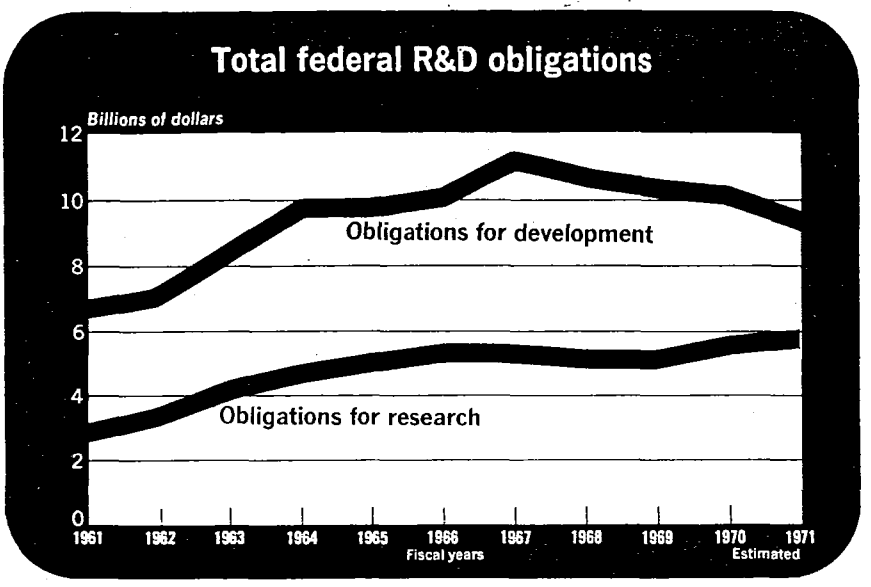
Chemical & Engineering
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BUDGET PARADOX IN R&D FUNDING

The Administration's first budget is a paradoxical victory for research and development funding. Federal support of research is boosted $260 million above the fiscal 1970 level only to be cut down by inflation to roughly the current level of $5.5 billion. Overall R&D obligations will tumble about $600 million to $15.2 billion.

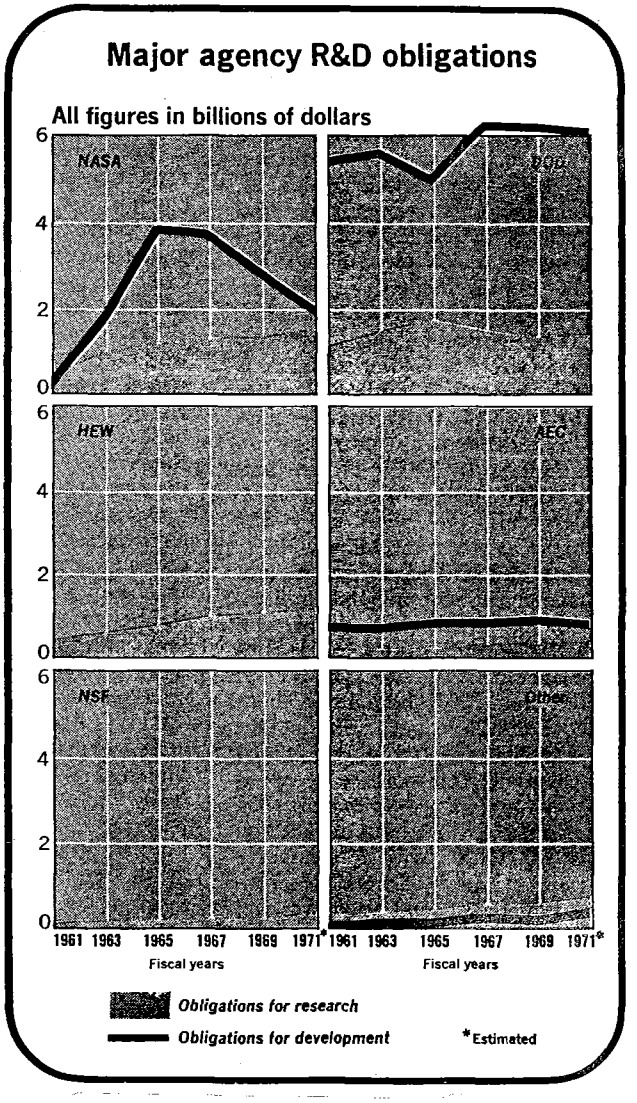
The Nixon budget for fiscal 1971 reflects a "shift in priorities . . . a turn in new directions," by targeting more money for R&D related to the solution of social problems, including those of the environment, education, housing, transportation, and crime. About 41% of an estimated $200.8 billion outlay will be devoted to human resource programs. Outlays for defense, claiming 36% of the federal dollar, will be the lowest in 20 years. The space program, with the expensive development phase of the Apollo project now over, will command little of the federal dollar.

If President Nixon has his way, the NASA budget will be about $500 million smaller next year than in fiscal 1970. NASA Administrator Thomas Paine told a press briefing that he hopes that space spending will not slip any lower, adding that the proposed budget "means substantial cutbacks and deferrals in a number of programs."

For instance, the space agency will close its Electronics Research Center and may close certain other facilities, terminate its sustaining university program, stretch out lunar missions to about two a year with a hiatus in 1972, and postpone the Viking mission to Mars. Projects that the space agency will have a commitment to undertake in fiscal 1971 include technology studies on a space shuttle and space station, building a polymer research laboratory, and beginning plans for a manned Mars mission.

While NASA struggles with its lowest budget since fiscal 1962, the National Science Foundation will have its largest budget in history. NSF obligations will be $511 million, $73 million more than appropriations for fiscal 1970. For scientific research NSF will budget $57 million more in fiscal 1971, boosting support of this activity to $292.3 million.

NSF director William D. McElroy comments that the proposed budget permits a "vigorous although austere" program of support for basic science and graduate education. NSF will budget $190 million for scientific research



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to $455 million in fiscal 1971 to $689 million to $801 million in fiscal 1974. Estimates of spending at integrated steel mills, asphalt plants, batching plants, hydraulic cement plants, gray iron foundries, sulfate pulp mills, oil refineries, and sulfuric acid plants are projected to increase from $42 million to $82 million in fiscal 1971 to $76 million to $142 million in fiscal 1974. For most industries annual costs of controlling these emissions are less than 2% of each industry's projected 1974 shipments. The sulfuric acid industry is an exception; control cost is 12.7%.

R&D RESOURCES: Slowing Growth Rates

R&D spending by government and nongovernment sources may reach a record high of $27.2 billion this year, according to a report issued last week by the National Science Foundation. "National Patterns of R&D Resources, 1953–70" states that this figure is $1 billion, or about 3.8%, higher than the estimated 1969 level of $26.2 billion, and nearly $7 billion more than the $20.4 billion spent on R&D activities during 1965.

Almost half of the $1 billion rise between 1969 and 1970 is accounted for by research spending, which increased 5%. At the same time, development spending increased by 3%. Federal government R&D support rose only 1% over this period, while nongovernment funding, which includes industry, colleges and universities, and nonprofit institutions, increased by 8%.

Despite overall growth in scientific and technological areas between 1953 and 1970, the rate of R&D spending has decreased during the same period. For example, the total average annual growth rate between 1965–70 was only 5.9% compared to the 1958–65 average of 9.4% or the 1953–58 growth rate of 10.2%. The major reason for the decline in the growth rate has been the leveling off of all R&D spending by the Federal Government, the report says.

This relative decrease is particularly dramatic in applied research and development, which accounts for about 85% of total R&D spending, and to a lesser degree in basic research. The Federal Government's annual growth rate in 1958–65 in applied research was 11.7% as compared to only 4.4% in 1965–70. Industry, on the other hand, showed a rise in the growth rate of applied research between 1958–65 and 1965–70 from 4.8 to 6.0%. In development, the growth rate for Government dropped from 11.3 to 2.1%.

The NSF report also points out that the rate of increase of R&D scientists and engineers, like the rate of increase of R&D expenditures, has been declining in recent years. Between 1954 and 1961, the annual average rate of growth in the number of R&D scientists and engineers was 8.7%. This growth rate fell to 4.1% between 1961 and 1968. In 1968, the latest year for which figures are available, 564,600 full-time-equivalent scientists and engineers were engaged in research and development, 70% of whom were employed by industry.

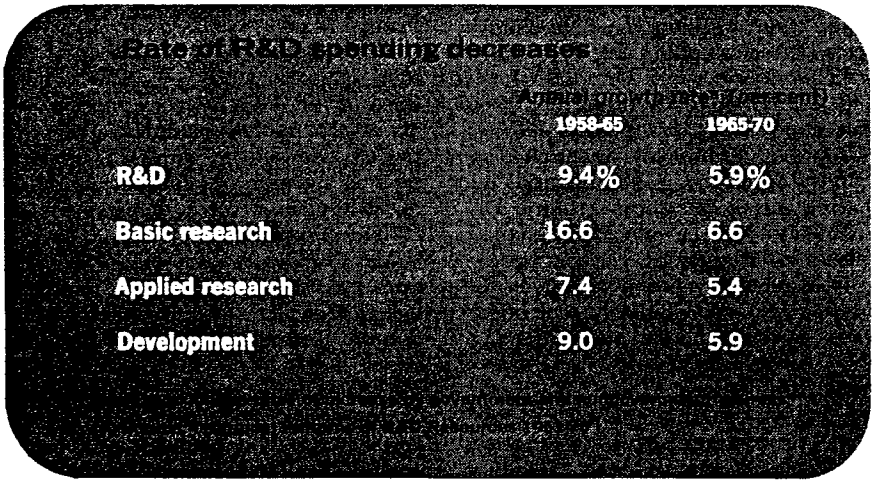
The decline in the growth rate of R&D scientists and engineers during this time may be a reflection of the decline in the number of first-year graduate students in the sciences and social sciences, a trend that is examined in another just-released NSF report—"Support of Full-time Graduate Students in the Sciences, Fall 1967." Out of 41 fields in the sciences and social sciences, only six fields showed an increase in first-year enrollment between 1966 and 1967, the foremost of these being oceanography, which increased by 4.5%. Chemistry enrollment declined by 2.5%.

"This situation," says NSF director William D. McElroy, "has serious implications for the long-term health of our scientific research potential, particularly in view of recent NSF studies projecting Ph.D. utilization in many new and needed areas—if the Ph.D.'s become available."

The report states that the decline in the proportion of first-year graduate students may be expected to continue in the years immediately ahead, assuming that there is no dramatic increase in graduate student support.

Students of engineering, psychology, and the life and medical sciences receive the bulk of their support from fellowships and traineeships, whereas students in the physical and mathematical sciences depend chiefly upon teaching assistantships. Social science graduate students, more than any other, rely on personal and family resources for support.

For six scientific areas studied, the proportion of full-time graduate students receiving major support from federal sources varied considerably, ranging from a high of 48.8% in the physical sciences to a low of 24.9% in the social sciences. Engineering received 44.3%.



PVC: Plastic in Plumbing

B. F. Goodrich is calling 1969 a landmark year for vinyl plumbing pipe. The Cleveland-based firm cited action taken last year by both the American Society of Testing and Materials (ASTM) and the Federal Housing Administration, as well as increasing acceptance by plumbers and individual code groups as reasons for optimism about PVC's future in the plumbing pipe market.

In 1969, consumption of PVC for drain, waste, and vent (DWV) piping systems rose to a record level of 30 million pounds, compared to about 20 million pounds used in 1968, says R. T. Holtz, Goodrich's manager of market development for rigid vinyl piping. For 1970, Mr. Holtz predicts about a 33% growth, with consumption topping 40 million pounds.

Accompanying the growth of PVC for DWV was a 30% increase in the use of chlorinated polyvinyl chloride (CPVC) pipe for hot and cold water distribution systems, Goodrich says.

Plumbing distribution systems may be a particularly dynamic market for chlorinated PVC in the near future as a result—at least in part—of ASTM's action "which gives code officials a recognized standard of quality," Goodrich notes. In like manner, FHA's "Use of Materials Bulletin" No. 53, which for the first time permits use of PVC-DWV piping in new multifamily structures (not exceeding six stories) and for horizontal branches

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in any structure, should give impetus to PVC's growth.

Operation Breakthrough, the Department of Housing and Urban Development's program to build 26 million housing units in 10 years, places its emphasis on ease of fabrication and lower costs, two criteria that B. F. Goodrich believes PVC piping can help satisfy.

Though CPVC stands largely alone among plastic piping materials in hot and cold water plumbing distribution systems, PVC itself has a less clear-cut edge in DWV systems and other uses. PVC accounts for somewhat more than 40% of plastic pipe use, styrene rubber has about 25% of the business (principally in sewage pipes), polyethylene—used largely in water mains—rings up about 18% of the action, and ABS trails with from 13 to 15% of total plastic pipe sales.

ABS, however, is currently a bigger factor in DWV piping than is PVC. This fact, along with the as-yet undecided battle for the water main and sewage line markets now dominated by polyethylene and styrene rubber (among plastics), is causing Goodrich and others to keep their hands in both ABS and PVC.

DETERGENTS:
NTA Is Best

In the continuing search for substitutes for phosphate builders in detergents, nitrilotriacetic acid (NTA) may be the best one found so far, according to Charles C. Johnson, Jr. administrator of HEW's Environmental Health Service. Speaking at the 43rd annual convention of the Soap and Detergent Association (SDA) in New York City, Mr. Johnson said that NTA is 70% degradable by biological sewage treatment. Animal experiments have revealed no genetic effects, he added, and no evidence of acute toxicity from NTA.

Phosphate builders, which have been branded by environmentalists as major pollutants, are detergent-enhancing ingredients. Among other functions, they soften water, sequester dirt, buffer, and prevent stains. Spokesmen for the detergent industry claim that there is no safe, adequate substitute for phosphates that can be supplied economically. About 2 billion pounds of phosphate builders are consumed per year. NTA production capacities total about 100 million pounds per year.

Industry spokesmen also maintain that phosphorus is only one of some 15 to 20 nutrients that can cause eutrophication (overfertilization of lakes and streams which results in choking algal growths and drastic consumption of the oxygen).



HEW's Johnson
Looking closely at enzymes

But government agencies continue to apply pressure for the elimination of phosphates in detergents because these are the most readily controllable nutrients. One suggestion from Government is that phosphate content should be announced on product labels, allowing housewives a choice between polluting and not polluting. Industry spokesmen feel that housewives will opt for cheap cleaning power, which requires phosphates.

Mr. Johnson says that government agencies are also looking closely at respiratory and dermatological problems associated with the enzymes in some detergent formulations. There is increasing concern for workers who have incurred ailments from dust, fumes, chemicals, and noise. And an Administration-backed bill concerning general occupational health and safety is now before Congress.

Elizabeth Hanford, executive director of the President's Committee on Consumer Interests, says that her office has received a number of complaints about detergents, including claims that washing machine linings peeled after use of enzyme detergents.

General Electric's Dr. Leo Loeb told the SDA convention audience that enzymes in detergents have necessitated additional research on laundry appliances. The material requiring the most careful scrutiny, Dr. Loeb says, is the porcelain enamel finish inside the typical washer.

The quiet revolution going on in the fiber makeup of the typical home wash load—synthetics are displacing cotton—will force innovations in detergent formulations, too, Dr. Loeb predicts. Laundry hardware and detergent products have been tuned over the years for washing cotton.

PACKAGING FILMS:
Clearly Cellophane

Polyethylene film continues to dominate the packaging market with a current volume of about 900 million pounds. Gaining in use are polyvinyl chloride, polypropylene, and polyvinylidene chloride films. But cellophane is "very much alive today among all packaging films" and is firmly entrenched in the second place slot, FMC's William E. Coggins told the glycerine division of the Soap and Detergent Association, meeting in New York City.

Cellophane hit its peak in the U.S. in 1960 when demand rose to nearly 440 million pounds per year. "We know the market for cellophane is mature," says Mr. Coggins, who is market planning manager of film products at FMC's American Viscose division. Demand in 1970 will be "somewhat under" 340 million pounds. The forecast for the next 10 years calls for further decline until the mid-1970's when, he believes, the industry will experience a level market followed by a slight rise in consumption tied to the general growth of the economy and increase in population.

Cellophane lost two lucrative markets to polyethylene and PVC films in the past few years. Polyethylene pushed cellophane out of a 100 million pound-per-year packaging market for baked goods. PVC stretch and shrink films usurped the second market of nearly 50 million pounds per year used in wrapping fresh meats and produce.

The use of polyethylene in the wrapping industry has nearly quadrupled in the past 10 years. Among its major advantages are low cost, inertness to most chemicals, good durability and tear resistance, and impermeability to moisture. Polyethylene is already extensively used in laminating and extrusion coating of films, and Mr. Coggins sees significant growth for polyethylene film in shrink packaging of case loads and pallet loads.

Among other films widely used by the wrapping industry, PVC ranks third with current consumption of about 90 million pounds. Polypropylene is fourth with 75 million pounds and polyvinylidene chloride is in fifth place with a demand of 22 million pounds.

Mr. Coggins sees moderate growth rates for PVC, polypropylene, and polyvinylidene chloride films over the next decade. Among packaging films which aren't likely to show appreciable gains are polystyrene (current consumption 14 million pounds), polyester (8 million pounds), and polyamide (5 million pounds).

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