work and $700 million for new civilian, nonspace R & D. Both the President and his science adviser insist that the latter figure represents a 15 percent increase above the current level for domestic programs.

This rise could not be immediately verified from available budget figures. In any event, the increase for the coming year is more apparent than real, since actual *outlays* for R & D would only grow from $15.8 billion to $16.5 billion. This amounts to a jump of 4.4 percent, a cost-of-living raise that will probably be just large enough to compensate for inflation in the current fiscal year.

With a hint of impatience in his voice, David told newsmen who sought to check the Administration's arithmetic to pay less attention to bookkeeping and more to the policy implications of the new budget. "You can play the numbers game any way you want," he said, and noted that outlays always lag behind obligations when the budget is going up.

Some of the implications for science policy are illuminated by the programs and agencies picked to receive major increases in money for R & D:

► Obligations for the National Science Foundation (see box) would increase by 12 percent to $675 million, and the NSF's outlays for research would cross the $420 million mark. However, the percentage increase for NSF's support of problem-related work would be four times that for basic science.

► Military spending would increase substantially. Money for research would rise about 6 percent, that for exploratory development about 8 percent, and strategic weapons would receive the lion's share of both. Proportionally, the Navy would receive the largest increase in R & D money, partly to accelerate work on its Undersea Long-range Missile System (ULMS), a huge new kind of nuclear submarine that will replace the present Polaris-Poseidon fleet in the 1980's. These increases would be only faintly reflected in Defense Department spending in colleges and universities, however. Military R & D outlays to academia would rise by 2 percent, to $197 million.

► Disease-related biomedical programs would be significantly enlarged. Cancer would receive another $92 million in obligations, $57 million of which would be spent in the coming fiscal year, thereby pushing the President's cancer conquest campaign fund above one-third of a billion dollars. Heart disease, sickle-cell anemia, and lung ailments were picked for a total increment of $22 million. The Food and Drug Administration's obligations would rise by 63 percent, or $77 million, $18 million of which will go for added research. Staffs of the nation's veterans' hospitals would grow by 10,000, seven old hospitals would be modernized or replaced, and six new ones activated.

► The budget of the Department of Health, Education, and Welfare (HEW) also includes a request for $197 million in obligations for education R & D, a boost of 40 percent over the current year. Most of this would go into a National Institute of Education (NIE), which the Administration has proposed as a center for developing and testing new tools and methods to assist learning. The NIE would absorb most of the research functions of HEW's present Office of Education.

► An aggregate increase of $271 million would go to beef up "focused" R & D programs in such "domestic" agencies as the Commerce Department, the Department of Transportation, the Office of Economic Opportunity, and

NSF: A Boost for Relevance

The new Nixon budget seeks another moderate increase in funds for the National Science Foundation and at the same time gives NSF a further nudge toward helping the Administration carry out its expressed intent of making nonmilitary research contribute more directly to the solution of national problems.

In the fiscal year 1973 budget requests made public this week, about $100 million in NSF funds would be earmarked for research and development activities focused on social, environmental, and economic problems, including $22 million for an "Experimental R & D Incentives Program" aimed at stimulating nonfederal investment in R & D. Funds for the RANN (Research Applied to National Needs) program would be increased from $50 million for the current year to $80 million under the FY 1973 budget request.

At a budget briefing last Saturday, retiring NSF Director William D. McElroy took special pains to emphasize that, for the third straight year, the largest single program increase would be in basic research support. He apparently sought to forestall any suggestion that NSF was neglecting basic research for applied science.

The total budget request for next year is $674.7 million, to be obligated, but not necessarily spent, in the coming fiscal year. Since NSF has some $21.7 million on hand in unobligated funds from previous years, the Administration is asking Congress for new appropriations of about $653 million, compared with $622 million in the current year. Support for research in colleges and universities would rise from $391 million to $446 million.

Funds in the category of "scientific research project support," which go principally into university research grants, are set at $275.3 million in the new budget, an increase of $28.7 million over last year. To put this in perspective, it must be noted that NSF has been shifting to a policy of supporting graduate education mainly through research grants rather than through separate funds for traineeships and fellowships. Funds for graduate student support declined from $30.5 million in FY 1971 to $20 million this year and are scheduled to drop to $14 million in the coming year. The rationale seems to be the Administration's view that, while there is a tight job market in many sectors of science, it is wise to fund research assistantships to attract graduate students to particular fields where jobs exist or there are needs for special types of manpower.

Fiscal year 1973 will not be a big year for Big Science. Some $3 million is included, however, for the initial development phase of a Very Large Array (VLA) radio telescope. The design calls for a system of 27 antennas, which, according to NSF officials, can be positioned in differing modes along Y-shaped railroad tracks to give the array a 25-mile diameter. Total cost will be an estimated $70 million. The site is yet to be selected.

The new experimental R & D incentives program will attract special interest because it so clearly bears the Administration trademark. In introducing the budget, McElroy described the program as one "to explore ways of increasing industrial and other nonfederal investment in research and development, speed up the application of R & D results to improve products and services, and increase productivity."

Plans call for NSF to cooperate with the National Bureau of Standards (NBS), which will have $14 million in its own budget for a parallel program. NBS is expected to concentrate on working with industry, NSF with universities and also with research associations and professional societies. Officials of NSF acknowledge that the program faces potential difficulties with proprietary secrets, patents, and antitrust laws, but say that similar problems have been overcome in the military area and can also be surmounted in domestic research.—J.W.

the Interior Department for new work on environmental problems, transportation, and urban social problems.

Much of the latter bonanza is presumably contained in a package of technological undertakings which the President briefly alluded to in his State of the Union address, and which comprises just about the only new wrinkle in Nixon's entire domestic program for FY 1973. This package holds a proposed increase of $400 million for R & D in six very specific topical areas and in nearly a dozen federal agencies.

The package will be the subject of a special presidential message to Congress at some date still to be decided, but for now, the new budget reveals these details: obligations for energy R & D would rise by $88 million to a level of $480 million; transportation funds, including money for studies of quieter jets and trucks and for advanced urban mass transit, would grow to $666 million (up to $210 million); an "apocalypse" package of $136 million would be applied to efforts to reduce losses of life and property from such natural disasters as hurricanes and earthquakes ($43 million more than in FY 1972); money for R & D on drug addiction would climb $10 million to a level of $60 million in FY 1973; and funds for pilot projects in improved emergency medical care would go from $8 million to $15 million.

Finally, as part of this bundle, the Administration wants to give a total of $40 million to the National Bureau of Standards and the NSF to learn what makes serendipity run. The two agencies would search for new ways to foster support of R & D by sources other than the federal government, and would explore the process whereby new technology is transformed into new markets.

David refused to say whether or not all this was, as it seemed to be, part of the much-heralded program of new technological initiatives assembled partly under the guidance of former SST chief William Magruder, now employed by the President's Domestic Council (*Science*, 21 January). David did go so far as to say that the Domestic Council had made a "special contribution" to the budget-forming process, but whether still more money would be requested as a result of Magruder's labors was "too iffy" a question to answer. And anyway, he said, the content of the President's special message "has not been decided yet."

Table 1. Conduct of research and development (in millions of dollars).

Department or agency	Obligations			Expenditures		
	1971 actual	1972 estimate	1973 estimate	1971 actual	1972 estimate	1973 estimate
Defense—military functions	7,423	8,013	8,756	7,541	8,031	8,177
National Aeronautics and Space Administration	3,284	3,327	3,302	3,337	3,137	3,131
Health, Education, and Welfare	1,466	1,769	2,012	1,288	1,450	1,708
Atomic Energy Commission	1,303	1,308	1,375	1,303	1,308	1,375
National Science Foundation	337	453	525	335	409	455
Transportation	220	296	380	198	233	282
Agriculture	318	356	370	315	349	359
Interior	185	216	250	175	212	238
Commerce	143	169	229	114	146	192
Environmental Protection Agency	137	176	186	101	157	174
Veterans Administration	64	70	70	61	66	73
Office of Economic Opportunity	84	50	78	75	70	65
Postal Service	40	68	74	34	39	64
Housing and Urban Development	48	53	63	40	56	54
Justice	10	27	30	9	20	26
Labor	23	27	31	22	26	30
Smithsonian Institution	17	23	29	17	22	28
All other	42	48	52	40	48	49
Total	15,143	16,447	17,819	15,005	15,779	16,480

Amid all this prospective largesse for applied research, how might the basic sciences fare in the coming year?

Not badly it seems, although the signals are mixed. On the positive side, no major cuts in fundamental work are visible (though some small, covert ones are). The NSF's basic science budget would rise by 10 percent, more than enough to compensate for inflation. And Administration officials point to one major new start for Big Science (and the only one), an initial outlay of $3 million for the long-awaited Very Large Array antenna system, billed as the world's most advanced radio telescope.

What's more, as David noted in his news conference, support of R&D in the nation's colleges and universities—a traditional measure of the fiscal health of basic research—would grow by 12 percent under the new budget to an all-time high of $1.96 billion.

It must be observed, however, that the bulk of this growth emanates from the National Institutes of Health (NIH) and the NSF, both of which are undergoing substantial shifts toward directed, problem-related work and away from classic, fundamental research. Two-thirds of the science in colleges and universities is commonly regarded as "basic," but it is by no means certain that this rule-of-thumb still holds true. The mix of basic and applied work in academia is probably not changing in lockstep fashion with the supporting agencies, but such a shift would seem to be the inevitable result of the Administration's efforts to maneuver R&D support toward the applied end of the spectrum and to encourage universities to establish new ties with industry.

It should also be pointed out that support for academic work by the Atomic Energy Commission (AEC) and the National Aeronautics and Space Administration (NASA)—both angels for basic work—would remain level or decline slightly in FY 1973 if the rate of inflation remains unchanged. [Nor were the budget-makers kind this year to the Office of Science and Technology (OST), which is meant to advise the President. The OST suffered a cut in budget authority of $144,000, to $2.15 million. Last year's budget requested 60 staff positions, but this year's asks for only 50.]

Within the AEC itself, it seems at first glance that both basic and applied research would flourish in the coming year. Except for the nuclear propulsion program, money for reactor development is up across the board (the NERVA nuclear rocket program that the AEC shared with NASA has been canceled). Administration officials also point with some pride to the fact that physical research by the AEC is allotted a 6 percent increase, and that within this category money for high energy physics would rise for the first time since the mid-1960's.

At the same time, however, there appears to be a pattern within the AEC and other agencies of concentrating new money in one or two major programs of considerable glamour—such as controlled thermonuclear fusion and the 200-Gev proton accelerator at Batavia, Illinois—while cutting elsewhere. Support of a number of programs and projects in physics will be reduced, and chemistry, materials science, and mathematics are budgeted for small cuts.

There is evidence of a similar pattern inside NASA. Within the confines of an essentially static $3.1 billion budget, spending for research would decline by about 1 percent, to $1.47 billion.

The new budget does allow for stepping up work on a High Energy Astronomy Observatory sensitive to celestial sources of x-rays, gamma rays, and cosmic rays. Perhaps as a necessary response to the Soviets' more or less successful landing of a spacecraft on Mars, funding would increase 30 percent for two Mars-bound Viking spacecraft. And money for the space shuttle would rise to $228 million, more than twice what it was last year. Simultaneously though, the unmanned "Grand Tour" of the outermost planets in the late 1970's has been scrubbed. Space agency officials will spend the next year thinking about what, if anything, might take its place.

Within this context, budget documents emphasize that NASA programs which have a "direct benefit to society" will grow by $73 million. These programs include studies of noise suppression in vehicles, work on short take-off and landing aircraft, and, perhaps ironically, a look at new ways of digging tunnels through the earth for power lines and subways.

Yet another example of directed research being boosted at the expense of basic research is afforded by the budget of the NIH. At $2.2 billion the NIH

budget authority for FY 1973 is essentially unchanged from last year. Within this total, the budget for the research institutes has risen by almost 10 percent ($139 million), to $1.6 billion, but the increase has been entirely financed at the expense of a $142 million cut in construction.

Of the $139 million increase for the institutes, by far the largest part ($92 million) goes to the National Cancer Institute (NCI) for the purposes of the presidential cancer crusade, leaving the other institutes with a 4.3 percent increase in their FY 1973 budget, barely enough to cover inflation. In accordance with the new cancer legislation, the NCI director bypassed his two immediate superiors and submitted his budget directly to the White House.

After the NCI, the National Heart and Lung Institute fared best, with a budget increase of $22 million. Of this amount, $5 million is earmarked to give a second major boost in 2 years to the sickle-cell anemia program, which, like cancer, has benefited from being adopted as a political football. Other new money for health seems designed to preempt Democratic initiatives in Congress. Bills to provide extra funds for heart disease, for instance, were introduced in the last session by representatives Paul G. Rogers (D–Fla.) and Claude D. Pepper (D–Fla.), as well as by Senator Walter F. Mondale (D–Minn.). And Senator Alan Cranston (D–Calif.) has been plumping strongly for improved medical care for veterans, which happens to be a major target for new health money in the Nixon budget.

The basic research grant program in NIH's FY 1973 budget contains the untoward feature that there is $11 million less for funding new proposals than was available last year. The cost of commitments to existing research projects has risen by $57 million, making an overall increase of $47 million (8 percent) in the regular research grant program. Applied research (defined as including special programs and contract research) has risen by 10 percent, to $465 million. The emphasis on applied research within the NIH budget is in keeping with the overall picture in federal outlays for health research. Basic research in the health field will increase by 11 percent, to $527 million in FY 1973, while categorical research will rise by 16 percent, to $1.4 billion.

In the Administration's 3-year effort to wring from science what salve it may contain for society's problems, it seems as if science, the "endless frontier" of the 1950's and 1960's, is fast becoming the meticulously planned and managed frontier of the 1970's and 1980's. One result has been an apparent waning of the traditional view that basic science should stand preeminent while its benefits were left to somehow filter down to the common man.

Now, if one can believe a news release on the budget from the OST, quite the opposite view has come into favor: "problem-oriented R & D will provide healthy spillover into basic research."

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Space Shuttle: Compromise Version Still Faces Opposition

"We must sail sometimes with the wind and sometimes against it," said Oliver Wendell Holmes, "but we must sail, not drift, nor lie at anchor." So with man's epic voyage into space—a voyage the United States has led and still shall lead.
—RICHARD M. NIXON, 6 January 1972

In his dramatic endorsement of a multibillion dollar space shuttle project, President Nixon never made it entirely clear whether he regarded himself as sailing with the political winds or against them. Certainly leading Democrats, among them the chief executioners of the supersonic transport (SST), wasted no time in attacking the shuttle as being equally unjustifiable in the face of a scarcity of federal dollars for earthbound social problems. "A senseless extravaganza," Senator Walter Mondale (D–Minn.) called it. Senator William Proxmire (D–Wis.) said it might keep the aerospace industry happy, but with "a steady drain on the federal budget" of monies needed elsewhere. Senator Edmund Muskie (D–Maine), Nixon's most likely opponent in November, reaffirmed his long-standing disapproval of the shuttle, a position some congressional observers found remarkable in view of the impending Florida primary.

However the winds may blow, the President's enthusiastic support of the shuttle clearly pumped a fresh breath of life into the National Aeronautics and Space Administration, buoyed the spirits of a flagging aerospace industry and lost no friends in politically vital West Coast and southern states. As NASA Administrator James C. Fletcher noted, it will take 6 years to transform the shuttle from a drawing board dream to a flying reality. And in that time the project will help to maintain, through the still-uncertain post-Apollo years, the huge teams of engineers and technicians assembled at Cape Kennedy, the Marshall Space Flight Center in Alabama, and the Manned Spacecraft Center near Houston.

More than that, Fletcher said, the $5.5 billion committed by the President for shuttle work will generate 50,000 jobs, half of them in California—where Nixon chose to reveal his endorsement shortly before returning to Washington to declare his candidacy for President. The 50,000 jobs, over 70 percent of which will probably go to workers earning $6,000 to $15,000 a year, will obviously help substantially to offset the loss of some 200,000 aerospace jobs in the past few years. Left unmentioned was the fact that the 50,000-job figure refers to peak employment in the shuttle project, which will not be reached until 1976–77. How many of the new jobs, and how much of the new money, is merely being sapped from existing programs to sustain the shuttle may never be fully known.

The shuttle Nixon endorsed was considerably less ambitious, and at least a billion dollars cheaper, that the shut-