The original documents are located in Box 31, folder "Science (1)" of the James M. Cannon Files at the Gerald R. Ford Presidential Library.

Union Calendar No. 564

93d Congress, 2d Session - - - - - - - - House Report No. 93-1184

FEDERAL POLICY, PLANS AND ORGANIZATION FOR SCIENCE AND TECHNOLOGY

INTERIM REPORT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

U.S. HOUSE OF REPRESENTATIVES

NINETY-THIRD CONGRESS

SECOND SESSION

Serial P

JULY 1974

JULY 10, 1974.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., July 1, 1974.

Hon. CARL ALBERT,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: I am transmitting to you herewith the first Interim Report of the Committee on Science and Astronautics dealing with Federal Policy, Plans and Organization for Science and Technology.

This report, brought out as a committee print and staff report last month, has resulted from the initial phase of a comprehensive inquiry begun by the committee in July 1973. As part I of the report explains, we expect this investigation to continue until mid-1975—at which time a decision should be forthcoming as to what further action the committee may wish to take as a result.

Sincerely yours,

OLIN E. TEAGUE, *Chairman,*
Committee on Science and Astronautics.

Union Calendar No. 564

93D CONGRESS, 2d Session } HOUSE OF REPRESENTATIVES { REPORT No. 93-1184

FEDERAL POLICY, PLANS AND ORGANIZATION FOR SCIENCE AND TECHNOLOGY

JULY 10, 1974.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. TEAGUE, from the Committee on Science and Astronautics, submitted the following

INTERIM REPORT

LETTER OF SUBMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., June 10, 1974.

Hon. OLIN E. TEAGUE,
Chairman, Committee on Science and Astronautics, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: A year ago, at your direction, this committee began the first phase of a comprehensive and continuing inquiry into Federal Policy, Plans and Organization for Science and Technology. Inaugurated by hearings in July 1973, the inquiry has continued through further study and examination by our own staff, the Science Policy Research Division of the Congressional Research Service, the Committee on Science and Public Policy of the American Association for the Advancement of Science and the Federal Science and Technology Committee of the Industrial Research Institute.

This report, which is a summation and record of the first phase, also includes tentative observations and findings which may be augmented during later stages.

It is my belief that the report, prepared under the direction of staff member Philip B. Yeager, will be a valuable addition to existing documentation on this very important matter as well as a guide to those who will be involved with future phases of the inquiry.

Sincerely,

JOHN L. SWIGERT, Jr.,
Executive Director.

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PART I

BACKGROUND AND TENTATIVE FINDINGS

FOREWORD

The past decade has been one of unusual importance for the Federal role in science and technology. It was also one of considerable fluctuation in Federal support and, while strongly influenced by space and security needs, included marked advances in virtually all R&D areas.

This period saw the formation of a number of congressional committees designed to deal with the scientific upsurge. Among these was the Science, Research and Development Subcommittee of this committee, established in August, 1963. Others included the House Select Committee on Government Research [known as the Elliott Committee], the House Subcommittee on Research and Technical Programs of the Government Operations Committee, the Senate Government Operations Study of Executive Reorganization for Science, the Senate Subcommittee on Government Research (the latter two under the Government Operations Committee), and the Senate Small Business Subcommittee on Science and Technology.

During the same period significant developments, both programatic and organizational, were taking place within the Executive Office of the President and throughout the various departments and agencies. One of the most important of these was the establishment of the Office of Science and Technology within the Executive Office—initiated in 1962 but not fully operative until several years thereafter. OST was set up to assist the President in coordinating and evaluating science activities across the broad spectrum of the government.

During the mid-1960's Federal support for R&D reached a relative peak of about $16 billion, a little more than 12½ percent of the total Federal budget outlay. [In 1950 total Federal R&D support was $1.1 billion, or 2.5 percent of the Federal budget.] By 1967, however, national attention was focusing elsewhere; dissension existed throughout the country for a variety of reasons; some were saying an anti-technology trend had set in. Whatever the cause, the Federal effort in support of science and technology began to drop, at least relatively, and has been dropping ever since. The nearly $16 billion obligations for R&D in 1965 has increased to a little over $18 billion in 1974; expenditures from $15 billion to about $17.5 billion. This is a reduction in relative effort from 12.6 percent of the Federal budget to 6.5 percent in expenditures, and from 13.3 percent to 6.8 percent in obligations. That trend has been consistent since 1965 and represents a fall-off of effort in absolute as well as relative terms when inflation is taken into account.

This shifting situation caused the SRD Subcommittee to hold a series of hearings on national science policy in 1970. Subsequently, a

report was issued in October of that year which contained both a rationale for the development of a national science policy and specific recommendations for carrying out such a policy. Consistency of support was a key theme. (See p. 165.)

In March 1972, the President sent Congress a special message urging renewed emphasis on science and technology, with particular attention to applications. The message indicated that something over $700 million in new money was being requested for civilian R&D programs. Only two programs totalling about $40 million subsequently came into being; these were the so-called Technology Innovation Programs of the National Science Foundation and the National Bureau of Standards, designed to accelerate new technology into industrial and consumer use. Such programs, initially slowed by impoundment action of OMB, have never approached their planned level.

A major shake-up in the Federal science establishment occurred in January 1973 with the announcement of the President's Reorganization Plan No. 1, to become effective July 1. Under that plan the Office of Science and Technology was abolished and many of its functions transferred to the Director of the National Science Foundation. At the same time, the President did away with the Office of the President's Science Adviser as a separate top-level entity and the President's Science Advisory Committee; the remnant functions of these offices (national security excepted) also appear to be lodged with the NSF director. Another coordinating institution, the Federal Council for Science and Technology, was retained but with the Director of the Foundation designated as its chairman. NSF itself is providing the funding and personnel to handle these added tasks.

The Reorganization Plan was reviewed briefly by the Government Operations Committees of both houses. No other action was taken, which was tantamount to congressional approval of the plan.

Meanwhile, during the late '60s and the early '70s virtually all the special congressional committees involved with science and technology disappeared. While several new ones have emerged, they are primarily concerned with specific missions such as enhancement of the environment, energy or commerce. Hence, the Science and Astronautics Committee, in addition to being charged specifically with oversight of the National Science Foundation [which, together with its director, is now the repository of the major science advisory functions in the executive branch], is the only congressional committee with broad authority over science and technology per se.

In light of the foregoing, the Committee undertook the first part of an extensive review of Federal planning, policy and organization for Science and Technology through status and posture hearings in July, 1973. These described the basic Federal science and technology format and the objectives and modes of operation contemplated by the Executive.

The next step is an appraisal of the first phase—and an effort to acquire, from a broad range of sources, fresh observations and views and, if necessary, recommendations for improvement. (See page 13.) This should entail not only study and critique of our national science and technology institutions, but an assessment of the causal conditions and forces most likely to shape those institutions in the foreseeable future.

EVOLUTION OF THE COMMITTEE INQUIRY

Relatively speaking, national governments have concerned themselves with Science and Technology as a functional entity for only a few years. Certainly this is true for the United States. Except for the inclusion of the patent clause in the Constitution, plus sporadic modest support of applied research aimed at immediate needs, Science and Technology did not emerge as a prominent force demanding concentrated government attention until World War II.

That story and the advances which evolved from it in the next quarter of a century—including nuclear energy and enormous strides in electronics—are well known. So also are the events which have since transpired providing equal impetus to research and development: the ICBM, the Space adventure, the "wonder" drugs and vaccines, the computer and so on.

Era of Doubt

Then, during the mid-1960s, as has been suggested in the Foreword, came the era of doubt. This Committee was among the first of the governmental institutions to feel the early tremors. In its Second Progress Report in 1966, the Subcommittee on Science, Research and Development observed:

> We are convinced that governmental effectiveness in coping with the big issues of the future will require two special attributes:
>
> (1) An ability on the part of the Government, and particularly the Congress, to see and cope with each problem in its entirety—to deal with each as a complete system and to treat the entire syndrome rather than isolated phases of it. * * *
>
> (2) A willingness to encourage and support approaches to the problems of the future which will join the social sciences with physical sciences and engineering, and which will make use of their combined powers. The necessity for this appears obvious when one looks closely at the difficulties facing modern society. Few of them will be eliminated by the application of technology alone. * * *
>
> Time was when man could afford to look upon the innovations of technology with some complacency. For the innovations came slowly, they were put to use in a relatively slow and modest fashion, and their side effects developed at a sufficiently relaxed pace to permit man to adjust to them—or to alter his course if the threat were great enough.
>
> Surely it is obvious that this day is gone. The tempo of our times can almost be described as a gait of "running away." The sum of scientific knowledge is doubling every decade or so—and our galloping technology is doing its best to stay on even terms. * * *

> We can no longer blindly adapt technology to our needs with the traditional assumption that there will be ample time to iron out any bugs on a leisurely shakedown cruise. A bigger effort must be made not only to foresee the bugs but to forestall their development in the first place. The alternative could be disastrous and indeed might turn our physical and social world into something almost uninhabitable.

In retrospect, if that thinking had prevailed in the period since World War II, our energy situation today could be somewhat happier. On the other hand, if concerns of this kind ushered in the period of genuine soulsearching toward Science and Technology by the Government, they did not arrive without occasional harbingers. One of these was the former Chairman of the Atomic Energy Commission, Glenn Seaborg, who remarked in 1955 that:

> The scientific revolution * * * is only beginning. What we have seen in the past is as nothing compared to the future. We shall be found wanting if we do not plan with that thought in mind. Our success in achieving the objectives of creative evolution require both an ever more vigorous effort in science and technology and an enormous improvement in techniques for integrating the products of science and technology into society.

In any event, while matters involving Government attention to Science organization, Federal planning for support and utilization of Science and Technology, and the development of national priorities and policies dealing with them had surfaced from time to time in prior decades—by the mid and late sixties such concerns had achieved unprecedented visibility.

By this time the public in general and the Government in particular were well aware not only of the social dividends to be reaped from the science harvest but of the potential disadvantages as well. In fact, the apparent discontent directed toward technology in 1970 moved the Subcommittee on Science, Research and Development to report:

> Our choice in dealing with science and technology—and thus our policy—is predicated on two basic questions:
>
> (1) Do we ignore them or use them?
>
> (2) If we use them—how?
>
> At this point in history it is quite clear that our Nation is committed to the use of science and technology. In fact, the Federal Government is implicitly so charged by the Constitution which entrusts to it the responsibility to "establish justice, insure domestic tranquillity, provide for the common defense, promote the general welfare"—none of which, however imperfectly innovated, could be possible without reliance upon science and technology.
>
> From the long rifle to the laser, this has been so.
>
> But even if, to this point, it had not been so, the future would require it. There is no need to reiterate the many critical problems facing modern society by way of proof. We need only take note of the fact that when, in conjunction with these problems, we are called upon to handle hard, specific questions—our answer more often than not is "I don't know." It makes little difference whether we are dealing with pollution, transportation, unemployment,

> crime, education, health care or international trade, all too often we do not have sufficient accurate information on which to base rational decisions for the years ahead.
>
> We have a plethora of questions but a dearth of answers. Answers come with knowledge. Knowledge comes with research. Research means scientific investigation—physical and social. Solutions require the *appropriate* application of research results. . . .
>
> So how do we go about it? . . .
>
> Even a cursory examination has disclosed the nonexistence of any formal or structured policy with regard to the use, support or management of science and technology. It further discloses that the Congress has never made a sustained inquiry into the question of a national science policy per se—although it has many times considered isolated facets of science policy, usually in conjunction with some specifically defined problem, program or mission.

The investigation referred to made a number of discrete, considered recommendations (page 173) which were largely ignored by both the Executive and Legislative branches. Nonetheless, an important philosophical base was created which now—four years later—is serving the full Committee well in its current inquiry.

Need for Continuing Study

Now, also, the need for an investigation which is both broad and continuing has become apparent. Hence the scope and design of this effort which is described in more detail in the next section of the report. The resulting pattern is following a natural and consistent sequence in the wake of the Subcommittee's 1970 hearings and the evolution of the Technology Assessment Act of 1972 which originated and developed in the Science and Astronautics Committee as well.

The complexity of the issue as it has finally crystallized was recognized by some authorities years ago. Alan Waterman, the first director of the National Science Foundation, was one of these. In the Foundation's 1961 annual report, Dr. Waterman discussed it in these terms:

> The question of central coordination and planning inevitably raises the question of policy—concerning which there has been much discussion. The insistent question is, What is our policy with respect to science and technology? * * *
>
> But, before answering that question, let us examine what is meant by policy.
>
> What is the meaning of a national policy for science? Is it the same as policy for scientific research and education? If not, with what is it concerned? Does national policy mean the policy of the Federal Government, for the country, or in terms of its own activities?
>
> Webster's New International defines policy as "A settled or definite course or method adopted and followed by a government, institution, body, or individual." By extension, this means the principles under which an organized group consciously and deliberately operates or aims to conduct itself and its activities. An essential element is awareness, that is, the planned and purposeful nature of the theory and practice of the activities of the organization. Thus, policy may run all the extremes between complete

laissez-faire and rigid autocracy, but neither is policy unless planned and encouraged. * * *

Viewed in broad perspective, the whole matter of national science policy may be summed up as follows: For any nation, science and technology constitute an essential element of progress and, in particular, of national security and economic strength. For this country to exercise leadership in a competitive world, it is essential that policies and practices be developed along the following lines:

(1) The vigorous cultivation of science not only along the paths of foreseen objectives but also throughout its breadth and depth. In particular, this means thorough attention to the education and training of the scientists and engineers that will be needed. * * *

(2) Among the possible developments that may result from science, careful attention must be paid to those that offer greatest promise in the accomplishment of our objectives. Such selectivity is important in maintaining a sound economy.

(3) A strong effort should be undertaken to educate our people to a general understanding of the purposes of science and technology, their potentialities, and their limitations in order that wise and intelligent use may be made of these capabilities.

But we cannot stop here. In an age where science has given us the key to unlock the energy of the atomic nucleus and has shown us the feasibility of escaping our planet and exploring the universe, we must understand that the capital discoveries of science are only just beginning and that science and technology will inevitably raise issues of the deepest social significance. * * *

To solve these major problems and maintain any kind of equilibrium will require the utmost of all participants. Whether future developments take the form of stupendous power over nature's resources, of influence and control over life or over man's minds, or of traffic with our sister planets, they will certainly create problems of such concern to the human race that mankind must learn to cooperate in their solution.

Major Policy Changes

At that point in the history of science policy development, the National Science Foundation was about to be stripped of its original statutory responsibility for coordinating and evaluating the support and conduct of basic research throughout the Federal government. This was a task which Congress had bestowed on NSF without providing it with either the authority or status within the Federal hierarchy to do the job. Dr. Waterman had found the task impossible and said so. He was clearly relieved to have this duty removed from NSF through Reorganization Plan No. 2 of 1962. Under the Plan this same duty fell to the new Office of Science and Technology, leaving the Foundation primarily with the function of supporting basic research and science education through academic and non-profit organizations.

However, another cardinal shift in policy appears to have begun with the National Science Foundation Amendments Act of 1968 which authorized NSF, under special conditions, to engage in applied research. This Act had been preceded by a number of internal Presidential directives from President Johnson to the major research agencies of the Federal government to concentrate funds and efforts in areas designed to produce rapid results. President Johnson left little doubt in anyone's mind that a quick return on our scientific effort was uppermost on his own.

In rapid order there followed the so-called Mansfield Amendment which, though technically applicable for only a short period of time with regard to Defense Department appropriations, had the effect of reducing some of the support of basic research by the "mission agencies." The Mansfield Amendment, simply stated, stipulated that the Defense Department should not support basic research except in cases where a tangible defense objective could be identified.[1] While many scientists, and others, considered the Amendment to be cast as a contradiction in terms, the philosophy behind it nonetheless spread. Other agencies caught the drift quickly and in practice began to follow suit.

Added to these trends, and in spite of the pronouncement of the Nixon Administration in March 1972, which espoused the cause of Science and Technology as an ingredient in the solution of major contemporary problems, most Federal agencies moved rapidly in the direction of applied research and development. The theme of the Office of Management and Budget came through quite clearly as one of concentration on the kind of research oriented toward the rapid use of either "off the shelf" technology or applied science. The objective, in most cases, seemed to be the "quick fix." This *modus operandi* extended to the National Science Foundation itself, to the extent that the intent behind the 1968 expansion of the total research mission of NSF became distorted—so much so that in a few years NSF found itself expending almost a quarter of its total research support on applied research.

As might be expected, during the course of this metamorphosis lessons of the past regarding the dependence of applied technology upon the findings of basic research were, if not lost from view, perceived rather dimly. Few seemed to recall that virtually all of the "breakthroughs" which permitted the development of such devices as nuclear power, radar, jet propulsion, transistors, antibiotics and the like, had been based purely upon findings resulting from the efforts of men and women whose motivation was in large part one of curiosity and a thirst for knowledge.

The movement toward scientific pragmatism, then, is a major one which the Committee will consider as it looks at other more tangible problems definitively linked with planning and organization.

Relevance of Research

It is not difficult to see, in the foregoing context, that the enlistment of science and technology in the cause of such matters as a strong economy, international relations, sufficient energy, clean environment, and the availability of critical materials will be lengthy and complex; possibly controversial. In fact, the very relevance of Science and Technology *per se* and the measure of its use will doubtless be called into question.

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[1] Public Law 91–121, Sec. 203, specified that "None of the funds authorized to be appropriated by this Act may be used to carry out any research project or study unless such a project or study has a direct or apparent relationship to a specific military function or operation."

The Committee is cognizant of the first of a series of "White Papers," issued by former Presidential Science Adviser Edward E. David, which concluded with the following observation:

> We now have the problems of overpopulation, of pollution, of diminishing resources, of the risk of totally-destructive war-weapons. But what is the solution? A retreat from technology? Impossible. We can retreat from technology only by arbitrarily decreasing world population and restricting man's range. Mankind has never agreed to arbitrary restrictions and he never will voluntarily give up the benefits of technology. He knows he has far more to lose than gain.
>
> The solution is exactly the same as it has always been: the still further advance of technology. One solution lies in new and unlimited sources of energy, which are clean and safe. With such energy, man can clean the world, recycle its resources, reduce its inequities.
>
> Can we be sure that science and technology will find the answers? Can we be sure that solutions to our problems exist? No, but we can be sure that nothing but science and technology can find them, if they do exist.
>
> To put it as bluntly as possible: Science and technology must answer our problems. If they don't, nothing else will.

While it is tempting to espouse this theme wholeheartedly, in the interests of fairness and an approach as devoid of bias as possible the Committee at this point has indicated no assumptions of any kind—including the *relative* value of Science and Technology as an instrument for improving the public welfare.

THE COMMITTEE PLAN

By way of translating the need for this inquiry into action, the Committee designed its proposed investigation into three major segments.

The Initial Phase

The first part was devoted primarily to eliciting information on the background and status of the contemporary Federal posture on science and technology.

The purpose was to derive an accurate view of just what the policy and planning situation is—with regard to goals, programs, and organization. The Committee reviewed appropriate historical and background material. So far as possible it tried to ascertain what plans were and are contemplated for carrying out the objectives asserted by the President in both his Science and Technology Message of 1972 and his Reorganization Plan No. 1 of 1973.

To repeat, that reorganization plan eliminated the Office of Science and Technology from within the Executive Office of the President and transferred its functions to the Director of the National Science Foundation. This action was done statutorily and became effective on July 1, 1973.

The President also apparently did away with the Office of Science Adviser to the President (at least in its traditional Special Assistant sense) and with the President's Science Advisory Committee—with the remnant functions of these offices (the military excepted) likewise transferred to the Director of the Foundation. The inter-agency Federal Council for Science and Technology, consisting of representatives of all the science-oriented agencies and which has always been chaired by the President's Science Adviser, is also chaired by the Director of the Foundation.

Among other reasons, the first set of hearings last July was held partly in response to the need for studying the effect of the reorganization plan and partly because of this Committee's oversight responsibility of both the National Science Foundation and science and technology generally.

It is significant that as those hearings opened, Chairman Teague took special notice of the apparent fall-off of Federal support for science and technology:

> I do not wish to dwell on the trends of Federal support for science and technology over the past decade or so. But I do wish to point out that of the six committees of Congress which existed during the middle sixties with the function of studying and keeping track of Federal research and development efforts, only this committee remains today.
>
> I should also like to point out, at least dollarwise, the peak Federal effort in supporting scientific research and development which took place in the mid-sixties has been diminishing. Where

the Federal Government put 12.6 percent of its budget into research and development in 1965, it is today putting an estimated 6.4 percent of its budget to this use. And while Federal obligations for research and development have increased an estimated 9 percent since 1965, the inflation factor has increased from 35 to 39 percent, depending upon what index is used.

I think the implications of these facts are clear. Government attitude toward and support of science and technology is not what it was a few years ago. Without presently attempting to define this trend as right or wrong, it is incumbent upon this committee to try to find out what is happening and why.

The hearings were held July 17–24, 1973, and included most officials who are in charge of the overall Federal science effort. Witnesses were as follows:

Dr. H. Guyford Stever, Science Adviser to the President and Director, National Science Foundation; accompanied by Dr. Russell C. Drew, Director, Office of Science and Technology Policy, Dr. Lloyd Cooke, Chairman, Planning-Policy Committee, National Science Board, and director of urban affairs, Union Carbide Corp., New York; Dr. Raymond L. Bisplinghoff, Deputy Director of National Science Foundation and Dr. Paul F. Donovan, Head of the National Science Foundation Energy Task Force.

Dr. William O. Baker, president, Bell Telephone Laboratories, and ad hoc adviser to the Administration on technological matters.

Dr. John C. Sawhill, at that time Associate Director for Natural Resources, Energy and Science, Office of Management and Budget.

Dr. Edward E. David, executive vice president, research and development and planning, Gould, Inc., former Science Adviser to the President.

Mr. William D. Carey, vice president, Arthur D. Little, Inc., formerly chief of Science and Technology for the Bureau of the Budget.

Hon. George P. Shultz, then Secretary of the Treasury and special assistant to the President on economic and domestic affairs (written response to questions only).

Following the hearings and subsequent to preliminary review of them by the staff, the Committee requested a critique of the information and plans disclosed by the hearings from three different organizations:

(1) The Committee on Science and Public Policy of the American Association for the Advancement of Science.

(2) The Federal Science and Technology Committee of the Industrial Research Institute.

(3) The Science Policy Research Division of the Congressional Research Service, Library of Congress.

The work of these groups in response to the request has been completed, and the three reports are carried in full in Part II of this report. Each has identified a variety of issues and problems which the respective groups believe need to be further probed. The reports are summarized beginning on page 16.

The Current Phase

In the near future the Committee expects to resume its hearings with major emphasis on the views, commentary and criticisms of non-government witnesses who will, hopefully, represent a broad variety of background and thought.

It is further intended that this report and the materials contained in it—together with the first phase hearings—will provide a general base for the second phase of the hearings.

In this regard, it is important to point out that while there have been a number of changes in key personnel as well as relationships within the Executive branch since July, 1973, it does not appear that these have seriously affected the picture presented to the Committee at that time.

In response to an inquiry from Chairman Teague, Frank G. Zarb, who succeeded John Sawhill in the Office of Management and Budget, stated: "In reviewing Mr. Sawhill's testimony, I find that I am in agreement with the points of view he expressed." (See page 233.) Dr. Baker has indicated no substantial change from the ad hoc science advisory arrangements originally contemplated. Finally, the departure of Mr. Shultz as Secretary of the Treasury and as the conduit to the President for science advice, according to the 1973 reorganization, seems unimportant; there has been little evidence that Mr. Shultz' role was ever much more than pro forma.

For these reasons, it is believed the Committee can reasonably proceed with its plans without undue concern that the Executive science policy apparatus has altered drastically since the initial phase began.

The Future Phase

When the Committee has finished the hearings now contemplated—and it may be necessary to extend these depending on the nature of their contents—it plans the following action:

(1) Intensive staff study of the information and views received.

(2) Based on such study, the solicitation of a wide range of additional written commentary designed to supplement oral testimony and to accommodate those unable to appear as witnesses.

(3) The issuance of a second interim report by the Committee containing an advanced set of findings and possibly suggesting alternative courses of action for both Legislative and Executive branches in order to make more effective use of science and technology.

By the time the foregoing plans are completed and the hearings of the second phase have been available long enough to be digested, the contemporary Federal mechanisms for promoting and carrying out policies, plans and organizational structure to deal with science and technology will have been in operation for approximately two years.

At this point, the Committee would expect to undertake a third hearing phase—this time to make a concrete assessment of how well or how poorly our Science and Technology programs have turned out, the reasons for their effectiveness or lack thereof, and, if warranted, the promulgation of legislation to accomplish significant alterations of the system.

AREAS AND ISSUES FOR STUDY

The Committee's request for observations and comments on its July 1973 hearings produced three reports which presented three substantially different approaches. The AAAS subcommittee focused on substantive policy needs. The Congressional Research Service examined policy implications of the hearings, concentrating upon organizational issues and questions. The study group of the Industrial Research Institute likewise addressed organizational aspects.

While each group had the record of the hearings, none of them was limited to its content. Rather each could address observations and issues for future inquiry and hearings.

A comparison of principal issues and questions identified by the three groups and by the Committee appears in the matrix to follow.

Note that the three groups each mentioned:

Coordination and evaluation of Federal science activities;
The role of the Science Adviser in military R&D;
The functioning of the NSF's Science and Technology Policy Office;
The multiple assignments of the Science Adviser together with possible consequent conflicts of interest; and
Access to the President.

At least two of the groups identified the following additional items for future attention:

Advice for science policy;
Advisory bodies for science policy;
An annual report on science policy;
Budgeting for science and technology;
Decisionmaking and priorities re science policy;
Functions of the Federal Council for Science and Technology;
Implementation of Reorganization Plan No. 1;
The OMB and science policy;
The role of the Committee on Science and Astronautics;
Stability of funding for science and technology; and
A strategy for science policy and programs.

MATRIX OF TOPICS

Issue	AAAS	IRI	CRS	Committee hearings
Advice for science policy		X	X	X
Advisory bodies for science policy		X	X	X
Annual report		X	X	
Budgeting for science and technology	X		X	
Responsibility of Congress	X			
Role of Committee on Science and Astronautics	X		X	
OMB responsibility	X			
Stability of funding	X		X	
Congress: Ability to get information for science policy			X	
Centralization for science policy			X	X
Coordination and evaluation	X	X	X	X
Decision making and science policy	X			
Defense R. & D		X	X	X
Separation of military and civil science advice	X			
Role of science adviser	X	X	X	X
Civil use of defense R. & D				X
Downgrading of science			X	X
Executive Office of the President:				
The President and science policy	X			
The OMB		X	X	X
The Domestic Council				X
The Federal Council for Science and Technology		X	X	X
Transciency of present science policy organization			X	
Interagency teams for R. & D				X
International science policy	X			X
The National Science Foundation		X	X	X
Implementation of reorganization plan No. 1			X	
NSF's Office of Science and Technology policy	X	X	X	X
Role in developing new strategies for science and technology in international affairs	X			
Focus on policy research	X			
A science policy advisory committee	X			
Performance for new policy needs	X			
Public policy decisions	X			
Institutions to link R. & D. to public policy	X			
Crisis planning			X	X
The science adviser to the President:				
Access to the President	X	X	X	X
Independent advice				X
International functions			X	X
Conflict of interest	X	X	X	X
National goals	X			X
Authority to authorize R. & D		X		X
Role as adviser to an elected official			X	
Science policy:				
General	X		X	X
Agency use of science and technology	X			
Assumptions about science policy	X			
Organization for	X		X	
Objectives	X			
Gaps in				X
Planning of	X			
Institutional requirements for policy research	X			
In regulatory agencies	X			
State and local science policy	X			
Strategy for science policy and programs	X		X	X
Technology assessment	X			X

SUMMATION OF REPORTS TO THE COMMITTEE

To indicate further the issues and questions raised in the three reports set out in Part II, there follows for each a summary of principal observations, recommendations and questions.

The AAAS Committee on Science and Public Policy

The subcommittee of the AAAS committee suggested an issue-oriented framework for evaluating new organizational arrangements for federal policies for science and technology. Its comments were presented in five sections that included many questions for future consideration.

Section I. The context of science and technology policies in the seventies

Science policy [1] in the mid-seventies operates in a situation different from that of the fifties and sixties. Some of these differences will affect its future substance and organization.

Declining budgets mean harder choices.—The experience of no-growth Federal budgets for research and development [2] together with a larger number of federal agencies engaged in R&D require improved capabilities to determine the need for and use of R&D investments for specific policy objectives. These developments place demands upon several categories of policymakers.

For Federal agencies, competent planning and evaluation is required to determine the agency's need for and use of R&D investments.

For the OMB, the need is more imperative than ever to choose intelligently among competing claims and, in making these choices, to avoid substituting its judgment on goals, policies, and programs for that of the President or of Congress.

For the NSF's Office of Science and Technology Policy (STPO), in addition to directly advising OMB on R&D allocations for specific programs, STPO must provide OMB with information concerning the long-term effects of changes in R&D funding in specific programs and areas.

For the Congress, it must perform program review and budget allocation with three objectives in mind: (1) to allocate R&D funds more consistently with a careful and deliberate judgment of national priorities; (2) to ensure that the scientific and technical capabilities of the nation are uniformly strong enough to meet new needs as they

[1] The AAAS committee defines "science policy" to mean "science and technology policy."
[2] Apparently the Committee did not take into account the substantial increase in Federal funding for energy R&D now about to emerge from the legislative process.

arise; and (3) to assure the inherent health of science and technology as basic national resources.[3]

Questions proposed for future consideration included:

(a) What has been the experience in allocating a no-growth R&D budget among changing claims?
(b) Have long-term concerns, such as support of basic research and graduate training, suffered unduly?
(c) How can the STPO strengthen its contribution to preparation of the President's proposed budget?
(d) How can Congress help in achieving a balance between responsiveness to new needs and ensuring adequate funding for long-term tasks?
(e) How can the House Committee on Science and Astronautics serve the proposed joint budgetary committee of the House and Senate?

Science policy must be considered as part of public policy decisions.—The AAAS subcommittee sees policy makers in need of a better understanding of how science and technology fit into the policy process, where science and technology need to be encouraged, and where discouraged as the public interest demands caution. "Science policy, in other words, needs to be integrated into general policy planning and program evaluation."

Questions posed for this theme included:

(a) Should science policy considerations be integrated into the decision-making process in much the same way that economic, financial, and social factors are?
(b) To the extent one opts for a strategy stressing integration, how ought the science policy function be organized in agencies and departments?
(c) What special problems arise due to the risk and uncertainty which are characteristic of science?
(d) Is there a need to supplement agency efforts in linking science to policy goals with attention to the overall coherence of the nation's R&D capacity? Should this be a responsibility of STPO for the government and of the House Committee on Science and Astronautics for the Congress?

Different science policy strategies are needed to meet the variety of policy goals.—The need for planning and improving the operations of complex social systems (as opposed to development of items of technological hardware) reveals two goals for national science policy: (1) To provide financial and other incentives to further the growth of institutions capable of problem-oriented policy research and social demonstration and experimentation; and (2) to develop a more comprehensive policy-oriented way of generating and using knowledge in major policy areas—such as defense, natural resources, or human development.

Questions posed for consideration included:

(a) How can science and technology contribute to meeting national goals during the years head?
(b) Should science and technology contributions to different policy areas be more policy-specific?
(c) How should this be done?

[3] The AAAS Subcommittee notes that these objectives are difficult to translate into concrete Congressional action, partly because Congress does not review the budget as a unitary body, and partly because short-term and long-term needs have to be carefully balanced.

Science policy requirements of State and local governments are changing.—The AAAS subcommittee expects that the gradual shift of government priorities in the direction of quality of life, state and local governments will become more involved with technological issues, and in need of a new kind of science advice. It would have State, regional and local governments develop their capabilities for policy planning and analysis and for program management. The Federal government should shift its emphasis from assistance in creating scientific advisory mechanisms to assistance in improving the quality of state and local policy planning and analysis and program management.

Questions posed included:

(a) What has been the experience with Federal science policy assistance to state and local governments to date?

(b) What are the principal science policy needs of state and local governments in the years to come?

(c) How can the Federal government help to meet the science policy needs of state and local governments?

International science policy cooperations demands rethinking.—The extension of many national problems across international boundaries—in matters of environment, limited natural resources, shortages of food, population control, and public health—illustrate urgent problems which can be addressed only on an international scale. Many of them are directly related to science and technology in origins, solutions, or both. Increased international cooperation is necessary. The starting point is a rethinking and reform of relations among nations which are increasingly interdependent, and impact on each other through their industry and growth. Plans and institutions for a truly international science policy should be designed and readied for action.

Questions posed included:

(a) What has been the experience with bilateral or multi-national cooperative projects in science and technology?

(b) What new approaches are required to deal with worldwide problems such as man-made changes in the environment or shortages of natural resources?

(c) What should be the respective roles of STPO, the Department of State, and other Federal agencies in developing a new strategy for science and technology in international affairs?

Section II. The need for diversified strategies for science and technology

Section II develops the concept of sectorial policies for science and technology and draws the organizational implications of that approach. Specific strategies for linking knowledge and action in major policy areas need to be developed for, among others, national security, foreign policy, economic development, infrastructure development [4], physical environment and natural resources, social programs and human resources, and advancement of science and technology.

Assumptions about science policy and their organizational implications.—The AAAS committee identified three major assumptions for science policy during the fifties and sixties.

(1) Science and technology were integral components of many policy issues and therefore were the legitimate business of several departments and agencies of the government.

[4] Including energy, transportation, and communications.

(2) Science and technology figured importantly in Presidential decisions, and that therefore a scientific advisory body of the highest quality and objectivity is needed to serve the head of state and his policy planners.

(3) The foundations of the scientific enterprise needed sustained Federal support and therefore specialized institutions—NIH and NSF—had to be developed to provide this support.

These assumptions need reassessment as to their present validity and need for change. The AAAS subcommittee recommended that the Committee on Science and Astronautics focus its future hearings on the entire range of institutions involved in the discharge of science policy recommendations, including those of Federal agencies as well as State and local governments, academic institutions, industry and other R&D centers.

Specific questions suggested included:

In the past, Federal science policy was structured around three organizational objectives: a basically decentralized approach to federal R&D activities; the provision of direct science policy advice to the President; and the availability of support for basic science and graduate training from science-oriented agencies.

(a) Are these goals still valid?

(b) What changes, if any, are required?

(c) What new principles, if any, need to be added?

(d) If the above goals are still valid, how have they been affected by last year's science policy reorganization?

Diversity in Agency uses of science and technology.—The AAAS subcommittee suggests that decentralization of major R&D programs among individual agencies has its limitations, and indicates that the agencies have yet to develop specific and detailed connections between their policy missions and their R&D programs. One should know whether, and in what detail, departments and agencies with major R&D responsibilities have defined and developed their objectives and methods for science and technology in terms specific to each agency.

Science policy and regulatory agencies.—The AAAS subcommittee breaks new ground in pointing to the direct impact of regulatory agencies upon R&D efforts and directions, decisions that can impose constraints and create uncertainty that may curtail important R&D, often unknowingly. The effects of FPC regulation of the price of natural gas upon developing the technology of coal gasification is an example that raises the question whether the FPC considered this effect at all, and whether FPC consulted with science policy leaders at the time. It is vital, according to the AAAS subcommittee, that all regulatory policy decisions be examined as to their implications for science policy. This is the responsibility of the regulatory agency involved, and for the NSF's Science and Technology Policy Office and the Congressional Office of Technology Assessment. These offices should become active when regulatory agency research ignores these implications.

Social R&D.—Science policy should also extend to agency social experimentation or demonstration and agency evaluations of different social intervention strategies. Innovations in agency activities should be viewed as a policy tool encompassing demonstration and evaluation as well as traditional R&D.

R&D strategies for broad policy areas.—Additional argument for stronger relationships between R&D and agency policy can be made in view of the trend towards grouping Federal agencies in broad policy clusters. "Goals, needs, resources, programs, and implementation arrangements need to be defined in terms of the policy environment characteristic of each agency." It would be desirable to examine the different ways Federal departments and agencies relate their R&D to the policy missions for which they are responsible, and to ask: How are results of R&D programs brought to bear on the policy planning and evaluation process? At what level in the agency does this effort toward integration and feedback take place? What results are achieved? What plans exist for improvements?

A suggested format for examining agency science policies.—The AAAS subcommittee suggested that the heads of several agency policy planning and evaluation be asked to appear at hearings. If the results prove useful, OTA could be invited to hold hearings on agency science policy, examining one agency at a time. Later, a more ambitious examination could be undertaken, focused upon major policy areas that involve several agencies so as to delineate the division of labor among them and to highlight organizational issues. Such science policy reviews might inquire into national security, foreign policy, economic development, infrastructure development (energy, transportation and communications), physical environment, natural resources, social programs, human resources, and advancement of science and technology.

Questions suggested included:

(a) What are the science policy objectives of agencies administering major R&D programs?
(b) How are science policy implications of regulatory decisions assessed?
(c) How can science policy be use in planning and implementing social programs?
(d) For which specific functional policy areas should science policy strategies be developed?
(e) How do Federal agencies relate their R&D activities to their policy missions?
(f) How can STPO, OTA, or the Committee on Science and Astronautics facilitate the development of sectorial science policies?

Section III. Institutions needed to Link R&D to Public Policy

Section III examines the institutional requirements for using science and technology in pursuit of social objectives. The public sector needs new institutions and cooperative arrangements to perform policy-oriented research for different levels of government. Work by these institutions should include experimentation and testing in real world environments. Much can be learned from the institutional innovations which accompanied breakthroughs in agricultural and military R&D, but direct transfers of institutional arrangements from one policy objective to another will not work. Against this background, the AAAS committee poses the question: how do the various departments of the Federal government today perceive the task of developing or revitalizing institutional networks for putting knowledge to work and linking the separate functions of research, technological development and social application? It can be asked also whether the social introduction of new technologies should not be left to the forces of the market. It is increasingly obvious, to the AAAS subcommittee, that

research and development can come to fruition only if equal attention is given to the appropriate institutional and social arrangements surrounding innovation. "Linkages between research and technology and social change are too important to be left to circumstance."

Institutional requirements for policy research.—Attention is needed to the linkage between the Nation's research and development goals and its research and development institutions. Most attention to date has focused on goals and managing R&D, while the research system itself has received little attention. Most R&D institutions came into being in response to older social goals. "Are they willing and capable to respond to new political objectives?"

Specific questions suggested include:

The success of military R&D during and after World War II and of agricultural R&D around the turn of the century illustrate the need for building institutions capable of linking R&D to current policy purposes.
(a) Is sufficient attention given to the application, experimentation, and diffusion stages of R&D in the public sector?
(b) What has been learned from the private sector in this respect? What has been learned from other countries?
(c) Which policy areas are doing well and which are doing poorly? What can be learned from both success and failure?
(d) What can government do to remedy deficiences? Should government become involved at all?
(e) Specifically, what should be the roles of STPO and of other government agencies?
(f) Are there characteristics common to institutions responsible for policy research, social experimentation and demonstration, testing of public investments in new technologies, and other forms of using R&D in the public interest? What has been learned from organizations such as COMSAT or government-university-industry consortia?
(g) Should Congress study alternative institutional arrangements to foster debate on the issue? Should it do more than that at this time?

Section IV: Central science policy responsibilities.

Section IV describes the potential role of the NSF's Office of Science and Technology Policy in advancing new science policy goals. This office could become a center for analysis of R&D policy options and the science policy implications of public policy developments. Several unresolved issues caused by Reorganization Plan No. 1 of 1973 are identified and discussed, including the double role of the science adviser, the split between military and civilian science policy and the remoteness of the science adviser from the President.

A policy reearch focus for STPO.—The AAAS subcommittee sees the role of the STPO mainly as one of stimulator, facilitator, and monitor of all aspects of Federal science policy. It could closely follow, evaluate and synthesize the efforts of agencies to develop specific R&D strategies and institutional networks for innovation. The subcommittee believes the STPO would be well advised to focus on high-level policy research and attempt to exert its impact on decision making through the quality of its studies rather than through attempts at exercising authority. "If STPO is good at this task, it will provide indispensable assistance to OMB and the President's principal staff, as well as to the operating agencies involved. Ideally, STPO would supplement the work done by OMB by introducing a longer time frame into the assessment of policy options than is allowed by the 24-month perspective of OMB's budget cycle." Agencies would analyze their spe-

cific areas of responsibility, and STPO would do so for the entire government—giving priority to issues straddling agency lines, or without a lead agency.

A science policy advisory committee.—The AAAS subcommittee recommends that a science policy advisory committee be created. It would consist of informed individuals from many disciplines and occupations, responsible only to the science adviser, and would re-establish a vital link to experts outside the government.

The dual role of the science adviser.—The AAAS subcommittee noted concern over the potential conflict inherent in the science adviser's double role as policy coordinator for agency policies and recipient of Federal funds for his own NSF programs. Unquestionably this arrangement is awkward and eventually it must be changed.

The separation of military and civilian science policy advice.—Reorganization Plan No. 1 has caused a most serious problem for the relation between civilian and military R&D advice. A definite split in sources of this advice is part of the new arrangements. The science advisory function based in NSF is not expected to perform the former role of PSAC in questioning and evaluating military R&D. Science policy advice for national security is no longer the responsibility of the President's science adviser. "It probably is not even the responsibility of any single individual . . ." The AAAS subcommittee recommends that this important issue be raised for clarification.

The President and science policy.—The AAAS committee expressed concern over the increased difficulty in bringing science policy matters to the President's attention, saying: "We suggest that the committee ask how damaging it could be in time that science policy is absent from the President's office and from his most intimate circle of counselors."

The immediate future.—Lacking direct access to the President, "the only avenue open to the science adviser for the immediate future will be to work as closely as possible with OMB, the Domestic Council, the the President's Economic Adviser . . ."

Questions suggested included:

(a) How does STPO, after almost one year's experience, define its principal responsibilities?

(b) What has been achieved so far? What is planned for the future?

(c) How have STPO's relations with OMB and other offices of the Executive Office developed? And relations with agencies and departments?

(d) Should STPO see its principal task as defining policy options for R&D decisions and analyzing science policy implications of major policy issues? How is this done?

(e) What arrangements for external advice have been made or planned? Should there be a permanent body advising the science adviser?

(f) How successful has the science advisor been in combining his roles of science advisor and head of NSF?

(g) How serious has been the effect of separating civilian from military science policy advice?

(h) Who is responsible for science policy advice regarding national security and foreign policy, and how is this function carried out?

(i) What can be said about the long-term effects of removing the science advisor from direct advisory responsibility to the President?

Section V. A word on Congressional responsibility

The AAAS subcommittee anticipates broadened general science policy responsibilities for the House Committee on Science and Astronautics under the recommendations of the House Special Committee on Committees. It also anticipates substantial use of OTA by Congress to study budgets, evaluate programs, and identify new policy issues for Congressional action. OTA also should be able to help Congressional committees on specific matters.

THE INDUSTRIAL RESEARCH INSTITUTE, INC.

The report of the IRI study group to the Committee on Science and Astronautics found, in reviewing the national programs that are urgently needed and the difficult technical management and policy problems that must be surmounted, that it is "critically important" for the House Committee on Science and Astronautics to pursue several lines of inquiry as to the adequacy of the recently established science policy organization and to provide a forum for examination of refinements and alternatives. Selected excerpts from the study group's report follow:

The nature of the challenge

> . . . the nature of our technical problems has changed since the OST was founded, because performance systems have been replaced by economic systems in our high priority needs. This shift brings with it a powerful new set of policy issues with the necessity to include not only science and technology but also economic, social, legal and political factors.

The National Science Foundation

The study group recognizes the need for the NSF to sponsor and support the abilities and contributions of the University science community. At the same time, the NSF ". . . is not culturally suited to intercept the industrial research science scene and even less the world of technology.

> . . . we suggest that the Committee pursue the matter of qualifications within STPO to bring experienced judgment to Dr. Stever's assistance in the cost-benefit and incentive aspects of incorporating new technology into commerce and society.

Authority level of the new structure

Testimony before the Committee is cited questioning whether the new science advisory mechanism provides Dr. Stever with authority, mechanism and "clout" for science and technology overview. "We believe it would be unwise to take a long term "wait and see" risk in this connection . . ." The study group urges the Committtee to continue monitoring the effectiveness of the structure to marshal the justification logic for critically important technical directions and appropriately influence the budgetary process."

The study group suggests attention to Dr. David's proposal that the Science Adviser have the powerful prerogative of executive authorization of Federal R&D, and the concept of a statutory term for the advisor.

Ability of OMB as a receiver of technological advice

> We believe there is good reason for the Committee to inquire further as to whether OMB is developing a strength of techno-

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logical understanding sufficient to receive and give judicious treatment to advice from the Science Advisor, the mission agencies and industry.

* * * *

In particular, we recommend that your Committee examine the . . . links between OMB, STPO and mission agencies in the light of evidence that they are effective in the budgetary process.

Mission-oriented agencies

The study group approves plans to make the FCST a Committee of Assistant Secretaries, for this mode of operation is critically important to the Science Advisor's role. Again, it calls attention to Dr. David's concept of executive authorization as to the tool or prerogative by which the Science Advisor could be more effective.

Dual burden on the Science Advisor

In our view the Committee should examine a body of opinion as to whether there is a necessary association of these functions or that better results would be expected of a Science Adviser who is not only underburdened as to the NSF directorship but also independent in his treatment of the NSF. . . .

Absence of Defense R&D from Science Advisor's scope

It is suggested that the Committee look into coordinating Defense research and development with civilian technology so as to "derive timely benefits from defense R&D without compromising its special nature and mission."

The interface between science and technology

The study group emphasizes that technology and its close partner economics will be more important than science in many of the difficult decisions ahead. It notes the need for a "continued and purposeful mix of basic and applied research to refine and generate technology."

Public reporting

It is also suggested that the Committee examine the merits of a public reporting role for the science advisory apparatus, as proposed by Dr. David.

Adequacy of the present structure—the central questions

According to the IRI study group, the matter of adequacy of the present structure transcends any question as to whether science has been downgraded. Rather the question to be addressed by the Committee is whether the present arrangements operates effectively:

(a) To review the activities of the mission agencies on an overall basis;

(b) To study and judge their interactions and to balance their relative merits and priorities;

(c) To provide the Chief Executive and Congress with an overall view that includes a creative synthesis rather than the least common denominator of many pressure groups.

Stated more broadly the Committee should seek to determine whether the Science Advisor and the apparatus supporting him provide a unifying point of sufficient authority and competence within the government to ensure coherence in policy, wisdom in decisions and effectiveness in organization for:

(a) Taking timely counsel from the broad, pluralistic participation in study and discussion that lead to great national decisions;

(b) The solving of mission problems involving high technologic content and the participation of more than one agency;

(c) Continuing consideration of defense research, development, and of technologic and engineering activities in the industrial sector;

(d) A basic research program intelligently integrated with the above in quality and quantity;

(e) The development of a trained manpower resource geared to all the above.

The scale of this task raises again the questions:

(a) Should this assignment be one unhampered by a further responsibility for administration of NSF?

(b) Does the task call for additional authority (clout) and if so how can such authority be installed in the function without resorting to the unreliable base of presidential closeness or the short term influences of political change?

The Congressional Research Service

The CRS report identified the policy implications of the Committee hearings of July 1973 and selected, unresolved problems; presented several considerations for committee action; and closed with 15 specific questions for future hearings.

Policy implications of the July 1973 hearings

CRS identified the policy implications of the hearings from five points of view:

1. Effect on the science advisory mechanism.—The scheduling of the July hearings so soon after the Reorganization Plan may have forced NSF and OMB to move faster in arrangements for NSF policy assistance to Dr. Stever. "With the emerging energy crisis and the distractions in the Executive Office by the revelation of events related to Watergate, it is doubtful if the NSF director could have commanded the attention of the OMB so promptly had the hearings not made this necessary."

2. Effect on relations of agencies to the science advisory mechanism.—No evidence was seen to indicate that the hearings had improved inter-agency relationships in areas for which NSF and Dr. Stever assumed the coordinating functions of the OST. Future hearings should include witnesses from some agencies to provide more insight on how the coordinative system is working, as well as the NSF Director's assessment of agency relations with his office.

3. The ability of the Committee to obtain statements and testimony from the Executive Office science advisory unit.—The limited appearences of Dr. Stever in his Presidential science advisory role did not tell much about whether executive privilege may be an obstacle. While other science advisers did not invoke executive privilege, should NSF assume a more influential position the chances of it invoking executive privilege may increase.

4. Effect of the hearings on attitude of the scientific community.—The hearings probably had a maximum policy impact in providing information on the executive science advisory system to the scientific community. The hearings publicized the Administration's intention to rely more extensively on a wider segment of the scientific community through ad hoc groups than in the past.

5. Effect of the hearings on funding and direction of the scientific effort.—The hearings registered the Committee's concern that the level of funding for research and development did not compensate for inflation so that the actual level of effort was on the decline. The hearings also registered strong disapproval of impoundment of science funds by OMB. In January 1974, OMB Director Ash is reported to have announced the discontinuance of impoundment, in favor of placing funds in reserve. "The Committee may have had an impact on the OMB action in releasing all NSF FY 1974 funds in December 1973, but we believe it is more likely that the energy crisis was the motivating factor."

Selected unresolved problems

CRS identified five unresolved problem areas relating to the 1973 reorganization:

1. Direct access to the President.—The scientific community appears convinced that direct access to the President by the Science Adviser is necessary. The White House staff tend to become an inaccessible elite necessarily concerned with power and tactical maneuvering for position. The hearings brought out that (1) a voice from the White House has more "clout" than a communication from NSF; (2) it would be extremely difficult for NSF to get a message to the President through the tiers of non-scientists in the chain of command.

2. Dangers of the "all eggs in one basket" syndrome.— The present policy arrangements appear designed to weed out options in science advice and to present a single choice by "proven management techniques . . . cost effectiveness . . . accumulated analytical wisdom." A Presidential science apparatus should help to identify multiple options that warrant some support, even when the bulk of the effort goes elsewhere.

3. The role of the science Adviser serving an elected official.—Whether the Science Adviser and advisory bodies that advise the President should publicly differ with the President is an issue which might be explored to clarify the roles of science advisors in the political environment close to the top of the Executive hierarchy.

4. Interagency coordination.—The Federal Council for Science and Technology is not an effective body for interagency coordination of Federal science programs. This coordination, including determination of priorities and formulation of a strategy for science, is a vital question.

5. A summary evaluation of the reorganization is needed.—Reorganization Plan No. 1 was decided upon without consulting either the NSF Director or the National Science Board. New responsibilities were assigned to NSF without supplementary resources and the Foundation had to divert manpower and funds from other programs. Despite a small budget for FY 1975, OSTP plans to examine in depth such broad subjects as international science and technology, materials, the world food situation, the role of social research and the transfer of technology in the civil sector.

CRS reports it has seen nothing in the public record which really appraises how the new functions assigned by the reorganization have impacted upon the Director and the NSF. It notes Dr. Stever's testimony that he had underestimated the problem of his new responsibilities, and suggests exploration of this matter.

CRS notes too the designation of Dr. Stever to represent the President in international scientific programs, including chairing such joint bodies as the U.S.–U.S.S.R. Joint Commission on Scientific and Technical Cooperation. This new major responsibility is a third "hat for the NSF director, one that can be demanding of time and energy because of foreign travel."

Considerations for future Committee action

CRS cannot see any course of action for the Committee other than to continue the lines of inquiry begun in the July 1973 hearings. Five specific commentaries included:

1. The present science advisory arrangements are considered transient and likely to change considering the departure of Treasury Secretary Schultz and Dr. Sawhill from the OMB, which have closed two of Dr. Stever's channels to the President.

2. The Committee may wish to continue the initial objectives of its hearings.

3. The Committee may invite suggestions to improve the present system, CRS offers 11 specific suggestions for the committee to explore.

4. The Committee could reexamine proposals for changes in the Federal science structure. Over the years many proposals have been examined by the Committee, including its own proposal for a National Institute for Research and Advanced Studies, other organizational suggestions for Federal science and technology, and those to improve the former OST and Executive Office organization. Summarizing, CRS suggested that the Committee can serve both immediate and longer range national interests by considering the various alternatives for science advisory organization and perhaps taking a position with respect to those it considers meritorious.

5. The Committee can continue to monitor the situation for Federal support for research and development and the role of science in government. CRS called attention to allocation of resources by the "firebell" approach. "The Nation consistently whistles up in time of crisis, turning to science and technology to provide instant answers to first one urgent problem, then another . . ." CRS highlights Dr. Stever's discussion of the "crisis approach" and his assignment of first priority to the need for the Nation to be freed from the trap of having to use science on a crisis-to-crisis basis. On the other hand, Dr. Sawhill of OMB saw advantages in a crash program response to the demands of a crisis. The questions which should be answered is whether Dr. Sawhill's rationale represented OMB and Executive Office philosophy, or his own. Is a crisis situation indeed necessary before a problem can be addressed? "Only by anticipating problems and planning ahead can quick, flexible, and orderly responses be mobilized. Forward plan-

ning can help ameliorate a crisis situation. At very least, such a stance can greatly reduce the costs of national adaptions to great challenges . . ."

6. An overview of biomedical research issues is needed Lacking in the present organization is some source at the White House level in the biomedical and medical sciences that can consider and advise on the role of the Federal Government on policy questions.

Questions for future hearings

CRS concluded its report with the following listing of 15 questions which the Committee might wish to explore in future hearings.

1. Who or what is providing *advice* PSAC formerly provided? Specifically, what groups have been utilized and how?

2. What is NSF doing to assure that the several national programs of research and development—energy, health, transportation, education, social systems, and renewable and non-renewable resources among others—are *coherent and coordinated* across departmental lines and that Government efforts are coordinated with industrial efforts? What are other departments and agencies doing to help Dr. Stever? What differences, if any, do they see in relationships with NSF as compared to OST?

3. What further developments have there been in making the *Federal Council for Science and Technology* a more useful mechanism for interagency coordination? Meetings of the Council since July 1973? Actions taken? What committees have been activated, reconstituted, or newly created? What staff support is provided and by whom? Meetings held, actions taken, and future plans for these committees? What arrangements are there for interface of FCST structure with the nongovernmental scientific and technical community? With the National Science Board?

4. In November 1973, Dr. Stever told an Appropriations subcommittee that he had "underestimated" the extent of *his science policy responsibilities* "when we first had these responsibilities thrust on us." What is Dr. Stever's distribution of time among his multiple roles? How much additional authority has he delegated to subordinates in order to free himself? How are the duties being institutionalized within NSF so that they would be carried on when Dr. Stever leaves at some time in the future?

5. *How does STPO differ from OST* as to organization and approach? In assignments? Are its resources considered adequate to do its job? How does Stever use the office? What are the interrelationships of the Office of Energy R&D and STPO? What is STPO's program emphasis? Relations with departments and agencies? Mechanisms for coordination? Contacts with the scientific and technical community? Evidences that the views of this community actually reach the President?

6. *Who in EXOP is using science advice from NSF?* What channels are used to obtain this advice? How is the President kept informed of developments? What evidences are there that the White House actually cares, that it participates in decisions knowledgeably? Who makes what decisions with what knowledge?

7. Are there any indications that NSF is rising in the *executive hierarchy* or is it too soon to tell? A rise in the executive hierarchy is both a necessity for NSF success and an indication of it.

8. What are the implications for NSF of *pending legislation* to reorganize energy R&D? How does Dr. Stever interact with Dr. Weinberg in the FEO?

9. What other *organizational arrangements* have been proposed to strengthen the science advisory structure? Examples are a Technology Resources Council in EXOP; and a Council of Scientific Advisers.

10. Is "*riding the waves*" a viable strategy for research and development funding? Dr. Stever said that in the long run science will benefit from the present situation because it will be riding an energy wave for the next few years. When asked if this would be disastrous for science, he said a study of the ups and downs of science over the last 30 years showed that we've always ridden waves. Waves of the future will be the basic issues of life.

11. Must we rely on *crisis motivation* as a basis for action regarding science and technology? Dr. Sawhill approved this idea; Dr. Stever said we need to release ourselves from the trap of having to use science on a crisis-to-crisis basis.

12. How are health research, and defense research, under other Associate Directors in OMB, *coordinated* with energy and science? The question was asked of Dr. Sawhill at the July 1973 hearings but only a general answer was received.

13. Who is providing the counterveiling advice to balance the "monolithic pressure of the Defense Department" on military technology? All the science advisers except Dr. David are on record as registering concern on this point.

14. What can be done to help Dr. Stever in his job? What can the committee do? What can the scientific societies and the scientific community do? What have they done since the plan became effective?

15. What inhouse scientific and technical capability does *OMB* have to make it competent to determine relative priorities in allocations of resources for competing civilian R&D programs?

QUESTIONS ARISING FROM THE FIRST PHASE OF THE COMMITTEE INQUIRY

The first phase of the Committee's hearings on Federal Policy, Plans and Organization for Science and Technology were completed in July, 1973.

The record of those hearings helped to identify and crystallize many of the issues, problems and concerns which abound wherever and whenever the matter of effective science policy and science advice emerges.

The following 24 categories of questions have been developed in response to the concerns then expressed and as a general guide toward further inquiry into them.

Functions of a Science Strategy Center

What are the central ingredients of a "strategy center" for the mobilization of science and technology for public purposes? Specifically:

How important is the gathering of a current data base on opportunities, needs, and research directions to be exploited?

How important is the existence of an analysis team to examine the data base in order to draw from it policy recommendations for consideration at policy levels?

How should the relationship be characterized between those at policy levels and those performing the analyses of science and technology data?

What are the requirements of those at science and technology policy levels, with respect to authority for decisions, ability to mobilize full national support for decisions, ability to obtain initial funding, access to the Congress for presenting testimony to authorizing and appropriating committees?

What are the requirements on the analysis team at the center for such fields of expertise as economics, political and social assessments, urban problems, legal problems, and international affairs?

Can such non-technical expertise be adequately integrated into analyses when supplied by other agencies, or does it need to be organizationally a part of the analysis team in STPO?

In determining the scope of issues suitable for analysis, should the analysis team be subject to restraints from the White House, or should these restraints be applied at a later point in the analysis?

If the analysis team, in addition to its responsibility for assessing major problems and opportunities in science and technology, must also implement international science agreements, respond to requests from the White House for analyses of urgent scientific/political crises, and attend to the health of the national science and technology system, will it necessarily have to limit its scope to issues in crisis? Can it do any orderly planning to avert crises?

Democratic Control of Technical Advice

The American Association for the Advancement of Science analysis of the President's science advisory mechanism concludes that the role of technical experts ought to be subordinate to democratic control.

Where are the points of entry for expression of political opinion in the STPO structure? Or is the opinion of the President's Science Adviser supposed to be apolitical and value-free, with political values injected at a later point?

A Stable Channel From Science Policy Studies to Decisionmakers

The importance of continuity in policy formulation and analysis is repeatedly stressed in the literature of science policy. The place of the President's Science Adviser in the hierarchy of executive opinion-forming raises questions as to how a stable pattern in the flow of policy advice can be sustained.

Testimony in 1973 by the Secretary of the Treasury, and by the principal OMB science official, to the Committee may be somewhat vitiated by the movement of these officials to other pursuits shortly after giving their testimony. Even if STPO generates the highest quality of studies, and the President's Science Adviser translates them into the most considered and incisive guidance, who will be prepared to make use of this guidance or read the supporting studies with understanding based on long familiarity with the issues they discuss?

Future Planning vs. Current Program Monitoring

At what point in the evolution of a large new technological issue is it imperative that the office of the President's Science Adviser withdraw from the scene?

For example, in his testimony before the Senate Space Committee, Dr. Stever referred to his responsibilities "in the energy area," and in particular to the "Office of Energy R&D Policy." Such responsibilities cannot help becoming operational. They are, accordingly, enormously time consuming. Because they involve decisions affecting ongoing programs, they command highest priority of attention. (Long-range planning is almost always put aside in favor of short-range operating decisions, in an agency with both kinds of functions to perform.)

Will not such priorities divert Dr. Stever's operation from science and technology policy to program monitoring in specific areas of national effort, while the equally important but less urgent task of science and technology planning goes unattended?

Measuring Policy Effectiveness

Against what criteria does the President's Science Adviser propose to measure his own effectiveness and that of STPO?

In enhancing the utility of scientific knowledge for public purposes? In increasing the level of governmental effort toward the fulfillment of priority programs? In building necessary institutions of Government? In searching for incentives to motivate private efforts and in applying such incentives? In detecting and removing obstacles to technological progress?

An Annual R&D Policy Report

A number of witnesses and commentators have suggested the utility of an annual report on issues and policy actions at the level of the

President's Science Adviser. Presumably, such a report would resemble in scope that of the National Science Board. However, there would also be important differences: the Board's advice would come from outside the executive establishment while the President's Science Adviser is intimately within it. Would his report then tend to cover matters after the fact rather than proposals for future action? What functional purposes might such a report serve? Would it be fair to say that such a report might:

Provide for a continuity in the evolution of national science and technology policy?

Provide a longitudinal record of change in policy for Congressional inspection?

Alert the Congress to emerging issues likely to involve legislative action?

Provide communication to the science and technology community nationwide about focal issues, to invite the building of a national consensus of informed opinion?

Maintaining the Quality of Science Policy Studies

If STPO and the President's Science Adviser are not equipped with line authority for the control of policy or even for requiring reports or funding decisions, then their impact on policy appears to depend on the quality of their studies of major policy issues. What procedures have been established to ensure that they achieve and maintain this level of quality? Specifically, what procedures have been established:

To insure selectivity of issues so that the limited resources of STPO are reserved for issues of paramount national importance?

To communicate to agencies concerned with these paramount issues the intention of STPO to take the issues under advisement?

To mobilize the best available personnel with expertise in these issues to study them?

To assure that before policy studies and reports are issued they are of the requisite quality and objectivity?

To assure that STPO also maintains a continuity of expertise in the areas for which it has assumed policy custody?

Balancing Industrial R&D

If, as Dr. Stever has suggested, the "best check is the results," the question arises as to whether this principle has relevance to the observed fact that different categories of industry in the United States show wide differences in level of technological skill and achievement, and in their use of the resources of science and technology.

Is it considered within the scope of STPO or the RANN program, to ascertain and measure such differences, and devise corrective measures, incentives, and opportunities?

Science and Technology or Science vs. Technology

Is a conflict developing between the community of science and the community of technology? At its inception, the National Science Foundation was told to concentrate on the support of basic research. Personnel in NSF were thoroughly indoctrinated in this policy. Subsequently, when the NSF charter was broadened to encompass applied research and exploratory technology, a tendency might have been expected for staff resistance to this expansion in scope. Similar conflict might also be expected in the two communities in the Nation concerned with these related but different kinds of activity. This conflict, if indeed it should exist, would come to the point of resolution in the Office of the President's Science Adviser. A number of questions arise in this context:

Is such a conflict evident or in prospect?

How has the National Science Foundation staff resolved the difference between science and technology in its programing?

Is it possible for the Science and Technology Policy Office to combine representatives from both science and technology on its advisory panels?

Does the staff of STPO reflect the dual nature of the Science Adviser's scope of responsibility?

Recent industrial criticism of the tendency toward irrelevance to social problems of much university research, presumably including that sponsored by NSF, suggests the need for some institutional means for the closer coupling of such research with the industrial user. Is such an institution in prospect, and if not then what means might be entertained for improving the function of technology transfer from the basic science laboratory to applied science and technology in industry?

STPO Staff Organization

Should the STPO organization be established by categories of social impact, scientific disciplines, agency missions, or some combination of these? In other words, should it be a miniature national goals staff, National Science Foundation, a scientific OMB, or some combination of several or all of these?

STPO Operation

It is understood that pressure is being applied to administrators of Federal research laboratories to contract out an increasing fraction of their programs.

Has the issue of inhouse versus contracted research received analysis at the STPO level? Will it? How does STPO view this issue now? Does STPO propose to conduct its own analyses entirely inhouse, or will it resort to contract studies as the basis for policy determinations?

Regulatory Agencies

How can the Science Advisor establish rapport with the regulatory agencies whose work has a significant technological content?

The substantive aspect of regulation requires scientifically-developed standards and criteria. Should the Office of the President have the obligation to assure scientific excellence in establishing these? Is there also an obligation to assess the social consequences of regulatory decisions based on scientific findings?

Ad Hoc vs. Continuing Science Advisory Panels

The asserted preference of the President's Science Adviser for ad hoc advisory panels over advisory units possessing continuity seems to carry the implication that the emphasis of his office will be on crisis management rather than on development of a continuity of expertise to deal on a sustained basis with persistent, recurring, and emergent issues.

Does this preference for ad hoc panels indeed forfeit opportunities for crisis avoidance?

Science Coordination and the New Federalism

Has the Science Advisor established contact on policy planning, programs, or information exchange, with science advisory organizations at the State Government level? How does STPO propose to respond to the President's concept of the "New Federalism"?

Limitations of the Advisory Role of Technical Societies

Advice from technical and scientific societies can be very useful, but it has its limitations. One of the main problems, of course, is lack of continuity. Officers of such organizations tend to be replaced annually, yet it is the officers who tend to be called on to speak for the group.

How does the Science Advisor propose to achieve continuity of advice on changing trends from this source? Would it be useful to conduct as much as possible of the advisory relationship in writing, so as to have a record that succeeding officers could consult? Or would it be worthwhile to encourage the formation of policy boards within the technical societies, serving for longer periods than a year and perhaps with membership serving staggered terms to achieve continuity? A third course might be to limit the substance of such advisory activities to ad hoc and transitory problems rather than continuing issues. A fourth solution might be to select senior advisory panels without reference to the membership of panelists in technical societies. Are these suggestions valid?

Elevating the Federal Council

The Federal Science and Technology Committee of the Industrial Research Institute attaches importance to making the Federal Council for Science and Technology a committee of Assistant Secretaries, rather than of lower level delegates.

However, this issue involves much more than the question of interagency control and direction. Detailed technical knowledge and wide acquaintance with personnel with related expertise throughout government agencies are at one pole and senior level authority and breadth of scope are at the other. As the civil servant rises in the hierarchy of executive authority, the first set of qualities diminish while the second increase. Persons lower down in the hierachy provide continuity of program and planning, as well as technical expertise. Yet, the gap between technologists at these levels and the Assistant Secretaries high above them tends to be wider than that among Assistant Secretaries of different Departments of the Government.

How might the Science Adviser close this gap, or preserve to the Federal Council the expertise that tends to be lost when coordination is relegated to upper levels? As a practical matter, the intra-agency gap between technical expertise and policy control tends to widen unless positive steps are taken to close it. Relations between the technical staff and the Assistant Secretary require a lot of attention. What means are there to achieve both inter- and intra-agency policy coordination?

Executive-Legislative Science Policy Seminar

What would be the utility of a seminar series in which the membership of the Federal Council for Science and Technology met periodically with the members of the Science and Astronautics Committee, or with a selected group of Members of Congress from a number of committees, to explore in depth, one at a time, the most salient issues of mutual concern?

What alternative operational arrangements might be tried to couple these two institutions in a constructive cooperation? How can the two institutions be assured that they share a common data base for policy decisionmaking?

Strengthening International Science Policy in Government Agencies

To what extent and with what effect is it the responsibility of the President's Science Adviser and STPO to work for the adequate staffing of science and technology policy units in other agencies of Government?

For example, the U.S.–U.S.S.R. science agreement appears to be centered in STPO. Other international arrangements are managed out of NSF, by the Bureau of Science and Technology (SCI) of the Department of State, and by the Foreign Office of the National Academy of Sciences. This diffusion looks like an awkward arrangement. While an active role for the Science Adviser and STPO may be reasonable in the evolutionary phase of a new international agreement, the sustained implementation and monitoring of established agreements would seem appropriately to be located elsewhere.

Should it be a responsibility of the Science Adviser to ensure that recipients of such continuing operations are adequately staffed, funded, and supported?

The Federal Function: Military and Space vs. Civil Programs

Is it necesarily true that as R&D priorities shift from defense and space to civilian needs, the support and coordination functions of the Federal Government will diminish? Has this been the case, for example, with either the environmental or the energy crisis?

Major Categories of Budget Allocation

The major problems of the United States today and in the early future appear to involve energy, the environment, materials supply and conservation, food production and allocation, and shoring up a faltering economy. Yet, although the problems are multiplying and the opportunity to search for solutions through R&D would seem to be expanding, the level of R&D investment is, if anything, declining. What are the implications for the leadership of the national scientific effort if this assessment is correct?

For example, defense and space were and continue to be inherently Federal concerns. But as Government attention shifts to problem areas like the food/population balance, materials supply, housing and urban development and urban transportation, there is a tendency toward a lessened Federal role; traditionally these have been commercial or municipal concerns. However, Federal funding is implicit in contemporary social programs. Should the scientific aspects of such programs be left to local initiative, or is there a role for scientific intervention controlled at the presidential level?

Is not this a prime example of the need for a structured national science policy?

Staffing OMB For Science and Technology Budgeting

Given the somewhat conflicting motivations of the budgetary and science advisory functions, would it not be desirable for the President's Science Adviser to exert his influence to encourage the strengthening of the OMB staff competence in science and technology?

A fuller appreciation by OMB of the potential contributions of science and technology to national welfare, economic development, and the solving of problems of materials, energy, and environment, might increase the selectivity and eventual productivity of Government-supported R&D. Should this principle be emphasized to OMB?

Budget Cycle vs. R&D Time Cycle

The OMB develops its scientific and other budget programs on an annual basis. A great deal of our scientific research, however, needs to be planned and programmed on a much longer time scale.

Does the Science Adviser take this difference into account? Is it not possible to formulate or tabulate scientific research programs over a three-to-five year future on an outline basis—at least in a few selected categories of definitely needed national research?

The Role of R&D in Decision-Making

A number of knowledgeable people in both Government and industry are concerned that major decisions will be made involving national missions without careful consideration of their scientific and technological aspects.

For example, a significant number of such decisions are sure to be made with regard to energy and materials during the next few years. Will these decisions be made primarily, or perhaps solely, on the basis of economic factors? Or cost-benefit ratio? Will a careful appraisal or assessment of the scientific and technological factors be taken into account and given their appropriate weight—whatever that weight may turn out to be?

How can the present organizational mechanism effecting Federal science and technology programs be sure that the latter component will be taken into consideration?

Annual Review of R&D Budget

We are told that under current arrangements the Science Adviser reviews the total Federal R&D budget either for or with the OMB.

Is this correct? If so, what are the exact mechanisms used? What part does the STPO play? How is the review integrated into the budget process, and how much attention does OMB pay to it?

In cases where a conflict of view may arise, what weight is given to the Science Adviser's recommendations? Are they controlling?

TENTATIVE FINDINGS

Much of the preceding material set out in Part 1 has been devoted to identifying issues, problems, priorities and a host of specific questions related to Federal policy, plans and organization for science and technology.

If, in the furtherance of this inquiry, the Committee succeeds in clarifying or in resolving even a fraction of these, it will have made—it believes—a contribution.

Meanwhile, the Committee is projecting several tentative findings—perhaps observations would be a better word—with regard to certain overriding matters facing it. These may be summarized as follows:

Lack of Certainty

After study of the results of the first phase of the Committee's inquiry, there is a pervasive feeling of uncertainty in almost every aspect of the policy, planning and organizational science situation.

For one thing, the Committee has little reason to believe that the Director of the National Science Foundation in his role as science adviser to the President has greater access to the President than did his immediate predecessors. Secondly, the information which has thus far been made public by the Science Adviser and by the Science and Technology Policy Office, while suggesting internal progress, provides no clue as to the effectiveness of the current arrangement. Thirdly, the Committee is unaware of any concrete policies, programs or plans which have been formulated in a coherent way and promulgated as a guide to the conduct of general Federal support of science and technology.

These comments are not intended in a critical vein. Since the present arrangement did not become effective until July 1973, and since the general political atmosphere has itself been unsettled to an unusual extent, undoubtedly more time is needed. On the other hand, it is very desirable that such clouds of uncertainty be removed as soon as possible.

Basic Tenets in Question

The Committee may wish to call into question two beliefs which have tended to become "sacred cows" of the scientific community, at least in the past 10 or 15 years.

One of these involves a question stated earlier: Just what is the relative importance of science and technology as a concern of the Federal government? Where does it really stand in the order of national priorities? The background of this Committee would naturally tend to have it ascribe a very high position for science and technology—but is such a position genuinely deserved? Perhaps other more fundamental, more humanistic, less technical matters should replace science and technology on the list, or at least lower them. This is not to suggest that such

is the case, but the Committee would like not merely a reaffirmation but a well thought out re-examination of the original contention.

The second matter in question regards the "pluralistic system" of Federal support for science and technology. Under this system, of course, each mission agency normally undertakes by far the greater share of the research which is involved in its mission; undertakes it or oversees it. But how effective is this system in view of the following conditions which presently dominate the national scene: (1) the increased operational budgetary demands of every agency, (2) inflation, (3) the higher competition for that part of the total Federal budget which is not committed—and note that whereas in 1967 about 42% of the Federal budget was in the so-called "controlled" (or uncommitted) category, in 1974 only about 25% of the budget is in that category, (4) the "Mansfield syndrome", which has been discussed earlier and which has tended to discourage mission agencies from supporting basic research, (5) the modern tendency to look for the "quick fix" in tackling multidisciplinary social problems for which science and technology can be utilized as an important tool, and (6) the increasing complexity of problems (such as the energy shortage) which cross traditional organizational boundaries?

This final point once again brings to mind the need to reach and keep an appropriate balance between basic and applied research. This is a matter to which the Committee addressed itself in forceful terms as it considered this year's budget of the National Science Foundation.[1]

Quality of Advice

A correlary of the questions directed to the "pluralistic system" is the further question: How good is the quality of scientific advice on which a great deal of the value of the system depends? This matter is broached largely because of the dichotomy which exists concerning the effect of the Federal Advisory Committee Act enacted by the Congress in September 1972.[2] In general, this Act requires that the proceedings of advisory committees shall be open to the public and the record of such meetings available for public scrutiny. Without attempting to make any judgments regarding the value or effectiveness of the Act, the Committee nonetheless does take notice of continuing complaints which allege that the Act is reducing the effectiveness of advisory bodies as well as the willingness of many competent persons to serve on them. It is a matter which the Committee would like to hear discussed, particularly by those persons who have had experience with advisory committees both before the Act went into effect and since then.

The entire question also would appear to have sharp applicability for the "ad hoc" advisory system described by Dr. Baker during the first phase of the Committee hearings. According to Dr. Baker's testimony, a method of putting together temporary scientific or technological advisory groups, based on immediate need, would be followed widely in lieu of the more structured system which existed when the Office of Science and Technology was in existence. The questions raised here, however, would seem to have significant meaning for the ad hoc device as well.

[1] House Rept. 93-995, p. 126.
[2] P.L. 92-463; 86 Stat. 770.

The Evaluation and Coordination Function

The Committee inclines toward the belief that, in the conduct of the Federal R&D effort, some effective evaluating and coordinating force is necessary. It does not construe this belief in any way as being in conflict with the "pluralistic" theory, insofar as that theory has acceptance. The Committee does not feel that the two are mutually exclusive. But it does need to know whether such an evaluative force currently exists. If so, who is exercising it and how?

When the National Science Foundation was first formed it had, among other things, the task of developing policy with regard to basic research as well as that of evaluating scientific research programs undertaken by other Federal agencies.[3] In 1962 these functions were transferred to the Office of Science and Technology which was created under Reorganization Plan No. 2 in March of that year. In Reorganization Plan No. 1 of 1973 President Nixon abolished the Office of Science and Technology and, after noting that NSF had originally been responsible for "evaluation of the government's scientific research programs and development of basic science policy," transferred "to the Director of the National Science Foundation all functions presently vested in the Office of Science and Technology."

While there is some difference of opinion on the point, the evaluation and coordination function, if it exists at all, would appear to lie with the Director of the Foundation—not with NSF itself or with the Science and Technology Policy Office. The question is, since neither NSF in its early days nor OST during its existence succeeded in implementing these functions to a significant degree, what is the probability of their being implemented effectively now?

Organizational Structure

Since science and technology became a major factor in government operations, a number of organizational systems have been tried or suggested. These include the following:

(1) The Office of Scientific Research and Development—Under the Direction of Dr. Vannevar Bush, this Office inaugurated and coordinated research efforts needed to further the cause of World War II. The Office was an operational one and is widely conceded to have been successful in its mission.

(2) NSF's original dual role—This was the system previously described when NSF was charged not only with the support of basic science and education but in the development of policy and evaluation of Federal research in general.

(3) Special Assistant to the President for Science—This was the role of the original Science Adviser who functioned purely within the Executive Office of the President. That role was held by 3 advisers, James Killian, George Kistiakowsky and Jerome Wiesner. The system operated almost exclusively within the confines of the Executive Office and had no liaison with the Congress or the public.

(4) A Department of Science—About this time or shortly after, the idea of a cabinet level Department of Science was seriously broached, discussed and debated by several congressional committees. But it never picked up significant support.

[3] P.L. 81-507, Sec. 3(a) (1) and (6).

(5) The Office of Science and Technology—This type of advisory organization combined the President's Science Adviser with a further duty, which was primarily to be responsive both to the Congress and to the public. Otherwise, the function of the Science Adviser, in collaboration with the President's Science Advisory Committee and as Chairman of the Federal Council for Science and Technology, did not differ greatly from the way it had developed during the Eisenhower Administration.

(6) A Council of Science Advisers—Such a system has been advocated off and on for a number of years. The idea would be to establish a council of advisers in the same mode and using about the same operational techniques as are used by the Council of Economic Advisers.

(7) NIRAS—The National Institutes for Research and Advanced Study was suggested by the Science, Research and Development Subcommittee of this Committee in its 1970 report. While based somewhat on the National Institutes of Health model, the NIRAS concept encompassed a good deal more. It would have combined the function of science policy recommendation with major national research activities plus cross-fertilization with a number of advanced study institutes.

(8) NSF's present dual role—in which the Director of the Foundation serves not only as head of an operating agency but also as the science adviser to the President, plus acting as chairman of the Federal Council on Science and Technology.

A variety of other types of science and technology organizations have been suggested from time to time, including present legislation sponsored by Senator Magnuson which would provide for a Science and Technology Resources Council, among other things. However, those listed appear to have achieved the most attention to this point.

The Committee would very much like to hear more on the matter in two principal ways:

(a) A convincing rationale for the establishment of one of the foregoing types of organizations, or for a combination of several of them; or

(b) Completely fresh suggestions with regard to science policy organization, or at least concerning those which have not heretofore surfaced in the Congress.

A Formal Science Policy?

Finally, the Committee would like to explore in detail the question of whether the nation needs a formalized, structured kind of science policy—or whether an unstated, fluid policy which shifts and alters with the times is satisfactory.

If we assume that a formalized science policy is desirable, then we are faced with the question of whether or not it should be formalized by statute. If so, this presents a still further subset of questions, most of which break down into one of two categories: (a) should the statutory declaration be unrelated to any organizational factor or other ancillary purpose of the legislation; or (b) should the statutory formula involved be a part of some major piece of legislation which does look to the creation of a new or revamped science organization?

PART II

REPORTS TO THE COMMITTEE ON THE FIRST PHASE OF ITS INQUIRY INTO FEDERAL SCIENCE POLICY, PLANS AND ORGANIZATION

BY THE

BACKGROUND

Following the Committee's hearings on Federal Policy, Plans and Organization for Science and Technology held during July 1973, Chairman Teague and the Committee determined to request outside comments, observations and critiques of the record as it had been presented to the Committee at that time. In order to obtain a broad series of viewpoints, three separate and unrelated organizations were contacted and requests made for their assistance.

The three divergent groups selected were the following:

1. The Committee on Science and Public Policy of the American Association for the Advancement of Science. A request was made of this group for a number of reasons. One, it had only recently been established and might reasonably be expected to provide a fresh viewpoint. Second, the AAAS is the largest single science organization in the United States and one with which this Committee has had only cursory contact. Third, a report from this group could be expected to reflect, certainly in many ways, the sentiments of a sizable portion of the academic community.

2. The Federal Science and Technology Committee of the Industrial Research Institute. The IRI is a professional society whose membership includes approximately 250 of the nation's largest industrial companies and virtually all those which are heavily engaged in research. It therefore appeared to be a uniquely well qualified group from which to seek the observations and views of the American research industry. The Federal Science and Technology Committee has been in existence for some time and has had frequent informal contacts with this Committee. However, this is the first time that the House Committee has requested a formal report from the IRI.

3. The Science Policy Research Division of the Congressional Research Service is the third organization from which the Committee sought assistance to identify problems and issues raised during the first phase of its inquiry. The Division has worked closely with this Committee since its inception and has provided invaluable inputs on a regular basis. The survey which it has done has particular value since the CRS is well acquainted with the entire Federal scene, both Executive and Legislative.

It should be emphasized here, as the letters of transmittal in these reports make clear, that the reports themselves should not be construed as representing positions of the parent organizations in any way. They do represent a consensus of the individuals selected by the organizations to respond to the Committee's request.

THE UNIVERSITY OF TEXAS AT AUSTIN,
LYNDON B. JOHNSON SCHOOL OF PUBLIC AFFAIRS,
Austin, Tex., May 2, 1974.

Congressman OLIN E. TEAGUE,
Chairman, Committee on Science and Astronautics, U.S. House of Representatives, Washington, D.C.

DEAR CONGRESSMAN TEAGUE: I am pleased to submit a memorandum prepared for the House Committee on Science and Astronautics. The memorandum is in response to your letter of November 30, 1973 to Raymond Bower, Chairman, AAAS Committee on Science and Public Policy. The AAAS Committee appointed a small subcommittee which prepared the report.

We hope that the report will be of use to you. If additional information is needed please let us know.

Sincerely yours,

JURGEN SCHMANDT,
Professor of Public Affairs.

MEMORANDUM

TO: Olin E. Teague, Chairman, Committee on Science and Astronautics, U.S. House of Representatives.
FROM: AAAS Committee on Science and Public Policy, Subcommittee on House Hearings on Science Policy.
SUBJECT: Committee Hearings on Federal Policy, Plans, and Organization for Science and Technology.
DATE: May, 1974.

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INTRODUCTION

This memorandum is submitted in response to Chairman Teague's letter of November 30, 1973, requesting the assistance of the AAAS Committee on Science and Public Policy [1] in preparing for the 1974 hearings of the House Committee on Science and Astronautics on Federal Policy, Plans, and Organization for Science and Technology. Our task was defined as "a review, evaluation and such critique as you might care to make" of the July 1973 hearings held by the House Committee. In discussions with the Committee staff it was pointed out that to be most useful, our report should focus on substantive policy needs rather than on the recent history of reorganization and that specific issues should be identified for exploration during the next round of science policy hearings.

Although we readily accepted the invitation out of our desire to provide whatever help we could, we were apprehensive about the fact that our committee is in its first year and has hardly been able to develop the organization and support normally required for advising on public policy issues. We ask, therefore, that the House Committee keep in mind the severe limitations of time, resources, and manpower under which this document was prepared.

To draft this memorandum the following subcommittee was established:

Marlan Blissett, The University of Texas at Austin.
Sanford A. Lakoff, University of Toronto.
Mack Lipkin, Jr., Strong Memorial Hospital, Rochester, N.Y.
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Jurgen Schmandt, The University of Texas at Austin, *Chairman.*
Richard Scribner, American Association for the Advancement of Science.
Christopher Wright, The Rockefeller Foundation.
David Walrath, The University of Texas at Austin, served as staff assistant to the subcommittee.

The full AAAS Committee, as well as several other individuals, reviewed early drafts of the memorandum, and their comments are reflected in the present text. Nevertheless, the content and the opinions expressed here are the responsibility of the subcommittee, and the memorandum should not be regarded as an official statement by the AAAS.

In approaching our task we decided against a sequential point-by-point or witness-by-witness critique of the July 1973 hearings, but important issues identified on that occasion were examined and placed in the context of changing policy objectives. In addition, an effort was made to uncover some omissions or doubtful assumptions (as we saw

[1] For a list of committee members see the appendix.

them) in last year's hearings and to suggest an issue-oriented framework for evaluating the new organizational arrangements for federal science and technology policies. Our report is based on the expectation that the forthcoming hearings will discuss new policy needs and relate these to the prospects and limitations of the recently rebuilt policy mechanisms.

Our comments are presented in five sections:

I. The Context of Science and Technology Policies in the Seventies.

II. The Need for Diversified Strategies for Science and Technology.

III. Institutions needed to Link Research and Development to Public Policy.

IV. Central Science Policy Responsibilities.

V. A Word on Congressional Responsibility.

Section I provides an overview and defines major policy needs. Sections II through IV spell out in greater detail what those policy needs entail, primarily in terms of substantive considerations and secondarily in terms of organizational matters. Section V comments on some Congressional activities closely related to the policy developments discussed in this memorandum. All sections share a common format: discussion of substantive issues is followed by a group of questions suggested for consideration during the hearings.

SUMMARY

This report is to assist the House Committee on Science and Astronautics in preparing hearings on Federal Policy, Plans, and Organization for Science and Technology.

Section I identifies changes in science policy tasks characteristic of the seventies.

The experience of no-growth research and development (R&D) budgets, together with a larger number of federal agencies engaging in R&D activities, require improved capabilities to determine the need for and the use of R&D investments for specific policy objectives. While changing national priorities lead to changing R&D investments, support for the long-term health of science must be guaranteed. The government's operating agencies need to develop closer ties between R&D operations and policy planning. Different science policy strategies need to be spelled out to meet the variety of policy goals. State and local governments need help in developing policy planning and management capabilities—a task broader than science policy assistance as perceived in the past. New political vision and commitment are required to find solutions to problems which demand action by more than one nation. The role of R&D is large, at least potentially, but dependent on new political initiatives.

Section II develops the concept of sectorial policies for science and technology and draws the organizational implications of that approach.

Specific strategies for linking knowledge and action in major policy areas need to be developed. The following areas might lend themselves to such an effort: national security, foreign policy, economic development, infrastructure development (encompassing energy, transportation, and communications), physical environment and natural resources, social programs and human resources, advancement of science and technology. A format is suggested for systematic review by Congress of sectorial science policies.

Section III examines the institutional requirements for using science and technology in the pursuit of social objectives.

The public sector needs new institutions and cooperative arrangements to perform policy-oriented research for different levels of government. Work undertaken by these institutions should include experimentation and testing in real world environments. Much can be learned from institutional innovations which accompanied breakthroughs in military and agricultural R&D, but direct transfers of institutional arrangements from one policy objective to another will not work. It is suggested that the Congress provide a forum for discussion of alternative institutional approaches.

Section IV describes the potential role of the Science and Technology Policy Office (STPO) in advancing new science policy goals.

The office could become a center for analysis of R&D policy options and the science policy implications of public policy developments. It could develop a long-term study capability which would supplement the shorter time frame of OMB. Creation of an advisory group to the science adviser and the STPO is recommended. Several unresolved issues resulting from last year's reorganization are discussed. These include the double role of science adviser and agency head, the split between military and civilian science policy, and the increased distance of the science adviser from the President.

Section V discusses briefly the House Science and Astronautics Committee's enlarged mandate which follows from the transfer of the science advisory function from the White House to the National Science Foundation.

I. THE CONTEXT OF SCIENCE AND TECHNOLOGY POLICIES IN THE SEVENTIES

Science policy [1] in the mid-seventies operates in an environment significantly different from that of the fifties and sixties, and some of the differences must be mentioned to prepare for our discussion of national science policy goals and approaches in years to come.

Declining Budgets Mean Harder Choices

No-growth R&D budgets cause all-important differences. For the better part of a decade Federal spending for science and technology has hovered around the $17 billion mark. While the proposed budget for 1975 comes close to the $20 billion mark, this increase is barely enough to make up for inflation losses suffered over the years, and must be characterized as a no-growth adjustment. The impact of no-growth R&D funding on the quality and vitality of American science and technology let alone the long-term consequences for the well-being of society cannot yet be fully assessed. Many years may pass before shortages in scientific and engineering manpower or inadequate knowledge in new areas of national concern became apparent.

Allocation decisions have become tougher and can be expected to stay tough in the foreseeable future. The overall limitation of R&D funds came hand in hand with a diversification of national R&D objectives. An increasingly large number of Federal agencies are competing for a share of R&D funds and a variety of social policy programs now have significant R&D components. As a result, spending for civilian R&D increased from 20 percent of the total in 1964 to 35 percent in 1975. Spending for military R&D continued to rise, though more slowly than in the past, reaching the $10 billion mark in 1975. Significant budget reductions occurred in the space program with spending declining from $4.6 billion in 1966 to $2.3 billion 1975. While total Federal spending for R&D has remained at nearly the same level since the late sixties, the uses made of this budget category have changed significantly. A more even division of funds between military and civilian programs resulted, but no magic formula exists which would define the ideal split between the two categories.

These budgetary developments place several demands on policymakers. Competent planning and evaluation capabilities *on the part of each agency* are required to determine the agency's need for and use of R&D investments in achieving its policy objectives. *On the part of OMB*, the need is more imperative than ever to choose intelligently among competing claims and, in making those choices, to avoid substituting its judgment on goals, policies, and programs for that of the President or of the Congress *STPO* as the government's prin-

[1] We shall shorten the term "science and technology policy" to "science policy" from here on, but it should be clearly understood that this is not meant to give less importance to technology as opposed to science.

cipal science policy resource needs to assist OMB in this task. In addition to advising directly on R&D allocations for specific programs, STPO must provide OMB with information concerning the long-term effects of cuts or increases in R&D funding in specific programs and areas. Science allocations are easy to cut down in times of tight budgets. STPO must be resourceful in pointing out the long-term dangers of such a policy for the health of American science. *The Congress*, for its part, must perform its program review and budget allocation functions with three objectives in mind: (1) to allocate R&D funds more consistent with a careful and deliberate judgment of national priorities; (2) to ensure that the scientific and technical capabilities of the nation are uniformally strong enough to meet new needs as they arise; and (3) to assure the inherent health of science and technology as basic national resources. These objectives are difficult to translate into concrete Congressional action, partly because Congress does not review the budget as a unitary body, and partly because short-term and long-term needs have to be carefully balanced. The Bolling Committee's recommendations for improving the Congressional budgetary process will provide an opportunity for better linking of R&D expenditures with national policies. The House Committee on Science and Astronautics can help in coping with this task.

Questions for consideration during the hearings:

Group #1:

(*a*) *What has been the experience in allocating a no-growth R&D budget among changing claims?*

(*b*) *Have long-term concerns, such as support of basic research and graduate training, suffered unduly?*

(*c*) *How can the STPO strengthen its contribution to preparation of the President's proposed budget?*

(*d*) *How can Congress help in achieving a balance between responsiveness to new needs and ensuring adequate funding for long-term tasks?*

(*e*) *How can the House Committee on Science and Astronautics serve the proposed joint budgetary committee of the House and Senate?*

Science Policy Must Be Considered as Part of Public Policy Decisions.

A second factor accounting for changes in science policy is related to changing attitudes toward science and technology. For some time it seemed that an anti-scientific stance might spread widely, and although this has not materialized, some less dramatic changes have occurred that must be taken into account. Exalted visions of science and technology as universal problem solvers of last resort and prime movers toward the "Great Society" have been abandoned. Few would still see science and technology as means for eliminating partisan politics and political controversy. Many public issues have important scientific and technical components, but the dangers and limitations of shaping policies according to experts, however well qualified, and individuals not accountable to democratic control, have been recognized. The proper predominance of political considerations in the establishment of social goals has been reasserted. New national priorities, such as energy and environmental protection, need strong science programs, and it will be important to develop new ways for mobilizing the country's scientific and technical resources for meeting these goals.

Again, a number of policy needs can be identified. The policymaker must have a better understanding of how science and technology fit into the policy process, where they need to be encouraged, and where discouraged as the public interest demands caution. Scientists and engineers must operate increasingly as part of teams encompassing knowledge and experience of various kinds. Economic and political considerations will influence their work in many stages. Scientific advice to the government must be organized so that scientific and technical considerations are explicitly related to other factors influencing public policy decisions. Science policy, in other words, needs to be integrated into general policy planning and program evaluation.

Questions for consideration during the hearings:

Group #2:

(*a*) *Should science policy considerations be integrated into the decision-making process in much the same way that economic, financial, and social factors are?*

(*b*) *To the extent one opts for a strategy stressing integration, how should the science policy function be organized in agencies and departments?*

(*c*) *What special problems arise due to the risk and uncertainty which are characteristic of science?*

(*d*) *Is there a need to supplement agency efforts in linking science to policy goals with attention to the overall coherence of the nation's R&D capacity? Should this be a responsibility of STPO for the government and of the House Committee on Science and Astronautics for the Congress?*

Different Science Policy Strategies are Needed to Meet the Variety of Policy Goals

The widening range of policy areas to which science and technology contribute today highlights a third dimension of change. The earlier preoccupation with defense- and space-related issues has not completely disappeared: half the Federal R&D budget is spent for these purposes. But the percentage was higher in the past. A wide range of policy areas now have R&D components designed to improve understanding of that area's issues and to develop techniques for solving its problems. This is true, for example, in energy, environmental protection, resource development, international trade, public health, and a variety of social programs. The science policy input that could help in dealing with policy issues in these and other areas often does not require massive investment in either dollars or brain power to develop new technological systems. Instead, knowledge and experience are required that can tie together contributions from many disciplines and professions, including those concerned with human behavior, social organization, economics, and the law. Moreover, much of the knowledge required already exists, but needs to be brought together and addressed to the problems at hand.

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sulting from man's activities, the limited availability of natural resources, shortages in supplies of food and fertilizer, population control and public health provisions illustrate the range of problems which increase daily in urgency and which can be addressed only on an international scale. Many of these problems are directly related to science and technology, in their origins or their solutions or both.

Increased international cooperation is a logical answer to these challenges. In the opinion of some experts, nothing short of arrangements for "global management" are required. But little progress in this direction is made or can be expected through the use of existing international mechanisms. The trend is rather in the opposite direction of less international cooperation. To overcome disenchantment with present international arrangements and to mount projects adequate to the need, new political commitments must be made that will go beyond the technical considerations now determining scientific and technological cooperation among nations. New and more effective approaches to international cooperation generally—bilateral as well as multinational—need to be developed. Many projects will continue to be concerned with scientific and technical matters. But the starting point is a rethinking and reform of relations among nations which are increasingly interdependent, exerting an impact on each other through their industry and growth. While major action, in all probability, may have to wait until a worldwide crisis has reached the red alert stage, the United States would be well advised to prepare for such a condition. Plans and institutions for a truly international science policy should be designed and readied for action.

Questions for consideration during the hearings:
Group #5:

(a) *What has been the experience with bilateral or multinational cooperative projects in science and technology?*

(b) *What new approaches are required to deal with worldwide problems such as man-made changes in the environment or shortages of natural resources?*

(c) *What should be the respective roles of STPO, the Department of State, and other Federal agencies in developing a new strategy for science and technology in international affairs?*

* * *

The preceding overview of trends, developments, and goals for the Nation's science policy identified some of the issues that are discussed in greater detail in Sections II through V. The list of policy issues, obviously, was far from exhaustive. Those goals that were mentioned contained items for an agenda for action, but clearly there can be other action agendas. The hearings will serve an important function if they present and expore a variety of plans for action.

The suggestions in this report revolve around a central point: *the time is ripe for a more deliberate and diversified search for ways of putting science and technology to work in a large number of policy areas.* This requires a view of science policy not as a single policy tool for reaching social goals, not as an integral part of policy planning and analysis in all major policy areas.

II. THE NEED FOR DIVERSIFIED STRATEGIES FOR SCIENCE AND TECHNOLOGY

Assumptions about Science Policy and their Organizational Implications

Science Policy during the fifties and sixties was organized in response to at least three major assumptions: (1) that science and technology were integral components of many policy issues and therefore were the legitimate business of several departments and agencies of the government; (2) that science and technology figured importantly in Presidential decisions, and that therefore a scientific advisory body of the highest quality and objectivity was needed to serve directly the head of state and his principal policy planners; (3) that the foundations of the scientific enterprise—fundamental research and science education—needed sustained Federal support, and that therefore specialized institutions, such as NIH and NSF, had to be developed to provide that support.

The hearings held in 1973 explored some of the results that can be expected from the President's decision to abolish the Office of Science and Technology as part of the Executive Office of the President and to transfer most of the civilian but none of the national security-related responsibilities of the President's Science Adviser to the Director of the National Science Foundation. Little purpose will be served by additional comments on the advantages or disadvantages of the new arrangements compared with the old system. The forthcoming hearings, however, will provide an opportunity to assess to what extent the three basic assumptions underlying the nation's science policy organization are still valid and to what extent changes are appropriate. In this context it will be useful to ask how these assumptions have been affected by last year's changes in the White House science policy structure.

Beyond this, *we recommend that the hearings focus on the entire range of institutions involved in the discharge of science policy responsibilities, including those of Federal agencies as well as state and local governments, academic institutions, industry, and other R&D centers.* A broad examination along functional lines is necessary to assess the division of responsibilities in science policy matters best carried by different parts of the Federal government as well as state and private institutions. Such a division of responsibilities has long existed, to be sure. But it is undergoing changes both in response to the kind of policy changes identified in Section I and to the rearrangements instituted by Reorganization Plan No. 1.

Questions for consideration during the hearings:
Group #6:

In the past, Federal science policy was structured around three organizational objectives: a basically decentralized approach to

federal R&D activities; the provision of direct science policy advice to the President; and the availability of support for basic science and graduate training from science-oriented agencies.

(*a*) *Are these goals still valid?*
(*b*) *What changes, if any, are required?*
(*c*) *What new principles, if any, need to be added?*
(*d*) *If the above goals are still valid, how have they been affected by last year's science policy reorganization?*

Diversity in Agency Uses of Science and Technology

One would expect that a decentralized approach under which major R&D programs are administered as part of individual agency responsibilities would find as much general support today as it did in the past. Even past calls for centralization in science policy, perhaps in the form of a Federal department of science and technology, seldom aimed at combining under one roof the administration of all or most government financed R&D programs. But have the promises of diversification in fact been realized? Might it be that although decentralization was acclaimed as an organizational principle for the government's R&D approach, the administering agencies have not yet developed specific and detailed connections between their policy missions and their R&D programs?

In the first place, one would like to know whether and in what detail those departments and agencies with major R&D responsibilities have defined and developed their science and technology objectives and methods in terms specific to each agency. The number of agencies involved has grown considerably over the years and now includes at least the following: The Atomic Energy Commission; Agriculture; Commerce; The Environmental Protection Agency; Defense; Health, Education and Welfare; Housing and Urban Development; Interior; National Aeronautics and Space Administration; National Science Foundation; Transportation; Labor; and Justice.

Science Policy and Regulatory Agencies

In addition, agencies not administering a substantial R&D budget also have important science policy responsibilities. Decisions made, for example, by the regulatory commissions of the Federal government often have a direct impact on R&D efforts and directions. It is possible, as was pointed out during Phase One of the hearings, that regulatory legislation designed for certain social objectives, such as environmental protection, can impose constraints and create uncertainty that curtail important R&D work, such as energy-related research. In some instances society may opt to accept this consequence, but it should do so knowingly and deliberately. It has not always done so. Was enough known, for example, about the effects of gas price regulation by the FPC on improving exploration technologies or developing coal gasification? Were the relationships questioned at all? Did they come to the attention of those responsible for formulating the nation's science policy? Or, as a second example, were the FCC restrictions imposed on cable television ever assessed with respect to their impact on the growth of competing communication technologies? The point is vital: *all policy* decisions must be examined as to their implications for *science policy*. This is first of all a task for the agency involved, but it is also a task for the STPO and the Office of Technology Assessment (OTA). These offices should become active when agency research ignores these implications, or when the involvement of several agencies necessitates a more broadly based study.

Social R&D

Agency activities aimed at social experimentation or demonstration and agency evaluations of different social intervention strategies represent another group of projects not normally thought of as R&D programs. Income maintenance, vouchers for housing or education, and preventive health care plans are examples of recent Federally initiated demonstration projects. The number and importance of these activities will increase in the future as agencies such as HEW, Labor, and Justice attempt to develop R&D approaches suited to their particular orientations. It has been estimated that at the present time approximately $3 billion is spent annually for these purposes—an amount which should be part of the Federal R&D budget but is not currently included in it because of narrow statistical definitions developed in the past. While this in itself warrants correction, the more important point concerns agency policies: "innovation" should be viewed as a policy tool encompassing not only traditional R&D but demonstration and evaluation activities as well. The long-established DOD practice of subdividing its innovative activities in research, development, testing, and evaluation provides a useful model. Rethinking along these lines will help to remove R&D from its often isolated status within agencies, to break down artificial distinctions between "hard" and "soft" R&D, and to make departmental R&D functions more a part of the policy planning process.

Broadly viewed, some form of research is originated and used in the efficient operation of all Federal departments and agencies. Thus, they all play a role in shaping the government's science policy, and they need to be involved in this task more directly than in the past.

R&D Strategies for Broad Policy Areas

An additional argument for agencies to strengthen the relationship between R&D and policy can be made in view of plans for government reorganization. With a trend toward agency organization in broad policy clusters—such as defense, natural resources, environment, and human resources—the definition of mission-specific R&D strategies becomes an even more urgent and meaningful task. Goals, needs, resources, programs, and implementation arrangements need to be defined in terms of the policy environment characteristic of each agency. In the past, major agencies with intensive R&D programs, such as DOD, AEC and NASA, greatly influenced R&D thinking in other policy areas. But the limits of procedural transfers have become apparent. Each agency can learn from the other agencies, but this does not absolve it from the obligation to search for arrangements and ways to put knowledge to work specifically suited to its special needs and conditions. Differences among policy environments and constituencies

are great, and no single model for operating R&D programs can be expected to work across the board.

Improved planning of its R&D objectives and approaches should become an integral part of an agency's policy planning process. R&D should be viewed in conjunction with other policy tools, such as subsidies, taxation, or regulation. In many cases, similar results can be reached through different approaches, and it will be desirable to achieve at least some degree of comparability among the various alternatives. In other instances, one government activity may counteract another, unless both are seen in the context of the same policy problem. In agricultural policy, for example, it has long been recognized that direct subsidies sometimes achieve a goal precisely opposite from that sought by government financed agricultural R&D. The former aims at decreased production, the latter at increased yield.

It would be desirable, therefore, to examine the different ways Federal departments and agencies relate their R&D programs to the policy missions for which they are responsible, and to ask: How are results of R&D programs brought to bear on the policy planning and evaluation process? At what level in the agency does this effort toward integration and feedback take place? What results are achieved? What plans exist for improvements?

A Suggested Format for Examining Agency Science Policies

The type of questions raised here might be most effectively explored at the hearings if the head of agency R&D operations and the head of agency planning and evaluation were both asked to testify. Since the number of agencies involved precludes systematic agency-by-agency discussions, *we recommend that the committee try this approach for two or three selected agencies.* If the results are useful, the committee might invite the OTA to hold agency science policy hearings on a systematic basis. The review techniques originally developed by the OECD in its country review system might prove helpful in this task. Agency R&D assessments currently being conducted by the National Academy of Sciences provide another model.

In time, a more ambitious, more policy-oriented procedure for review and examination might be developed. Instead of reviewing single agencies, the focus could shift to major policy areas and involve the various agencies sharing responsibilities in each sector. As a result, the existing division of labor among agencies would become clearer and organizational issues in need of change would be highlighted. A sequence of science policy reviews might examine the following major policy areas: national security, foreign policy, economic develpoment, infrastructure development (energy, transportation, communications), physical environment and natural resources, social programs and human resources, and advancement of science and technology. Each review would lead to detailed reports and action recommendations to Congress and the Executive branch.

Different procedures can be developed for the systematic review of agencies and policies. The procedure matters less than that a new process come into being allowing for continual reexamination of the relationships between R&D and policy.

Questions for consideration during the hearings:

Group #7:

(*a*) *What are the science policy objectives of agencies administer-major R&D programs?*

(*b*) *How are science policy implications of regulatory decisions assessed?*

(*c*) *How can science policy be of use in planning and implementing social programs?*

(*d*) *For which specific functional policy areas should science policy strategies be developed?*

(*e*) *How do Federal agencies relate their R&D activities to their policy missions?*

(*f*) *How can STPO, OTA, or the Committee on Science and Astronautics facilitate the development of sectorial science policies?*

institutional ossification and weaknesses. But again, the contemporary critique does not negate the original achievement. Its history shows only what must be expected: successful institutional innovations are subject to aging and prone to cling to their original mission too long after it has been achieved.

Against this background of the past it can be asked: how do the various departments of the Federal government today perceive the task of developing or revitalizing institutional networks for putting knowledge to work and linking the separate but interdependent functions of research, technological development, and social application? As is true of research strategies, these institutional networks must be specific to each agency, and they will often have to be developed incrementally rather than through one ambitious master plan.

It can be asked if the social introduction of new technologies should not be left to the forces of the market. But in many instances the nature of the decisions to be made and the need for protecting the public interest no longer allow a laisser faire policy. For a long time, government has shouldered growing responsibilities for the promotion of innovation, and its agencies are well placed to give increased attention to the social, political, economic, and legal aspects of technological change. In doing so, they would add a third dimension to their traditional roles of originating knowledge and developing technology. It is increasingly obvious that research and development can come to fruition only if equal attention is given to the appropriate institutional and social arrangements surrounding innovation. Linkages between research and technology and social change are too important to be left to circumstance. Many have expressed concern that much of what is known never has an impact on social change. Perhaps the reason is not that this knowledge is irrelevant, but that knowledge without an appropriate institutional environment is powerless and therefore useless.

Institutional Requirements for Policy Research

The argument so far has been addressed mainly to the need for the linkage between research and its use, but the case must be extended to the linkage between the Nation's research and development goals and its research and development institutions. To date, attention has focused on goals and on reorganization within government for managing R&D, while the research system itself has received little attention. Most R&D institutions came into being in response to older social goals. Are they willing and capable to respond to new political objectives? The new domestically oriented objectives almost all require understanding of social and economic constraints, opportunities, and institutions that are of marginal importance to space and military R&D. Whether it be energy, the environment, transportation, crime, or any of the myriad concerns upon which we are now spending money, each area requires strenuous efforts at understanding the related social institutions, economic implications, legal constraints, and political feasibility. R&D work as presently organized rarely makes these efforts.

The university, to be sure, combines within its institutional borders the various competencies required. But both the discipline orientation of the university system and the problem orientation of the Federal government work against tapping the university's potential for the purposes we are now discussing. It would be erroneous to assume that

continuing reliance on project grants will bring about the necessary institutional changes in the universities and in other research organizations. As it is, universities are willing to accept the funds offered, but they will not organize to meet the government's needs unless stability and assurance of continuing support are also offered. A similar situation exists in much of industry and among non-profit organizations. Willingness to innovate and reorganize has diminished with the uncertainty of Federal funding in recent years. Support to state and local governments has been equally spotty and addressed more to imitating Federal science policy structures than to meeting substantive needs in policy research.

Questions for consideration during the hearings:

Group #7:

The success of military R&D during and after World War II and of agricultural R&D around the turn of the century illustrate the need for building institutions capable of linking R&D to current policy purposes.

(a) Is sufficient attention given to the application, experimentation, and diffusion stages of R&D in the public sector?

(b) What has been learned from the private sector in this respect? What has been learned from other countries?

(c) Which policy areas are doing well and which are doing poorly? What can be learned from both success and failure?

(d) What can government do to remedy deficiencies? Should government become involved at all?

(e) Specifically, what should be the roles of STPO and of other government agencies?

(f) Are there characteristics common to institutions responsible for policy research, social experimentation and demonstration, testing of public investments in new technologies, and other forms of using R&D in the public interest? What has been learned from organizations such as COMSAT or government-university-industry consortia?

(g) Should Congress study alternative institutional arrangements to foster debate on the issue? Should it do more than that at this time?

IV. CENTRAL SCIENCE POLICY RESPONSIBILITIES

A Policy Research Focus For STPO

The preceding sections of this report were addressed primarily to science policy tasks of individual departments and agencies of the Federal government. But this is not to say that the tasks requiring Federal action which were identified do not require important contributions from the Science and Technology Policy Office. *We see the role of STPO mainly as one of stimulator, facilitator, and monitor of all aspects of Federal science policy.* Specifically, STPO could closely follow, evaluate, and synthesize the efforts of agencies to develop specific R&D strategies and institutional networks for innovation. The suggestion was made earlier in this report that the House Committee on Science and Astronautics and OTA undertake systematic reviews of agency R&D policies. These reviews, of course, need contributions from STPO and OMB who would articulate general policy principles and coordinate contributions from different Federal agencies.

The precise role of STPO will emerge only in time. In our opinion, it would be well advised to focus on high-level policy research and attempt to exert its impact on decisionmaking through the quality of its studies rather than through attempts at exercising direct line authority (which it does not formally possess). It is an open question whether STPO will have impact through advice directly given to the President, but its weight throughout the government will be felt if it is capable of thoroughly defining policy options. If STPO is good at this task it will provide indispensable assistance to OMB and the President's principal staff, as well as to the operating agencies involved. Ideally, STPO would supplement the work done by OMB by introducing a longer time frame into the assessment of policy options than is allowed by the 24-month perspective of OMB's budget cycle.

The foregoing suggests that STPO should undertake policy research on major R&D options as well as on the science policy implications of a great variety of public policy developments. What the agencies are expected to analyze for their specific areas of responsibility, STPO would do for the entire government. Issues straddling agency lines or not under the responsibility of any one agency would receive priority. Obviously this function cannot be performed without significant and continuous input from individual agencies. Many of the tasks encumbent on STPO would consist of defining issues for analysis in like terms, reviewing and discussing agency contributions, and synthesizing agency papers to identify national policy options.

A Comment on Staff Assistance

It was suggested earlier in this paper that policy research concerning science and technology not only requires competence in these two areas, but also knowledge about the economic, social, legal, and political implications of technological change. Accordingly, the staff of

STPO needs to include people with experience in many of these areas. Science policy, while continuing to receive basic direction from policy-oriented natural scientists, cannot rely on their qualifications alone.

A Science Policy Advisory Committee

The same comment applies to outside advice which STPO might want to solicit in discharging its responsibilities. Some broadening of backgrounds represented was discernible during the later years of The President's Science Advisory Committee (PSAC), but an even more deliberate move in this direction would be desirable.

Another question is whether such sources of advice should be organized on a permanent or an ad hoc basis. We feel that some of the opinions expressed during Phase One of the hearings concerning the improved preparedness of the scientific community to advise the government are overly optimistic. It is certainly true that a larger number of scientists and engineers have become aware of the policy implications of their work and are prepared to comment on them, but informed judgment on specific policy options requires continuous interaction with STPO on a broad range of issues. A science policy committee of informed individuals from a variety of academic disciplines and occupational backgrounds, responsible only to the science adviser, would strengthen the new science advisory function and help in improving relations with R&D-oriented institutions, Thus a vital link to experts outside the government would be re-established.

We recommend that a science policy advisory committee be created. We also suggest that the PSAC practice be followed under which the main committee received assistance from a number of specialized expert panels. A new science policy advisory committee might strive for a higher degree of participation by members than can normally be expected from a group meeting infrequently for short periods of time. While the number of committee members might be small, each might be asked to contribute a significant part of his time, both to provide direct input into major staff activities and to maintain communications with his original constituency.

Obviously, a science policy committee would not prevent the science adviser from soliciting ad hoc advice on issues of his choice. But one external group of qualified individuals should examine, over a period of time, the entire scope of science policy. We suggest that the committee ask the science adviser for his reactions to such a proposal.

The Dual Role of the Science Adviser

Concerns have been voiced by a variety of observers about the disadvantages of performing the government's central science policy function from the institutional environment of the National Science Foundation. A primary concern is with the potential conflict inherent in the science advisor's double role as policy coordinator of agency policies and recipient of part of the Federal R&D budget to run NSF's programs. Unquestionably, the arrangement is awkward. First indications are that the science adviser tries to minimize conflict by removing himself from direct participation in OMB's preparation of the NSF budget, leaving this function to the director of STPO. Eventually this arrangement must be changed.

If STPO were to emphasize the kind of policy analysis suggested here, its coordinating role might be less objectionable to other agencies. It must also be recognized that some of NSF's programs, such as the RANN activities, are moving in the direction of policy-oriented and experimental activities which can properly be viewed as close to the functions of the office responsible for shaping the government's science policy. Also, the NSF functions in support of research in physics, chemistry, engineering, biology, and environmental and other sciences, as well as its support of science education, are directly related to general science policy objectives. The health of the nation's scientific enterprise is of such importance that it must not be left to the interests and programs of individual government agencies alone. In time, Federal R&D funds appropriated for NSF and the agency's diversified staff can be helpful in developing the functions of the science adviser. In his role as NSF director, he can initiate experimental programs to test new approaches to meeting policy needs which he has identified as science adviser. In addition, the search for new incentives and financing methods in R&D is clearly a science policy function which the NSF should pioneer. On the other hand, it seems unlikely that NSF itself will become the government's major testing ground for new policies and programs, a function which was once assigned to the Office of Economic Opportunity. The recent downgrading of NSF's program for Experimental R&D Incentives supports this observation.

The Separation of Military and Civilian Science Policy Advice

A most serious problem exists with respect to the relation between civilian and military R&D advice. Until last year's reorganization, this country was alone among Western nations in having its science advisory function address both civilian and national security needs and programs. For many years this meant an almost exclusive preoccupation with national security and space matters, because these figured so importantly on the President's agenda. During this period the members of PSAC worked closely with the staff of the National Security Council. In more recent years, attention shifted to other policy areas, such as energy and the environment. The shift has also been described as one from research and development opportunities to social needs.

While this trend can be expected to continue, a definite split between military and civilian science policy advice has become part of the system under the new arrangements. The science advisory function based in NSF is not expected to perform the PSAC role of questioning and evaluating military proposals. A former science adviser, James R. Killian, sees this as a major flaw in the new arrangements. He feels that the country must reconstruct a method for providing the White House with the kind of "countervailing, questioning, objective examination of military technology" that will allow the President to make effective appraisals prior to his decisions in this area. The history of PSAC supports the point of view that an independent advisory group, reporting directly and exclusively to the President, has been influential as a counterweight to proposals submitted by the armed services and DOD. The new science policy arrangements have turned us back to the times before Vannevar Bush who first brought together military and civilian aspects in advising President Roosevelt. Today

science policy advice in national security matters is no longer the responsibility of the President's science adviser. It probably is not even the responsibility of any single individual, with some responsibilities encumbent on the staff of the National Security Council and others carried out by the Chiefs of Staff and The Secretary of Defense. We recommend that the committee raise this important issue and request clarification about responsibilities and activities in military science policy advice.

The President's Science Adviser, under the new arrangement, has a say only over half of the government's R&D budget. Vital questions, such as the implications of military R&D for the economy, cannot be addressed without full access to and involvement in national security matters. The same can be said about science policy advice relative to foreign policy—an area straddling, by definition, both civilian and military concerns. We recommend that the committee ask the science adviser about his role in these matters. We further recommend that the committee explore ways for reuniting the military and civilian science policy responsibilities.

The Presidency and Science Policy

Members of the scientific community often express concern over increased difficulty in bringing science policy matters to the President's attention. Another former science adviser, Donald Hornig, has remarked that there is nothing sadder than an adviser whose advice is not wanted. If this describes the basic condition of the science advisory function in the years preceding Reorganization Plan No. 1, the new arrangements have only institutionalized what had become actual practice. However, such an explanation does not take into account that the NSF-based science advisory system is also more removed from day-to-day interaction with OMB and the principal assistants to the President. We suggest that the committee ask how damaging it could be in time if that science policy is absent from the President's office and from his most intimate circle of counselors. A broad-based assessment of current opinions might be the best first step toward corrective action in the future. Alternatively, a dispassionate examination of the realities of Presidential decisionmaking as well as changes in national priorities might lead to a different conclusion. It will in any case be valuable to reopen the discussion of the President's need for scientific advice.

The Immediate Future

The only avenue open to the science adviser for the immediate future will be to work as closely as possible with OMB, the Domestic Council, and the President's Economic Adviser, to whom he is now officially reporting. The role assigned to the science adviser in the view of OMB expressed during the hearings last July provides a broad mandate. His responsibilities were defined as follows:

(1) To provide an independent analytical capability;

(2) To develop and supply the Executive Office of the President with a framework for evaluating R&D systematically; and

(3) To identify and make recommendations concerning critical new research needs.

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APPENDIX

Membership of the AAAS Committee on Science and Public Policy

Raymond Bowers, Cornell University, *Chairman.*
Brewster C. Denny, University of Washington.
William Drayton, Jr., Mckinsey and Company, Inc.
Don E. Kash, University of Oklahoma.
Mack Lipkin, Jr., Strong Memorial Hospital, Rochester, N.Y.
Derek de Solla Price, Yale University.
Don K. Price, Harvard University.
Victor Rabinowitch, National Academy of Sciences.
Jurgen Schmandt, University of Texas at Austin.
Richard Scribner, American Association for the Advancement of Science.
Eugene B. Skolnikoff, Massachusetts Institute of Technology.
Eugene S. Uyeki, Case Western Reserve University.
Christopher Wright, The Rockefeller Foundation.

The AAAS Committee on Science and Public Policy responded to the invitation issued by the House Committee on Science and Astronautics by assigning responsibility for preparation of the preceding document to a special subcommittee. The AAAS Committee, in line with its general operating procedures, closely monitored preparation of the report without, however, assuming the role of authorship.

INDUSTRIAL RESEARCH INSTITUTE, INC.,
New York, N.Y., April 2, 1974.

The Hon. OLIN E. TEAGUE,
Chairman, Committee on Science and Astronautics, U.S. House of Representative, Washington, D.C.

DEAR MR. CHAIRMAN: The Congressional Subcommittee of the Federal Science and Technology Committee of the Industrial Research Institute is pleased to submit a critique of the subject hearings as per your request.

As noted in our discussions leading to this assignment and again in the report, these comments are offered to provide the Committee with viewpoints from an industrial background but do not represent a consensus or position of the Industrial Research Institute.

If a need for further discussion develops in your study of the report we will be happy to come to Washington for that purpose.

We commend the House Committee and its staff for their diligent interest in developing an effective Federal science structure.

Our committee stands ready to assist you further in this matter or any other area of science and technology policy in which the insight of industrial research and development experience would be useful.

Sincerely,

GLENN A. NESTY,
Chairman, Congressional Subcommittee, Federal Science & Technology Committee.

APPENDIX

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Raymond Bowers, Cornell University, *Chairman.*
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Sincerely,

GLENN A. NESTY,
Chairman, Congressional Subcommittee, Federal Science & Technology Committee.

COMMENTS UPON HEARINGS BEFORE THE COMMITTEE ON SCIENCE AND ASTRONAUTICS, U.S. HOUSE OF REPRESENTATIVES, JULY 17, 19, 23, 24, 1973

INDUSTRIAL RESEARCH INSTITUTE, INC., FEDERAL SCIENCE AND TECHNOLOGY COMMITTEE

Subject: Federal Policy: Plans, and Organization for Science and Technology

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FEDERAL POLICY, PLANS AND ORGANIZATION FOR SCIENCE AND TECHNOLOGY

The Industrial Research Institute appreciates the opportunity extended by the Committee on Science and Astronautics to present comments on the subject hearings.

The problem of developing and implementing the plans which this nation will have to carry out in the field of science and technology appears to us to be larger, more intricate and more challenging than ever before in our history because of significant changes in the size and nature of the demands we face. This is especially true with respect to the crucial role of technology as distinguished from science per se in the years ahead and the degree to which the interest and responsibility of multiple agencies, industry and education are involved. In reviewing the national programs that are urgently needed and the difficult technical management and policy problems that must be surmounted, we feel that it is critically important for your committee to pursue several lines of inquiry as to the adequacy of the recently established science policy organization in the federal government and to provide a forum for examination of refinements and alternatives. In the course of our comment on the record of the hearings, it was inevitable that judgements and preferences in Federal Science Policy and Organization would find some expression in this document. It should be recognized that the document is the result of discussion and study by a very small segment of IRI acting as interested and experienced individuals to assist your Committee and should not be taken to represent a consensus of IRI, which in fact has no clear mechanism or charter for expressing a consensus.

We organize our comments under headings corresponding to principal thrusts of the hearings.

The Nature of the Challenge

Drs. Baker and David are to be commended for noting that the nature of our technical problems has changed since the OST was founded, because performance systems have been replaced by economic systems in our high priority needs. This shift brings with it a powerful new set of policy issues with the necessity to include not only science and technology but also economic, social, legal and political factors. Major problems in this sphere cannot be approached through mechanisms such as NASA, for which considerations of performance took priority over costs and interfaces with existing institutions and traditions were minimal.

The National Science Foundation (NSF) and Science and Technology Policy Office (STPO)

The role of the NSF in the new science policy structure was an important aspect of testimony and committee questions. We clearly rec-

ognize the need for the NSF to sponsor and support the abilities and contributions of the University science community and to provide for an adequate basic research operation. At the same time the NSF is not culturally suited to interpret the industrial science scene and even less the world of technology. As Dr. David points out, the NSF could give the new structure supportive strength in technological areas only by a radical change in its role and mission. Dr. Stever noted that NSF would really be misused if it took technical developments beyond the "proof of concept" stage. Certainly the NSF would become heavily involved with issues much larger than those of proof of concept if it undertook a backup role in technology guidance. Clearly recognizing this fact, Dr. Stever states that he plans to seek a wider base of support in technology by calling on the mission-oriented agencies as well as NSF and emphasizes the special role of STPO in this regard. In view of this plan we suggest that the Committee pursue the matter of qualifications within STPO to bring experienced judgement to Dr. Stever's assistance in the cost-benefit and incentive aspects of incorporating new technology into commerce and society. Of particular concern should be the scope and effectiveness of STPO to tap the advisory capacity of industry.

Dr. Stever testified that in evaluation of applied science (technology), a practice which is the normal strength of industry, the standard used will be that "the best check is the results". We are sure that he would hope for a better yardstick through earlier evaluation by substantial methods and will work to that end. The Committee could well inquire as to progress in setting up such evaluative and monitoring strengths within the structure and with the assistance of industry.

Authority Level of the New Structure

Some of the testimony questioned whether the new structure provides Dr. Stever with authority, mechanism and "clout" for providing a science and technology overview at a level necessary to ensure coherent and effective actions in a time of great technical challenge. We believe it would be unwise to take a long term "wait and see" risk in this connection and we urge the committee to continue monitoring the effectiveness of the structure to marshal the justification logic for critically important technical directions and appropriately influence the budgetary process. The measurement of influence in terms of closeness and frequency of the presidential relationship, referred to in the hearings, would appear to be highly variable and thus unreliable even though very beneficial when it exists. A posture that transcends this relationship seems essential and we recommend that the committee probe for such. In this connection we invite the committee's attention to Dr. David's recent column in Science (March 1974, Vol. 183, No. 4127, p. 801). Under the title "Prospectus for Science Advising" he notes that a modernized White House science apparatus could take on status and "clout" by reason of having specific, recognized responsibilities, perhaps legislated. Dr. David suggests that one such responsibility could be the powerful prerogative of executive authorization of Federal R&D programs following substantive review and certification of those that are worthy. He adds "that the actual funding of the programs would, as now, be the task of OMB in the executive branch and of the appropriation committees in Congress". We suggest that the Committee invite this level of discussion in further hearings including also the concept of a reasonably long statutory term of office for the Science Advisor.

Ability of the OMB as a Receiver of Technological Advice

The OMB, like other bodies for budgetary choice, including some in industry, was suspected of a refractory viewpoint in technological matters at several points in the testimony. We believe there is good reason for the Committee to inquire further as to whether OMB is developing a strength of technological understanding sufficient to receive and give judicious treatment to advice from the Science Advisor, the mission agencies, and industry. As representatives of a large segment of the industrial research community, we place great value on skill of overall management to exercise sound budgetary control within the boundaries of finite resources. For that reason, we know how important it is for management to be provided with a solid understanding of science and technology as related to economics, and for management to be committed to science and technology if any fruitful technologic ventures are to be realized. In particular we recommend that your Committee examine the Committee links between OMB, STPO and mission agencies in the light of evidence that they are effective in the budgetary review process.

The Mission-Oriented Agencies

We note with approval that it is the intention of Dr. Stever to make the FCST a Committee of Assistant Secretaries (or equivalent) as actual participants rather than of much lower level delegates, which it had become. We believe that this mode of operation is critically important to the Science Advisor's role in supplying coordination and direction. We refer again to Dr. David's concept of executive authorization as the tool or prerogative by which the Science Advisor could be more effective in seeing to development of necessary technologies, the appropriate assignment of roles among competing agencies, and the best interests of taxpayers.

Dual Burden on the Science Advisor

Much justifiable question has been raised as to the wisdom of expecting the Science Advisor, however capable, to fulfill this major assignment while at the same time heading the NSF. In our view the Committee should examine a body of opinion as to whether there is a necessary association of these functions or that better results would be expected of a Science Advisor who is not only unburdened as to the NSF directorship but also independent in his treatment of the NSF as only one of his pluralistic supports for reaching judgments.

Absence of Defense R&D from Science Advisor's Scope

A wide range of opinion exists as to the extent of interaction of Defense R&D, T&E with civilian technology. However, the vastness of these expenditures and their call upon manpower, facilities, budgets, and priorities make it difficult to conceive of suitable machinery for coordination of the technologic program of the nation without a charter to be aware of and influence defense R&D as a

part of the same overall picture. We suggest that the committee obtain judgments as to how this can be done so as to derive timely benefits from defense R&D without compromising its special nature and mission.

Adequacy of the Present Structure—The Central Questions

The matter of adequacy of the present structure transcends any question as to whether "science has been downgraded." Rather the question to be addressed by the Committee is whether the present arrangement operates effectively:

(*a*) to review the activities of the mission agencies on an overall basis;

(*b*) to study and judge their interactions and to balance their relative merits and priorities;

(*c*) to provide the Chief Executive and Congress with an overall view that includes a creative synthesis rather than the least common denominator of many pressure groups.

Stated more broadly the Committee should seek to determine whether the Science Advisor and the apparatus supporting him provide a unifying point of sufficient authority and competence within the government to ensure coherence in policy, wisdom in decisions and effectiveness in organization for:

(*a*) taking timely counsel from the broad, pluralistic participation in study and discussion that lead to great national decisions;

(*b*) the solving of mission problems involving high technologic content and the participation of more than one agency;

(*c*) continuing consideration of defense research, development, and of technologic and engineering activities in the industrial sector;

(*d*) a basic research program intelligently integrated with the above in quality and quantity;

(*e*) the development of a trained manpower resource geared to all the above.

The scale of this task raises again the questions:

(*a*) should this assignment be one unhampered by a further responsibility for administration of NSF?

(*b*) does the task call for additional authority (clout) and if so how can such authority be installed in the function without resorting to the unreliable base of presidential closeness or the short term influences of political change?

The Interface Between Science and Technology

We have emphasized that technology and its close partner economics will be more important than science in many of the difficult decisions that will have to be worked out, i.e. experience in the world of application and implementation will take priority over scientific expertise in those instances. However, we do not mean to imply satisfaction with the information base, i.e. such emphasis should not be permitted to obscure the need for a continued and purposeful mix of basic and applied research to refine and generate technology. At the same time we would warn against the platitude that technology exhausts basic knowledge. On the contrary, in a well managed science and technology community the store of basic information will receive much input from the implementation phase.

Public Reporting

Borrowing again from Dr. David's comment in Science, referred to herein, we recommend that the Committee examine the merits of a public reporting role for the Science Advisory apparatus, i.e. a yearly state of science and technology report after the fashion of reports by the Council on Environmental Quality and the Council of Economic Advisers. Might this role add to public technological literacy and understanding and thus strengthen the authority of the Science Advisor?

The apparatus of the Federal science and technology structure and the problems of it merit the fullest possible attention of the Congress. Certainly, the House Committee, with its breadth of responsibility and its depth of experience in science and technology is a most suited mechanism to perform this function.

This report is the result of study and discussion by a group of IRI members (listed below) under the sponsorship of the Federal Science and Technology Committee of the IRI through its Congressional subcommittee:

G. J. Arquette—Airco, Inc.
J. W. Bernard—Foxboro Company
C. Bordenca—Glidden Durkee Div. SCM Corp
J. K. Bragg—Singer Co.
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N. C. Robertson—Air Products & Chemicals
B. H. Rosen—Cities Service
E. Ruh—Harbison-Walker
T. R. Smith—Maytag
J. E. Tessieri—Texaco
P. C. White—Standard Oil—Indiana

THE LIBRARY OF CONGRESS,
CONGRESSIONAL RESEARCH SERVICE,
May 3, 1974.

Honorable OLIN E. TEAGUE,
Chairman, Committee on Science and Astronautics, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN:

The enclosed study, "Federal policy, plans, and organization for science and technology: An unstructured critique of the July 1973 hearings of the House Committee on Science and Astronautics" has been prepared in response to the request of your committee made in December 1973 to our Science Policy Research Division.

In accordance with instructions, we have been as candid and frank in our expressions of opinions as possible. We hope you will find the study useful.

Principal responsibility for this study has been carried by Mrs. Dorothy M. Bates, Specialist in Science and Technology, who also received suggestions from Dr. Franklin P. Huddle, Senior Specialist in Science and Technology, and other members of the Science Policy Research Division.

Sincerely yours,

LESTER S. JAYSON,
Director.

FEDERAL POLICY, PLANS, AND ORGANIZATION FOR SCIENCE AND TECHNOLOGY

An Unstructured Critique of the July 1973 Hearings of the House Committee on Science and Astronautics

Prepared at the request of the
House Committee on Science and Astronautics

by the

Science Policy Research Division
Congressional Research Service
Library of Congress

April 26, 1974

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INTRODUCTION AND SUMMARY

In December 1973 the House Committee on Science and Astronautics requested the Science Policy Research Division of the Congressional Research Service to prepare for its own use an "unstructured critique" of the committee's July 1973 hearings, "Federal Policy, Plans and Organization for Science and Technology." The Committee specifically requested as frank and candid an appraisal of the hearings as was possible, and also actively invited suggestions for future action.

The critique which has been prepared in accordance with committee guidelines, has been organized in three major sections: 1) an analysis of the July 1973 hearings; 2) policy implications of the July 1973 hearings; and 3) considerations for future committee action.

The first section of the critique reviews the major purposes of the hearings, evaluates the choice of witnesses, summarizes the main points of their testimony, and concludes with our observations on the extent to which the purposes of the hearings were achieved.

The second section is a brief discussion of some of the policy implications of the hearings with respect to their impact on Administration action in implementing the new arrangements, fostering interagency coordination, lessening the possibility of executive privilege, improving relations between the Administration and the scientific community, and affecting the general level of science funding.

The third section considers future courses for committee action, with suggestions for particular lines of inquiry and some questions that might usefully be taken up in future hearings.

I. ANALYSIS OF THE JULY 1973 HEARINGS

A. *Major Purposes of the Hearings*

On July 5, 1973, the chairman of the House Committee on Science and Astronautics, Olin E. Teague, announced that the committee would begin a "comprehensive inquiry into Federal policy, plans and organization for the support and utilization of science and technology." In announcing the hearings, to begin on July 17, the chairman observed that the committee's inquiry had several purposes. These purposes derived from the jurisdictional assignments to the committee for oversight responsibility for scientific research and development generally, and for the National Science Foundation, in particular.

One immediate purpose was to ascertain the effect on the National Science Foundation of Reorganization Plan No. 1 of 1973. The plan, which in the absence of congressional disapproval, became effective on July 1, 1973, abolished the Office of Science and Technology and transferred its civilian responsibilities to the Director of the National Science Foundation. In related actions, the President designated NSF Director H. Guyford Stever to be his Science Adviser, and also named him to be the chairman of the Federal Council for Science and Technology. These significant additional responsibilities to the NSF Director were assigned without approval of additional funds or personnel to assist him in implementing them. Until the Foundation received supplemental appropriations at the end of the calendar year 1973, the additional costs were absorbed from the current Foundation budget.

A second purpose of the hearings was to draw commentary from key Administration witnesses on the reorganization. The committee also sought to obtain commentary from informed nongovernmental persons on the outlook for the successful implementation and operation of the Reorganization Plan, and to invite their suggestions concerning Government-science relations.

A final major purpose of the hearings was to place on the record the concern of the members of the House Committee on Science and Astronautics with the diminishing level of Federal support for scientific research and development, and to obtain information on the current attitude of the Administration toward the role of science in Government.

The Chairman cited statistics which showed that whereas 12.6 percent of the Federal budget had been allocated to research and development in 1965, the present percentage in 1973 was only one-half that amount; he noted also the increase in the inflation factor. His concluding statement at the opening of the hearings summarized his concern:

> I think the implications of these facts are clear. Government attitude toward [the] support of science and technology is not what it was a few years ago. Without presently attempting to define this trend as right or wrong, it is incumbent upon this committee to try to find out what is happening and why. (p. 2)

The July 1973 hearings were the first of a planned three-part series on the broad announced topic. The second part of the hearings, planned for late 1973, were to provide an opportunity for public witnesses from industry, academic institutions, not-for-profit institutions, and other sources to go on record with evaluations of the new arrangements as well as recommendations and suggestions for improvement. These hearings were deferred when other matters claimed the urgent attention of the committee at the close of the first session of the 93rd Congress.

As a substitute for the follow-on hearings of late 1973, the committee requested the assistance of representative groups of the scientific community—among them, the Committee on Science and Public Policy of the American Association for the Advancement of Science, the Federal Science and Technology Committee of the Industrial Research Institute, and the Science Policy Research Division of the Congressional Research Service—in the preparation of critiques of the July hearings.

The next phase of the inquiry was planned to be held at a time in 1974 when the committee had determined that sufficient time had elapsed to permit an evaluation to be made concerning how the arrangements under the Reorganization Plan were working. It is understood that the next committee hearings have now been tentatively scheduled for late spring or early summer 1974.

B. *The Hearings Record*

The hearings were held on July 17, 19, 23, and 24, 1973, barely three weeks after Reorganization Plan No. 1 of 1973 went into effect on July 1. The total time in hearings was approximately 7½ hours, not allowing for committee recesses to vote on the two afternoons the hearings were in session.

The witnesses and dates of appearance were as follows:

July 17, 1973 (2 p.m.-4:30 p.m.) Dr. H. Guyford Stever, Science Adviser to the Executive Office, and Director, National Science Foundation; accompanied by Dr. Russell C. Drew, Director, Office of Science and Technology Policy; Dr. Lloyd Cooke, Chairman, Planning-Policy Committee, National Science Board, and director of urban affairs, Union Carbide Corp., New York; Dr. Raymond L. Bisplinghoff, Deputy Director of the National Science Foundation; and Dr. Paul F. Donovan, Head of the National Science Foundation Energy Task Force

July 19, 1973 (10 a.m.-11:50 a.m.) Dr. William O. Baker, president, Bell Telephone Laboratories

July 23, 1973 (2:20 p.m.-4 p.m.) Dr. John C. Sawhill, Associate Director for Natural Resources, Energy and Science, Office of Management and Budget; since December 1973, Deputy Director and Director, Federal Energy Office

July 24, 1973 (10 a.m.-12:20 p.m.) Dr. Edward E. David, Jr., executive vice president, research and development and planning, Gould, Inc.; and William D. Carey, vice president. Arthur D. Little, Inc.

The hearings record, including responses to written questions transmitted to the witnesses following their appearances, was published in the autumn of 1973.[1]

1. *The witness list.* The witness list was a good short list, and certainly long enough for the hearing time. In fact, a more extended time with a number of the witnesses might have been profitable. For example, Mr. Davis took note of the fact that Dr. Stever's time was broken into by repeated roll call votes made more lengthy by failure of the electronic voting mechanism. Except for responses to a few specific questions put to Drs. Cooke and Donovan, the NSF testimony came wholly from Dr. Stever. Dr. Drew had a prepared statement, but time did not permit him to present it, nor was he asked any questions. The statement was entered into the printed record. It would have been useful for the committee to have had an opportunity to hear Dr. Drew discuss future plans for the Science and Technology Policy Office in light of his OST experience. Dr. Drew did not appear again before the Committee on Science and Astronautics until March 14, 1974, in connection with the NSF budget authorization for fiscal year 1975.

Dr. Baker, the second witness, was a logical choice because of his long service as a scientific adviser and consultant to the Federal Government on both civilian and military matters, and because of his position as cochairman of a voluntary, informal Science and Engineering Council. The announced purpose of this council according to Dr. Baker, "besides its advisory role, is to serve as another link between the national community of scientists, engineers and technologists and the Nixon Administration during the [1972] campaign and afterward." [2] As of early March 1974, the council was still in existence, and Dr. Baker was still associated with it.

Although high-ranking officials from the Office of Management and Budget have appeared before the House Committee on Science and Astronautics on other occasions, these occasions are infrequent enough to warrant comment when they occur. Dr. Sawhill's appearance, representing OMB, was such an occasion. His appearance however was too short to permit the committee members to question him fully.

The witnesses for the final day of hearings were Dr. Edward E. David, Jr., former Science Adviser to President Nixon, the last Director, Office of Science and Technology, former Chairman, Federal Council for Science and Technology, and Chairman, President's Science Advisory Committee; and Mr. William D. Carey, a former long-time employee of the Bureau of the Budget, including service as Director of the Resource and Science Division. These were good choices. They presented the only critical testimony of the hearings and helped to balance the Administration and pro-Administration witnesses.

It was unfortunate that Secretary of the Treasury George P. Shultz could not present his views of the new organizational arrangements in person. His prior commitments apparently made this impossible. Although he responded to questions submitted to him by the committee, the record on Dr. Stever's relationship to him and to the President remained unclear.

[1] U.S. Congress. House. Committee on Science and Astronautics. Federal policy, plans and organization for science and technology. Hearings, 93d Congress, 1st session. July 17, 19, 23, 24, 1973. Washington, U.S. Govt. Print. Off., 1973. 180 p. (Unless otherwise indicated, quoted material in this report and page references following quoted material refer to these hearings.)

[2] Committee for the Re-election of the President. Formation of a Science and Engineering Council in Support of the President. Press release. Oct. 17, 1972.

All the other witnesses except Dr. Baker prepared responses to additional questions submitted to them by the committee following their appearances.

2. *Significance of full committee hearings.* Science policy questions have over the past decade been customarily considered by the Subcommittee on Science, Research and Development of the House Committee on Science and Astronautics. Since its establishment in 1963, the subcommittee has been the focal point for hearings on questions relating to scientific research and development generally, congressional sources of information and advice in science and technology, the utilization of scientific and engineering resources, and congressional oversight of the National Science Foundation. However, the July 1973 hearings were held by the House Committee on Science and Astronautics, sitting as the full committee, and were presided over by Chairman Olin E. Teague. Apparently the committee sees its oversight responsibility extended and given "new clout, new leverage" through the increased responsibility given to the National Science Foundation by Reorganization Plan No. 1. This view was reflected in Congressman Mosher's comment to Dr. David that the committee has oversight responsibility for the National Science Foundation "to a degree that we never had any right to oversee your operation in the White House. So our committee role is enlarged and becomes much more important and I think we have got to keep that in mind." (pp. 143–44)

The interest and concern of the members of the committee was evident from the generally good attendance at the hearings and in the probing questions they put to the witnesses.

3. *Impressions of Administration witnesses and summaries of their testimony.* The Administration witnesses were Dr. H. Guyford Stever, (acccompanied by Dr. Russell C. Drew, Dr. Lloyd Cooke, Dr. Raymond L. Bisplinghoff, and Dr. Paul F. Donovan); Dr. John C. Sawhill, and Dr. George P. Shultz.

Dr. H. Guyford Stever's testimony, his responses to the oral questions, and his prepared responses to the written questions all indicated a sincere effort to be as helpful and informative as possible. Dr. Stever did not pretend to know all the answers, but he conveyed the impression that the plan was workable, if people put their minds to making it work, which was what he intended to do.

Dr. Stever made public a letter of July 1 from President Nixon designating him Science Adviser to the President and to other entities in the Executive Office, and appointing him to be Chairman of the Federal Council for Science and Technology. In discussing the establishment of the Science and Technology Policy Office, Dr. Stever said he had structured the office to maintain a "maximum degree of objectivity and impartiality on science policy matters." He noted further his intention to use the Foundation's resources as well as those of other Government agencies. Concerning advisory groups, he said he was looking into the establishment of formal mechanisms to insure good communication between himself and the scientific community, but his personal belief was that advisory groups are best used on an ad

hoc basis, to deal with a particular problem, and to go out of existence at the end of the problem. Dr. Stever discussed at length his activities as U.S. Chairman of the U.S.–USSR Joint Commission on Scientific and Technical Cooperation. He then described actions that had been taken to coordinate energy research and development, including the establishment of the Energy R&D Task Force at NSF, his role as Chairman of the Technical Advisory Committee on R&D of the FPC National Power Survey, relations with the Office of Energy Policy in the White House, and his assistance to Dixy Lee Ray relating to the conversion of AEC to the proposed Energy Research and Development Administration. Dr. Stever acknowledged the support of the National Science Board, and the interaction he was having with OMB Director Ash and his key staff members, and with Treasury Secretary Shultz. Dr. Stever was quizzed on the extent to which he, as Presidential Science Adviser, might take the initiative in making recommendations relating to technological aspects of problems under consideration. He said he considered it both a right and responsibility to do so. He acknowledged having had three conversations with the President since the plan was announced but stressed that he believed the best way to get results was through developing relationships with the top people in the White House rather than attempting "to run in a grandstand play with the ball all alone."

The chairman of the committee expressed approval of the new arrangement because "we have someone who's come down to where we can talk to him." Subcommittee chairman Davis said he had found the previous science adviser to be "most accessible."

In a prepared statement submitted for the record, *Dr. Russell C. Drew* outlined his initial responsibilities and those of the Science and Technology Policy Office in assisting Dr. Stever in his capacity as Science Adviser. These included:

1. Providing advice, consultation, and recommendations on national civilian science and technology policy.
2. Developing technical options related to the solution of national problems in the civilian area.
3. Appraising the overall effectiveness of ongoing Federal and national R&D efforts and recommending policy and program action toward the achievement of national goals through civilian science and technology.
4. Serving as the focal point for coordinating Federal R&D programs. (STPO will provide staff support for the Federal Council for Science and Technology and assist the Director in the formulation and coordination of FCST activities.)
5. Interacting with academic and industrial science communities on broad matters of science policy so as to further their application, in every appropriate way, in strengthening science and technology in the United States.
6. Providing advice and assistance in furthering U.S. international science and technology objectives. (p. 48)

Dr. Drew's statement to the Committee noted that the challenge facing him and his staff in carrying out these functions, would be "to identify the issues, to sharpen them to ensure that we are asking the right questions, and, when appropriate, to assemble and coordinate

the necessary resources of the National Science Foundation and other Government agencies and from the private sector." Their task would be to develop issues into reviews and assessments which will reveal the policy options available and, as appropriate, recommend courses of action to Dr. Stever. In the beginning, Dr. Drew reported his office would be very selective in choosing its activities, restricting its initial emphasis to very high priority areas.

Dr. Drew's statement contained no new information. There is nothing in the printed record concerning what staff he had on board at the time of the hearing, or even where the office was located. We do not know what former OST personnel transferred to NSF, nor do we know what unfinished OST business NSF may have inherited. Some of these questions might have been answered if Dr. Drew had had an opportunity to testify in person and respond to questions.

Dr. John C. Sawhill began his testimony with statistics on Federal research and development programs which showed that whereas in 1963 agencies other than DOD, AEC and NASA accounted for only 10 percent of the total, by 1974, this figure had increased to 24 percent. He gave numerous examples of how departments and agencies engaged in civilian R&D had strengthened their programs. Because the National Science Foundation has grown in size and stature as an agency, he thought the decision to place responsibility with the Director for looking across departments and agencies to assure an effective overall Federal and national effort in science and technology was an appropriate one. He stressed also, in addition to the expertise the NSF now has in many areas of science and technology beyond basic research, its ties to the scientific community, which he termed "particularly important."

He spoke of the recent reorganization within the Office of Management and Budget and the consolidation of natural resources, and energy and science under his jurisdiction as Associate Director. To show how Dr Stever in his capacity as science adviser might interact with his office in providing "independent advice and analysis," in one area—energy issues, problems and solutions through research and development—he enumerated several kinds of possible assistance, including—

> Developing and supplying the Executive Office with a framework with which to evaluate systematically energy R&D programs.
>
> Developing criteria for assessing the merits of individual technology approaches.
>
> Providing independent assessment of environmental, health, and safety standards and identifying necessary additional research to improve standard setting.
>
> Identifying and recommending critical new research needs in energy R&D.
>
> Identifying and evaluating significant research findings that could affect energy R&D or energy programs or policies.
>
> Determining ways in which universities and other research organizations can make their most effective contribution to energy R&D from a research and manpower standpoint.
>
> Maintaining awareness of current plans and viewpoints of industry and associations on matters related to energy R&D, and bringing those to the attention of the Office of Management and Budget, and other Executive Office agencies. (p. 108)

The kinds of assistance he had enumerated in the energy area, Dr. Sawhill noted, were "an example of the type of support and the kind of relationship that, I believe, can be developed in other areas under Dr. Stever's leadership. In other words, it is not only doing these things in energy, but this is the pattern we will follow in a variety of other areas, as well."

As a high-ranking OMB official, Dr. Sawhill's appearance was a novelty to the Committee members and he was questioned at length concerning the OMB's impoundment of science funds, the Agency's reticence, and its inaccessibility. His plea of innocence about impoundment rationale on grounds that it occurred before he came to OMB in April 1973 was not accepted. Representative James Symington summarized the general concern when he observed to Dr. Sawhill:

> If there is any one thing you must have been told early on, if you have not read it in the papers, it is that this committee and the Congress is disappointed with the impoundments that have occurred, especially with respect to our bills.
>
> So it would seem to me you would acquaint yourself rather specifically, and in some depth, with the rationale for why those impoundments occurred. Instead, you tell us you are new on the job and are not sure.
>
> But of course we cannot really function as a committee preparing legislation unless when we get such a rare opportunity as we have today to talk to someone from your shop, someone who really knows what has gone on in the past, and why, and can explain such actions to us [that this individual cooperate], so we can constructively continue the dialog to improve our relationship with OMB in the future. (p. 123)

An indication of OMB intransigence might be suggested by the weak response of Dr. Sawhill to Mr. Symington's observation. The impoundment issue is obviously of high constitutional concern, and the committee had a right to expect a more explicit response from the OMB witness.

Perhaps the most encouraging aspect of Dr. Sawhill's testimony was his implied assurance of OMB support in approving increased funding for staff to help Dr. Stever carry out his added responsibilities.

It is uncertain what importance should be attached to Dr. Sawhill's testimony since he is no longer in OMB. In December 1973, Dr. Sawhill was appointed Deputy Director, and in April 1974, Director, of the Federal Energy Office. His replacement is Frank G. Zarb, who since July 1973 has served as OMB Associate Director for Management and Operations.

Mr. Zarb, 38, has a business administration and investment banking background. His previous Government experience was as Assistant Secretary of Labor for Administration from April 1971 to December 1972. Like Dr. Sawhill, Mr. Zarb appears to have had no close prior connections with Federal science activities. However, continuity in his office at OMB is maintained in the Energy and Science Division which is headed by Hugh F. Loweth, a veteran OMB official with a long Federal science familiarity.

Dr. George P. Shultz, Secretary of the Treasury, was unable to appear in person to testify but he agreed to respond to written questions of the committee. The response to the questions provided little if any new information. In most instances, the questions consumed more space than the brief responses. The response could be an evidence of preoccupation with other apparently more important or pressing matters, or an indication of unfamiliarity or disinterest in the subject. In view of their reportedly long personal acquaintanceship, Dr. Shultz might have been expected to be more helpful to Dr. Stever.

Dr. Shultz is leaving his position as Secretary of the Treasury on May 1. His replacement will be Deputy Treasury Secretary and FEO Director William E. Simon. Mr. Simon's entire career prior to assuming his present government position in December 1972 has been in investment banking. It has been announced that Mr. Simon will not be named Assistant to the President for Economic Affairs. It was in this capacity that Dr. Schultz served as Dr. Stever's channel to the President.

4. *Impressions of public witnesses and summaries of their testimony.*

The three public witnesses were Dr. William O. Baker, Dr. Edward E. David, Jr., and Mr. William D. Carey.

Dr. William O. Baker's lengthy statement was in support of the reorganization. In placing the present situation in historical perspective, he noted that in the World War II period and thereafter, the challenges to science and engineering were through *performance systems*. Today the main challenges to science and engineering are in the service of man through *economic and social systems*, where other than scientific and technical factors play dominant roles.

Dr. Baker expressed the view that "if there has been a discontinuity or turbulence in the national community due to the Federal reorganization, it has a large factor of correcting a basic mistake in thinking about the earlier Federal activities in research and development." He illustrated his point by referring to "a widespread illusion" during the 1960's that our society and Nation were supporting research and development as "ends in themselves," the cultivation of science as a "new national sport." The shift in emphasis which has occurred during recent years did not signify that reduced importance has been assigned to the uses of research and engineering, but rather that the choices should be made "through the people's active Government agencies, in ways not possible in a small, elevated, but often remote, part of the executive branch of Government." (p. 95)

Dr. Baker illustrated his thesis of the need for public-private coordinated effort by a case history of the development of materials science and engineering policy and practice.

Dr. Edward E. David's testimony was candid, informative, and penetrating. As the most recent Presidential science adviser, he was in an unrivalled position to sketch the dimensions of the task in relation to the job ahead for Dr. Stever and the NSF.

While the theme of the 1950's and 1960's was the unity of science and technology, the theme of the 1970's and 1980's is extending the unity of science and technology to include economic and social factors, legal considerations, and political issues. Dr. David expressed the hope

that "this committee will play its traditional leading role in bringing this developing theme to the Federal policy level and to the scientific and engineering communities."

He characterized the science advisory arrangement in NSF as "unstable" because the tasks it must undertake are "formidable and demanding" and because an agency rooted in the academic style and dealing preeminently with academic basic research might find it difficult to take into account the non-scientific factors and considerations which are part of civilian science and technology policy issues. He volunteered a number of indicators by which the Committee might assess NSF's progress. (p. 135)

In his view, the reorganization did not mean that science had been downgraded, nor that it could be. However, he thought "the direct influence of scientists on societal affairs" *had* been downgraded. Whether this situation would persist would depend on whether NSF was successful in raising its standing in the executive hierarchy and its influence on other Federal agencies and departments.

Dr. David made a strong argument for the need for a technically based organization at an influential executive level to influence directly decision-making and program planning on the national level. He expressed the opinion that unless the input of technical people who understand the innovation process was incorporated at this level, "unrealistic goals will be set and technically incompetent programs will be put in place, will prosper, consume resources, and produce nothing. Such a situation [he said] can lead to much routine busywork, while others in the world find the ingenious and cost effective solutions." (p. 136)

This point was not expanded in the questioning. Since Dr. David did state that he had repeatedly recommended the strengthening of the Office of Science and Technology, it might be inferred that he had this kind of an organization in mind, reporting through its chief directly to the President. It would be useful to have Dr. David's further views on this subject.

Among the kinds of immediate policy issues which Dr. David identified as related to the current Federal emphasis toward "consumer and public-oriented technologies in energy, transportation, health, education, natural resources, ecology and environment, and social systems" were the following:

1. What is the proper role of Government in supporting R&D to yield commercial products?
2. What is the proper disposition of patent and other proprietary rights created by R&D partially or wholly federally supported?
3. Should the Government provide special incentives for private investment in R&D and for export of high technology products?
4. Should the Government provide grants and federally insured loans to entrepreneurial ventures?
5. Can federally supported R&D aimed at public technologies be responsive to marketplace needs and consumer preferences? (p. 139)

Looking to the future, he saw three major concerns which need to be addressed. The first relates to the sizing, shaping, scheduling and

monitoring of the national R&D programs (energy, health, transportation, natural resources, etc.) in each of which several agencies are involved. The second concern is the "rulemaking, standard setting, and regulatory activities of the Federal Government" whose impact is national, scope increasing, and costs "little short of monumental." The final concern is incorporating civilian technology as an instrument of U.S. foreign policy. Reconciling these major concerns, among the agencies involved, "and providing leadership to carry out the will of the executive" Dr. David said, "is another major challenge for NSF and its new office."

Mr. William D. Carey was the most critical of all the witnesses. His remarks reflected his experience in doing staff work for five Presidents during his 26 years' service with the Bureau of the Budget, which included responsibility for the funding and organization of Federal research and development and three years as an Assistant Director of the Bureau. Having worked with the White House science policy structure from its inception through three Presidents, he termed the decision to dismantle it and transfer its functions out of the Executive Office, "impulsive and mistaken." Transferring these offices out of the Presidency, even though the problems remain, signified to him an implicit message that the Administration believed "that policymaking had become less complex, that the choices are simpler, and that science and technology are no longer central inputs to national decisionmaking." (p. 159)

While he would have opposed the reorganization had he been consulted during the planning stage, once the decision had been made, and the plan submitted to Congress, he thought it "useless" to bar the door to reorganization. The President had to be the judge of the kind of staff he wanted around. Nothing was gained by forcing unwanted advisory arrangements on the White House. In fact he thought that the removal of an apparatus which gave an illusion of power where there was little in reality might even serve to clear the air.

In his view, the success of the new arrangements which he regarded only transient in the continuing "game of musical chairs" depends on the extent to which advice from an independent agency is accorded the same value that advice from Executive Office staff carries. The National Science Foundation's performance would be judged by the extent of usage by White House staff, the OMB, other Executive Office units, and the heads of departments and agencies, and by its identification of and the initiatives it takes regarding national issues of first order magnitude.

Of more fundamental concern to Mr. Carey is the future of science and technology in the Nation. Referring to recent actions in connection with the energy crisis, he said, "The firebell approach to R&D is being invoked once more to get us out of trouble. There seems to be rhythm, a kind of cyclical regularity, in the way we fall back upon crash R&D efforts. I wonder how often it will work. We habitually whistle up science and technology when we get into a jam, and then dismiss them as the crisis abates." (p. 160)

He expressed the view that science and technology should be regarded as public investments and managed over time with stability

and growth objectives, rather than on the year-to-year basis, which has been the case up to the present time.

He advocated closer ties between the Federal Government and the private sector on requirements and strategies for science and technology. He suggested that because there was no systematized way of determining our aggregate "technological potential," the Nation has to rely on observation and intuition, and may be running at "perhaps one-half of its rated potential." He suggested this subject for the committee's attention in future hearings.

In conclusion, Mr. Carey summarized what he believes should be areas of concern in national policies relating to science and technology:

Are we losing or gaining ground in our science and technology?

Are governmental incentives to increase our rate of technological output and productivity producing the desired results?

Are we excessively constraining commercial technology through regulatory legislation designed for other social objectives?

Are we identifying "stranded or slow-paced" technological opportunities which may have high potential pay-off where the Government should be sharing the exploration risks?

Are we looking at what other governments are doing to stimulate innovation and following their example where it meets our needs?

In response to a question concerning what Congress and the committee could do to improve the channel of communication to the President—whether the committee "should allow this thing to just sit like this and hope it will work or whether we should recommend to the President that he achieve a more durable focus for these questions," Mr. Carey replied that it was necessary to give the present arrangements a chance. However, he reminded the committee that President Kennedy proposed the reorganization plan creating the Office of Science and Technology because of pressure from Members of the Congress in the House and the Senate, who judged that science and technology were scattered throughout the Government and needed a strong center. The creation of OST had been proposed in order to head off a move to create a Department of Science.

Mr. Carey saw the committee's role as one of keeping the issue alive, through hearings and reports, and through suggestions for possible institutional changes. He speculated that the value of a planning process for science and technology at the President's level would again be recognized in the future; what form such an organization might take was uncertain. He suggested the possibility of an organizational arrangement analogous to the Council of Economic Advisers which Congress created through legislation and whose main influence is through education and leadership on economic strategies.

5. *Achievement of stated purposes of the hearings.* The stated purposes of the hearings were:

To determine the effect of Reorganization Plan No. 1 of 1973 on the National Science Foundation, for which the committee has oversight responsibility;

To obtain additional information on the reorganization from Administration witnesses;

nesses and to invite suggestions on how science and technology can be incorporated into the decision-making process at the Presidential level; and

To communicate the concern of the Committee on Science and Astronautics with the apparently diminishing level of Federal support for scientific research and development and to obtain information on the current attitude of the Administration toward the role of science in government.

Our summary impressions concerning the record on each of these purposes are as follows:

a. *Determining the effect of the plan on NSF.* The hearings were not really long enough to enable the Committee to examine the subject in depth. It may be unrealistic to expect more information concerning the implementation of important new responsibilities less than a month from the time they became effective. On the other hand, despite serious reservations, the Congress had taken no disapproving action with respect to the plan within the ninety-day period after it was submitted on January 26, 1973. This meant that the plan could have become operative when it appeared in the *Federal Register* on April 18, 1973, had the Administration not set a later effective date. So the Foundation had in reality a three-month period preceding the hearings when they had a clear go-ahead in which to formulate plans to implement the reorganization.

It has also been suggested that the committee members may have let the Foundation and other witnesses off too easily by not asking sufficiently penetrating questions or pursuing particular lines of inquiry more deeply, perhaps because they were being kind, or they lacked time, or for other reasons.

On the other hand, it is possible that the scheduling of the hearings so soon after the plan became formally effective may have speeded up implementation of organizational arrangements. Both NSF and OMB may have assigned this subject a higher order of priority in order to be able to report progress for the record. One of our colleagues has observed that "it seems reasonable to suggest that if it were not the intent of the committee to stimulate Dr. Stever and other witnesses into formalizing their first and best thoughts about their new responsibility, the committee did accomplish just that. The hearings may have forced timely thought and plans essential to some of the serious issues of our times, and the committee was provided with excellent preliminary insights."

b. *Obtain additional information on the reorganization from Administration witnesses.* The hearings provided an opportunity for committee members to hear and question the Associate Director for Natural Resources, Energy, and Science of the OMB concerning the reorganization and related matters, as for example, the impoundment of NSF and other funds. This was not the first appearance of a high-ranking OMB official before the committee but the occasion was a sufficiently unusual occurrence to be a topic for comment. Dr. Sawhill's testimony provided important insights into the kinds of assistance he

saw that Dr. Stever in his capacity as science adviser could provide to OMB. His preoccupation with energy issues was evident in the testimony.

If any one message was communicated to Dr. Sawhill, it was the members' dissatisfaction with the OMB's superimposition of its own assessment of priorities over that of the Congress in impounding congressionally-approved funds. Despite the committee's repeated questioning of Dr. Sawhill, the record is sketchy concerning the qualifications of OMB staff members to decide scientific priorities and allocations of funds. This gap in information is further widened by the shuffling of personnel since the hearings.

An encouraging note was the apparently sympathetic attitude of the OMB toward Dr. Stever's task and his need for additional resources, and the implied assurance by Dr. Sawhill that a request for these would be favorably received. It is to be hoped that his successor shares these views.

Perhaps the hearing provided the impetus for Dr. Sawhill and Dr. Stever to consult in advance on questions likely to be raised, and thus to become better acquainted. However, this advantage was short-lived, because Dr. Sawhill is no longer in OMB. Since December 1973, as Deputy Director of the Federal Energy Office, and now as Director, he has been devoting full-time to energy matters. The question now before the committee is how much of his testimony represented Dr. Sawhill's view only and what kind of rapport is being established between the new Associate Director for Natural Resources, Energy, and Science at OMB, Frank Zarb, and Dr. Stever.

The committee's attempt to illuminate the role of Treasury Secretary George P. Shultz as a channel for communication of science advice from Dr. Stever to the President was largely a failure. Dr. Shultz's responses to the questions submitted to him by the committee were extremely brief and contained little if anything not already on the public record. Dr. Shultz has announced his resignation as Secretary of the Treasury, effective May 1, 1974. Thus, by the time the committee resumes further hearings on the question of Federal science reorganization, a new Secretary will have been installed and it will be necessary to ascertain what, if any, his relationship will be to Dr. Stever.

c. *Obtain commentary concerning the reorganization and Government science relations from nongovernmental witnesses.* The public witnesses' testimony should be particularly useful to the committee. All provided useful background information on the White House science advisory process which helps in understanding the current situation. Each one offered suggestions concerning current and future issues facing any science advisory apparatus and ways to evaluate the operation of the present system. In this respect, despite the limited number of witnesses, it is probable that the hearings at least made an important start. Future hearings might perhaps concentrate on enlarging the record of evaluation and suggestions from informed observers among the scientific community.

d. *Communicate committee concern for the state of science and technology in the Nation.* The concerns expressed by committee members in the wide-ranging questions they put to the witnesses and the witnesses' testimony and responses to the questions comprises a printed record which has already been of considerable value to other Members of Congress, other committees of Congress, to the scientific community within the Federal Government and elsewhere, and to the public at large. The mere holding of the hearings and prompt publication of the record had value. However, to be useful, the monitoring of this subject must be done on a continuous basis.

It is also our belief that hearings of this nature need to be followed in relatively short order by some type of committee report, if only a summary of what the committee thought were the highlights of the hearing. This would, we believe, expand the audience of committee activity.

II. POLICY IMPLICATIONS OF THE JULY 1973 HEARINGS

It is possible to identify policy implications from at least five different points of view. These are discussed briefly below.

A. *The effect of attention by a congressional committee on the level of effort by the Administration in staffing, managing, and using its science advisory mechanism*

We have already expressed the opinion that we believe the scheduling of the hearings so soon after the effective date of the Reorganization Plan may have had a catalyzing effect in forcing the NSF and the OMB to move ahead faster in formulating arrangements in NSF to assist Dr. Stever. With the emerging energy crisis and the distractions in the Executive Office by the revelation of events related to Watergate, it is doubtful if the NSF Director could have commanded the attention of the OMB so promptly had the hearings not made this necessary.

No doubt the Administration was also aware that the exposure provided by the committee with legislative oversight responsibility for the NSF would be duly noted by the Government Operations Committees and by the Appropriations Committees. When Dr. Stever appeared before the latter committee in late autumn 1973 to request supplemental funds for FY 1974, he was questioned on many aspects of his new functions.

B. *The effect of the hearings on the responsiveness of executive agencies to efforts by the science advisory mechanism to obtain reports and data, to communicate policy advisories, and to coordinate programs and projects of multi-agency interest.*

We have not seen any evidence as of this time to indicate that the hearings may have facilitated or improved inter-agency relationships in areas for which NSF and Dr. Stever assumed the coordinating functions of the former OST. One would hope that the exposure of Dr. Stever's assignment provided by the testimony from the hearings might have been instructive to policy officials in the departments and agencies involved in civilian R&D and might have resulted in conscious efforts by these persons as members of the Administration team to make the system work. Certainly the decentralization of authority under the new arrangements should have provided an additional incentive for them to work to make the plan succeed. Future hearings should include witnesses from some of these agencies in order to provide more definite insight on how the system is working, as well as further questioning of the Director of NSF as to his assessment of agency relations with his office in its capacity as presidential advisory mechanism.

C. *The ability of the congressional committee itself to obtain statements and testimony from the Executive Office science advisory unit, based on the precedent of these hearings.*

The limited appearances of Dr. Stever in his Presidential science advisory role really do not tell us much about whether executive privilege may be an obstacle. Dr. Stever told the committee he did not think it would be a problem and so far he has not invoked the privilege.

The fact that Dr. Stever did not invoke executive privilege in the July 1973 hearings could be looked upon as having established a precedent. On the other hand, the question can be raised whether Dr. Stever had yet been sufficiently privy to Executive Office business to have anything to invoke executive privilege about.

We do not recall that executive privilege was ever invoked by the former Directors of the Office of Science and Technology.

D. *The effect of the hearings on the attitude of the scientific community towards the Administration, with particular respect to the Administration's evidenced attitudes toward science policy.*

Both the published hearings record and information from the hearings which was incorporated into numerous articles in scientific journals provided additional details concerning the reorganization of the executive science advisory system which have undoubtedly been noted carefully by concerned members of the scientific community. On the assumption that information showing the facts as they are is necessary for understanding and dealing with a problem, the hearings probably had a maximum policy impact in this regard.

The hearings publicized the Administration's announced intention to rely more extensively than in the past on a wider segment of the scientific community through the use of ad hoc advisory groups. The subsequent record is somewhat fragmentary on just how the Administration has gone about doing this. Reports of meetings Dr. Stever has held with certain groups have appeared in the press, and the fact that the Vice President met with one particular group—the Committee on Scientific Society Presidents—to hear their suggestions and comments was considered sufficiently newsworthy to be the subject of a single article. We do not know how useful these meetings have been, but we are dubious of the impact on the present Administration of exclusively critical advice such as was reported to have been given on the latter occasion noted above.

E. *The effect of the hearings on the actual level and directions of scientific effort supported by the Administration, with particular reference to the views of the committee.*

The hearings did not really examine the general science and technology situation other than to register the concern of the committee that the level of funding did not even compensate for inflation so that the actual level of Federal R&D effort was somewhat on the decline. The committee members did register strong disapproval of impound-

ment of science funds by OMB and the irritation over this disregard of the Congressional mandate by the Executive could not be overlooked. In January 1974, OMB Director Ash is reported to have announced the discontinuance of the practice of impoundment, but agency funds will continue to be placed in reserve. The latest OMB report of February 4, 1974, on funds in reserve shows that while some R&D money throughout the departments and agencies has been placed in reserve, the amounts appear to be far less than during FY 1973. According to the report, no NSF funds are now held in reserve.

The committee may have had an impact on the OMB action in releasing all NSF FY 1974 funds in December 1973, but we believe it more likely that the energy crisis was the motivating factor.

F. *Selected unresolved problems*

This section brings together additional commentary concerning aspects of the 1973 reorganization.

1. *Direct access to President believed necessary by scientific community.*

There appears to be a deepseated conviction within the scientific and technological community that direct access to the President is necessary to communicate the essence of science policies. The upward struggle of laboriously architectured position papers cannot replace the give and take of face-to-face communication, according to this view. Direct access to the President is necessary for full presentation of the scientific side of issues, to communicate the necessity for support of scientific programs, and to point out ways by which science can be exploited to solve public problems. Exposing the President directly to the realities of scientific controversy in adversary proceedings may have merit on particularly momentous issues.

Access to competent and informed scientific personnel in divisions and bureaus, even to those serving as scientific assistant secretaries, cannot substitute for access to the President. Actually, access to this lesser level has never been a problem. But the access of Government staff people to the White House establishment is bound to be limited, and the receptivity in the White House establishment, peopled with nonscientists, cannot be high.

To compound the problem, White House staff people tend to become an inaccessible elite, necessarily concerned with power and tactical maneuvering for position. A frequent attribute of power is inaccessibility. The hearings brought out that (1) a voice from the White House had more "clout" than a communique from NSF; (2) it would be extremely difficult for NSF to get a message to the President through the tiers of non-scientists in the chain of command.

2. *Dangers of the "all eggs in one basket" syndrome.*

One of the great dangers in the political use of science is the "all eggs in one basket" syndrome. A Presidential science apparatus should help identify options that warrant some support even when the bulk of effort goes elsewhere. The present arrangements appear to be designed precisely to weed out options, and to rely on single choice by (in the words of Sawhill) "proven management techniques . . . cost effectiveness . . . accumulated analytical wisdom."

The eggs-in-one-basket syndrome has another aspect: access to the President. According to Mr. Carey's analysis, for all practical purposes Dr. Stever's route to the President via Treasury Secretary Shultz has been clogged by excess of other business. The only other route is via the OMB. We do not know the extent of influence or interest of the OMB Director in serving as a channel to the President for science.

An encouraging note is the apparently improved relationship between OMB at the Associate Director level and Dr. Stever's Science and Technology Policy Office. Perhaps a key to the improved relationship is the realization by OMB that it needs help and there is no one else to turn to who is in a better position than NSF to provide it.

3. *What is the role of the scientific adviser who serves an elected official?*

This question was not addressed directly in the hearings but it is particularly relevant with respect to the role of advisory groups such as the former President's Science Advisory Committee. The subject was discussed at great length when all the Presidential science advisers met at M.I.T. in October 1973. There was general agreement that a science advisory mechanism could serve in the White House only if the President thinks he needs to have scientific advice at hand and only if he has confidence that the group will function as part of his team. Dr. Killian, who chaired PSAC during its most successful period, noted that the committee did not always agree with the President but they never disagreed with him *publicly*. In retrospect, it appears that some of the recent difficulties of the former White House science organization came about because both requisites for success were lacking. To some extent, the loss of confidence may be attributed to past *public* differences between the President and his science advisers. This is a subject which might profitably be explored at greater length in order to clarify the roles of scientific advisers in a political environment close to the top of the Executive hierarchy.

4. *Interagency coordination.*

There is very little in the record about how the NSF is discharging its coordinating responsibilities. There is general agreement that the Federal Council for Science and Technology is not now an effective body. Dr. Stever said he was trying to revive it. Since early 1974 the position of Executive Secretary, formerly a full-time position, has been filled temporarily by the STPO Director.

A high OMB official recently said the Federal Council was not even worth talking about, except as a debating society. We do not know whether the committees of FCST are more effective.

The coordination of Federal science programs, including determination of priorities and formulation of a strategy for science is a vital question.

5. *A summary evaluation of the implementation of the reorganization by NSF needed.*

All the information in the public record fitted together still does not present a total picture of what the NSF has done to carry out its new assignments and at what costs.

It is our understanding that neither the NSF Director nor the National Science Board had been consulted about the Reorganization Plan until the basic decisions had been made. The responsibilities were assigned to the NSF without immediate supplementary resources. Initially, the Foundation used positions and funds appropriated and intended for other programs. The fiscal year 1974 was three-quarters over before supplemental funds became available for spending by the Science and Technology Policy Office. As of mid-March 1974, STPO had 10 senior staff on board, including a Director, and eleven senior staff vacancies.

To compound the difficulties of the new unit, the simultaneous emergence of the energy crisis placed additional demands on the Director of the NSF and his support staff. Of 42 additional positions requested in the FY 1974 supplemental to support Dr. Stever in his new responsibilities, 17 were for the Office of Energy R&D Policy; the remainder were for all the rest of civilian science and technology.

The FY 75 NSF budget requests $1.5 million for Science and Technology Policy Research [STPO] and *triple* this amount ($4.5 million) for Energy R&D Policy Research "to provide data on science and technology issues required by the President's Science Adviser." (NSF Justification, p. 0–23.)

Despite this small budget, Dr. Drew claims that his office plans to examine in depth such broad subjects as international science and technology; materials (both minerals and materials); the world food situation; the role of social science research as it relates to domestic problems (housing, transportation, health care, poverty, urbanization and others); and the transfer of technology in the civil sector.

We have not seen anything in the public record which really appraises how the new functions assigned by Reorganization Plan No. 1 have impacted upon the Director and the NSF. A recent article in *Science*[3] cited several examples of scientific advisory assistance which the NSF has provided over the last ten months. We wonder what proportion of total time of the NSF Director and staff is accounted for by these several examples. Dr. Drew has said there was a period of inactivity in OST from January 1973 when the plan was announced until it became effective in July, and that he essentially had to start from scratch. The studies STPO proposes to undertake are so comprehensive that outside assistance will certainly be required. STPO is understood to be negotiating with the NAS to do a major study on the world food problem but what other outside resources it plans to use are not known.

Dr. Stever told a House Appropriations Subcommittee in November 1973[4] that since assuming the new responsibilities, business had

[3] Shapley, Deborah, Science Advising: New Setup Has More Resources, Less Visibility. Science, v. 184, April 12, 1974: 145–146.

[4] U.S. Congress, House Committee on Appropriations, Supplemental Appropriation Bill, 1974. Hearings before Subcommittees of the . . . . 93d Cong., 1st sess. Washington, U.S. Govt. Print. Off., 1973, 1364 p. At p. 822.

"picked up at a rapid rate, partly because people realized it was important and partly because I believe I had underestimated the problem when we first had these responsibilities thrust on us." There are several unknowns in the above quotation. Who were the people he was referring to who thought the transfer of duties was "important"? How far had he "underestimated" the problem? What significance, if any, should be attached to Dr. Stever's choice of verbs, i.e. "thrust", in that statement?

As part of his science advisory duties, Dr. Stever has been designated to act as the President's representative in selected cooperative programs in international scientific affairs, including chairing such joint bodies as the U.S.–U.S.S.R. Joint Commission on Scientific and Technical Cooperation. This is a major new responsibility for Dr. Stever and one which is understood to occupy a considerable attention within STPO.

Following through in working out international cooperative science agreements agreed on by heads of state has required previous science advisers to do a large amount of foreign travel. What demands are made on Dr. Stever's time by this assignment?

Recently, Dr. Stever concluded a major speech with the quote "Optimism is a moral duty" and he called on all scientists to join him in his conviction that together they can meet the challenges they face. When questioned whether his optimism related to his science adviser role, Dr. Stever replied that when he got discouraged in one of his two roles, he went to the other.

It appears from all the doubts expressed above, that the record must be made more clear before an accurate assessment can be made of the present situation.

III. CONSIDERATIONS FOR FUTURE COMMITTEE ACTION

We have pondered the question of future committee action at great length. We cannot see any course of action other than to continue the lines of inquiry which the committee began in the July 1973 hearings.

A. *Present arrangements considered transient.*

Three of the witnesses at the July hearings referred to the transient nature of the present arrangements. Dr. Baker supported Reorganization Plan No. 1 because he believed "it is the approach or the step that we need now. . . . We do not know that this present structure will be adequate for a long time, but we think it is a very good move for now." (p. 77). Mr. Carey referred to recent organizations in science and energy as a "game of musical chairs and I think we get too exercised over transient questions of organization" (p. 160). Dr. David expressed the view that the President must have a structure in which he has confidence and which he feels suits his style. He thought an argument for the reinstatement of an Executive Office science advisory apparatus "*at least in this Administration*, is really a theoretical rather than a substantive one." (p. 150).

Any arrangement involving personalities rather than institutions is bound to be transient. Two of Dr. Stever's channels to the President—Dr. Sawhill, and Dr. Shultz, have already gone or are soon to depart. But the biggest uncertainty of course is the President's status until the 1976 election. If the incumbent remains in office, it is not likely he will entertain any fundamental changes in the science advisory mechanism. The real question is, how transient is the present arrangement? This question is not likely to be answered for several more months, if then.

B. *Continuation of the initial objectives of the hearings.*

The lines of inquiry which the committee established last year were framed to consider both the immediate and longer range aspects of the Federal organization for science and technology. They included: (1) ascertaining and making public information from Administration sources on the effect of the implementation of Reorganization Plan No. 1 on the National Science Foundation and on departments and agencies engaged in civilian R&D; and on how scientific and technical advice is incorporated into national policy decisions at the Presidential and Executve Office level; (2) receiving commentary and suggestions from informed persons outside the Government on how science and technology can be incorporated into the decision-making process at the Presidential level; and (3) monitoring the general situation relating to Federal support for research and development and the role of science in Government.

In continuing to pursue these objectives, the committee can compile a record of the operation of present arrangements which should be valuable to concerned persons both within and outside Government as a basis for evaluating its success or need for change.

C. *Invite suggestions to make the present system work better in the national interest.*

While pursuing the above lines of inquiry, the committee may wish to consider what it could do to improve incrementally the immediate situation within present arrangements.

If the committee judges that change in the science advisory apparatus during the present Administration is unlikely it may wish to downplay the argument as to whether or not science has been downgraded and to enlist the active support of the scientific community in helping Dr. Stever in his task. One of our colleagues has suggested that in fact NSF may *need* committee help in order for it to succeed soon as the central body and force of the White House in science and technology.

Some suggestions which the committee may wish to explore along this line are listed below, in no particular order:

1. Urge scientists to offer their services through their scientific societies and technologists through their technical societies.
2. Hold panel discussions on topics of current interest; perhaps reactivate the Science Advisory Panel and use it more as the Research Management Advisory Panel is used.
3. Through hearings, publicize and alert the public and scientific community to emerging problems.
4. Encourage an attitude of support for Stever and NSF in this job; consider how the committee might strengthen Stever in his dealings with the White House.
5. Encourage Stever to be inventive—to design new apparati to help do his job and to utilize all manner of advisory mechanisms, including committees, commissions, contracts, WAE consultants, retired employees brought back as advisors or members of panels, use of NAS and NAE committees on science and public policy and public engineering policy.
6. Encourage Stever to utilize the NSF Deputy Director to greater extent for Foundation business, freeing him for his broader responsibilities; consider joint House-Senate sessions on subjects of mutual concern.
7. Reexamine the NSF mission. Is the agency's future in jeopardy by having too rapid diversification forced upon it? Consider whether NSF is orienting itself to tactical rather than strategic goals (see annual report 1973, p. ix–xi).
8. Explore ways that the President can be made to feel that the scientist and the lawyer should be friends—they need each other.
9. Explore what is the role of the scientist in providing advice to the President.
10. Consider the possibility of encouraging OTA to set up a system of advisory panels analogous to the old PSAC panels. This threat

of congressional competition might stimulate STPO into violent response, with White House support. The Domestic Council is already trying to come to grips with national materials policy, with STPO participation, but at a very low key. A move by OTA might raise the key and the scope.

11. To supplement the hearing process, it might be advisable for the committee to contract directly or through a non-executive branch agent for an organization like the National Academy of Public Administration, with the assistance of the National Academy of Sciences-National Academy of Engineering, to study and report on the institutionalization of scientific advice at the top level of Government. Such a study might differ from a study performed only by a scientific body in that the problem would be approached from a public administration view.

Ad hoc NAS Committee Study of Science and Government (Killian committee). We note that the Council of the National Academy of Sciences announced on February 1, 1974, the convening of an Ad Hoc Committee on Science and Technology to look broadly at the relationships between science and technology and government with the objective of suggesting means whereby science and technology can be incorporated into the policy-making process. The distinguished panel [5] under the chairmanship of James R. Killian, Jr., has set a four to six month date for the submission of its recommendations. David Z. Beckler, who was intimately involved in White House science advisory operations from 1953 to 1973, now Special Assistant to the President of the National Academy of Sciences, has been designated NAS staff officer for the committee.

It has been reported that among the subjects the ad hoc committee will study are the implications to the science advisory process of the separation of responsibility for civilian and military R&D, and the broad subject of energy policy formulation.

We are informed that the study is being funded by the National Academy of Sciences.

D. *Examine proposals which have been made for changes in the present Federal science structure and build up a record of opinion and evaluation of these proposals.*

Over the past several years, considerable attention has been given to the organization of scientific and technical activities within the Federal departments and agencies and in the Executive Office of the President. The 1969 and 1970 hearings and reports of the Subcommittee on Science, Research, and Development on Centralization of

[5] Members of the Ad Hoc Committee are: Graham T. Allison, The Public Policy Program, Kennedy School of Government, Harvard University; Ivan L. Bennett, Jr., Director, New York University Medical Center [former Deputy Director, OST, under Dr. Hornig]; Harold Brown, President, California Institute of Technology; James B. Fisk, Chairman of the Board, Bell Telephone Laboratories; Robert C. Gunness, President, Standard Oil Company (Indiana); James R. Killian, Jr., Honorary Chairman of the Corporation, Massachusetts Institute of Technology (Chairman); Edwin H. Land, President, Polaroid Corporation; Franklin A. Long, Department of Chemistry and Program on Science, Technology and Society, Cornell University; Emanuel R. Piore, Retired Vice President and Chief Scientist, IBM, New York, N.Y. (Vice Chairman); Kenneth S. Pitzer, Department of Chemistry, University of California, Berkeley (Vice Chairman); James Tobin, Department of Economics, Yale University; and Charles H. Townes, Department of Physics, University of California, Berkeley. (National Academy of Sciences Press Release of February 1, 1974.)

Federal Science Activities and concerning National Science Policy contain many different proposals, including the subcommittee's own proposal for a National Institute for Research and Advanced Studies, other organizational suggestions for Federal science and technology, and many suggestions as to how the Office of Science and Technology and the Executive Office science organization in general could be improved.

We believe it might be useful for the committee to take a fresh look at these various suggestions, to see which of them might be applicable at the present time.

The matter of science organization has continued to be of interest during the Nixon Administration but interest in this issue has been at a relatively low key until the last year. Within the past several months, we have seen numerous suggestions for instruments through which to return scientific advice to the Executive Office. For example, Dr. Edward E. David, Jr., has proposed a modernized White House science apparatus with specific authorized duties to do for the Executive what the authorization committees do for the legislative branch. (*Science*, Mar. 1, 1974: 801). Dr. George B. Kistiakowsky has proposed a Council on Science and Technology ("COST") whose concern should be primarily critical and analytical, not managerial, and include short- and long-range problems. Among its major short-range activities would be participation in the formulation of the budget related to science and technology. (*Science*, April 5, 1974: 38–42) Robert W. Sarnoff has proposed the establishment of a Science and Technology Commission to be the focal point for planning and coordinating government-supported research, development, and technical education, and to provide a means for setting priorities in science and technology. (*Congressional Record*, Feb. 25, 1974: S 143–44). The Committee of Scientific Society Presidents has urged consideration of reorganization of Federal science activities "such as creation of a Department of Science and Technology, the establishment of a Council of Science and Technology in the White House, or the elevation of the position of the Science Adviser to cabinet rank." (*The Chemist*, Nov. 1973: 13).

Dr. Arthur Kantrowitz has suggested the idea of using scientific judges as a substitute for the present advisory committee procedures. (Hearing before the Senate Committee on Rules and Administration on Office of Technology Assessment for the Congress, March 2, 1972, pp. 84–85).

Dr. Eugene Rabinowitch suggested the need for a Council of Experts or an Institute for the Analysis of Public Choices. (*Science and Public Affairs*, April 1973: 19–23)

The committee might hear some of the proponents of these ideas and others or invite them to submit statements for the record.

Proposals for new organizational forms have also been incorporated in pending legislation. Legislation has been introduced in the House (H.R. 10807) and the Senate (S. 2495) which would establish a National Science and Technology Resources Council in the Executive Office of the President to survey science and technology resources and recommended agency assignments for the application of such resources

to domestic problems. The Senate Commerce and Aeronautical and Space Committees have held joint hearings on the latter bill.

Other proposals, like Senator Humphrey's proposal to establish an Office of Balanced National Growth and Development (S. 3050), might be considered.

In summary, it is suggested that the committee can serve both immediate and longer range national interests by considering the various alternatives and perhaps taking a position with respect to those which it considered meritorious.

E. *Continue to monitor the general situation relating to Federal support for research and development and the role of science in Government*

There is an old saying, "The more things change, the more they stay the same." For more than a quarter of a century, the Federal Government has accepted a responsibility to provide support to assure the availability of a research data base and a trained scientific and technical manpower supply, in order to cope with the demands of emerging national needs.

The Federal R&D budget has continued upward from less than a billion dollars in the immediate post-war years to an estimated $17.9 billion for FY 1974. Despite the vast increase in resources allocated to R&D, the way in which those resources are allocated remains basically the same. Mr. Carey called it the "firebell" approach. The Nation consistently whistles up science and technology in time of crisis, seeking immediate answers to first one urgent problem, then another. First the motivation was the weapons and atomic race; to this was added the challenge of being first to the moon. In the late 1960's the problems of the environment received priority attention, followed by a brief surge of interest in what S&T could do to improve the worsening international trade position, before the recent energy crisis dramatized unmet needs in that area. Even now, another problem looms large on the horizon and is rapidly approaching—materials shortages.

Recently in addressing the American Association for the Advancement of Science, Dr. Stever discussed the "crisis approach" and past and present reliance on it as a triggering mechanism for bringing science into the policy process. He listed as a first priority the need for the Nation to be freed from the "trap of having to use science on a crisis-to-crisis basis." His view is shared by many others in the scientific community.

On the other hand, Dr. Sawhill recently expressed the opinion that "We can't [i.e., should not] move too fast on science and technology." He suggested that a crisis situation is necessary before the President can introduce a program that the people will support. He continued, "Once we are in a crisis we can shape a crash program to deal with it. I believe in the efficacy of crash programs. It is only when you marshall all your talents and resources on a crash basis that you get good, hard results." (Vernon Pizer. Who unplugged America's science machine? Washingtonian, February 1974, at p. 102)

The question which should be answered is does Dr. Sawhill's rationale represent OMB and Executive Office philosophy or his own personal philosophy. Is a crisis situation indeed necessary before a problem can be addressed?

The committee may wish to explore this question at greater length. If it takes from ten to twenty years to realize the results from a new scientific or technical program and if the leadership must wait for a crisis before mobilizing, doesn't that condemn the Nation to living in protracted and repeated crises? (Or, at least, leaving unexploited the contributions of science and technology to ameliorate the crisis?)

Although Dr. Stever decried the crisis situation as a basis for motivation, he did not express similar disapproval that for the past thirty years science has benefited from riding the "waves" generated by a succession of crash programs.

Just as today's money cannot produce an instant cure for cancer, or heart disease, or unemployment, or many other problems, neither can it produce the necessary research data base and the needed scientific manpower to solve today's crash problem. Only by anticipating problems and planning ahead can quick, flexible, and orderly responses be mobilized. Forward planning can help ameliorate a crisis situation. At very least, such a stance can greatly reduce the costs of national adaptations to great challenges. Crash responses are inherently costly and wasteful. Moreover, they tend to be followed by lax periods of recuperation when the over-stimulated Nation neglects its responsibilities for preserving its resources and readiness to respond.

The committee needs to hear some plain-speaking, nonselfserving, knowledgeable persons address this problem.

F. *Overview of biomedical research issues needed*

The Nation is scurrying to spend billions for energy research and development. At the same time, such pressing issues as health research for the acquisition of technical tools for disease prevention or control, and research on new systems for distribution, delivery, and payment of health care are being overlooked.

A recent editorial in the Journal of the American Medical Association [6] discussed emerging problems in three important areas—postdoctoral education, research in general, and "human experimentation." There are many others.

What is apparently lacking in the present organization is some source in the biological and medical sciences at the White House level who can consider and advise on what the role of the Federal Government should be on policy questions as broad as these.

One organizational response is contained in S. 2893, the National Cancer Act Amendments of 1974, as passed by the Senate on March 26, 1974. One of the amendments provides for the creation of a Presidential Biomedical Research Panel to oversee and monitor the biomedical research programs of the National Institutes of Health.

If the House accepts the recommendations of the Select Committee on Committees concerning realignment of committee jurisdictions, the House Committee on Science and Astronautics which will be renamed the House Committee on Science and Technology will receive a specific responsibility for biomedical R&D overview. The committee may wish to hear some witnesses on these questions.

[6] An Anti-Intellectual Movement in Medicine? JAMA, vol. 227, Jan. 28, 1974: 432–434.

G. *Questions for consideration at future hearings*

Below are listed some questions which the committee may wish to explore at future hearings. Each has arisen out of knowledge of a particular situation as derived from testimony, remarks or commentary from informed sources.

1. Who is providing advice PSAC formerly provided? Specifically, what groups have been utilized and how?

2. What is NSF doing to assure that the several national programs of research and development—energy, health, transportation, education, social systems, and renewable and non-renewable resources, among others—are coherent and coordinated across departmental lines and that Government efforts are coordinated with industrial efforts? What are other departments and agencies doing? What differences, if any, do they see in relationships with NSF as compared to OST?

3. What further developments have there been in making the Federal Council for Science and Technology a more useful mechanism for interagency coordination? Meetings of the Council since July 1973? Actions taken? What committees have been activated, reconstituted, or newly created? What staff support is provided and by whom? Meetings held, actions taken, and future plans for these committees? What arrangements are there for interface of FCST structure with the non-governmental scientific and technical community? With the National Science Board?

4. In November 1973, Dr. Stever told an Appropriations subcommittee that he had "underestimated" the extent of his science policy responsibilities "when we first had these responsibilities thrust on us." What is Dr. Stever's distribution of time among his multiple roles? How much additional authority has he delegated to subordinates in order to free himself? How are the duties being institutionalized within NSF so that they would be carried on when Dr. Stever leaves at some time in the future?

5. How does STPO differ from OST as to organization and approach? In assignments? Are its resources considered adequate to do its job? How does Stever use the office? What are the interrelationships of the Office of Energy R&D and STPO? What is STPO's program emphasis? Relations with departments and agencies? Mechanisms for coordination? Contacts with the scientific and technical community? Evidence that the views of this community actually reach the President?

6. Who in EXOP is using science advice from NSF? What channels are used to obtain this advice? How is the President kept informed of developments? What evidences are there that the White House actually cares, that it participates in decisions knowledgeably? Who makes what decisions with what knowledge?

7. Are there any indications that NSF is rising in the executive hierarchy or is it too soon to tell? [David, p. 135, hearings. A rise in the executive hierarchy is both a necessity for NSF success and an indication of it, for such a rise will be due to a combination of actions both by the Foundation and by other agencies.]

8. What are the implications for NSF of pending legislation to reorganize energy R&D? How does Dr. Stever interact with Dr. Weinberg in the FEO?

9. What other organizational arrangements have been proposed to strengthen the science advisory structure? Examples are a Technology Resources Council in EXOP; (S. 2495); and a Council of Scientific Advisers.

10. Is "riding the waves" a viable strategy for research and development funding? [Stever said at AAAS that in the long run science will benefit from the present situation because it will be riding an energy wave for the next few years. When asked if this would be disastrous for science, he said a study of the ups and downs of science over the last 30 years showed that we've always ridden waves. Waves of the future will be the basic issues of life.]

11. Must we rely on crisis motivation as a basis for action regarding science and technology?

12. How are health research, and defense research, under other Associate Directors in OMB, coordinated with energy and science? [The question was asked of Sawhill at the July 1973 hearings but only a general answer was received. (q. 12, p. 129, hearings)]

13. Who is providing the countervailing advice to balance the "monolithic pressure of the Defense Department" on military technology? [all the science advisers are on record as registering concern on this point—all except David at Oct 73 MIT meeting and David in Feb 74 interview]

14. What can be done to help Dr. Stever in his job? What can the committee do? What can the scientific societies and the scientific community do? What have they done since the plan became effective?

15. What inhouse scientific and technical capability does OMB have to make it competent to determine relative priorities in allocations of resources for competing civilian R&D programs?

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PART III

DOCUMENTS AND DATA RELEVANT TO THE COMMITTEE INQUIRY

DOCUMENTS AND DATA RELEVANT TO THE COMMITTEE INQUIRY

Throughout the first phase of the Committee's investigation, which includes not only the initial hearings but all the information and commentary contained elsewhere in this report, reference is frequently made to documents and data which are not fully explained.

In order to help modify any resulting difficulties, the following material has been collated into Part III:

CONTENTS

1

CHRONOLOGY OF KEY DEVELOPMENTS IN EXECUTIVE OFFICE ORGANIZATION FOR SCIENCE AND TECHNOLOGY, 1945–1974

July 5, 1945

Dr. Vannevar Bush, Director, Office of Scientific Research and Development, submitted report, "Science, the endless frontier" to President Truman covering all aspects of the study of post-war science which President Roosevelt had requested him to make in November 1944.

A principal recommendation of the report was for the establishment of a National Research Foundation, responsible to the President and to Congress, "to develop and promote a national policy for scientific research and scientific education" and for other purposes.

October 17, 1946

By E.O. 9791, President Truman established a Presidential Scientific Research Board under Dr. John R. Steelman, Director of War Mobilization and Reconversion, in the Executive Office of the President, to investigate and report on the entire scientific program of the Federal Government with recommendations for providing coordination and improving efficiency of Federal research and development.

August 6, 1947

President Truman vetoed S. 526, the first bill passed by Congress to establish a National Science Foundation and an Interdepartmental Committee on Science on the grounds that the proposed organizational structure would make it impossible for him to assure proper administration.

September–October 1947

The 5-vol. Steelman report entitled "Science and public policy" was issued. With respect to Executive Office science organization, the report recommended that the President designate a member of the White House staff for scientific liaison, that the Bureau of the Budget set up a unit for reviewing Federal scientific research and development programs, and that an Interdepartmental Committee for Scientific Research be created.

December 24, 1947

Interdepartmental Committee on Scientific Research and Development established by E.O. 9912. Presidential assistant, Dr. John R. Steelman, was designated to provide liaison between the President and the committee and between the office of the President and the scientific community.

December 31, 1947

Office of Scientific Research and Development in the Executive Office of the President was terminated and remaining personnel, records, and property were transferred to the National Military Establishment. OSRD, created in 1941, in the Office for Emergency Management, had under Director Vannevar Bush served as a high-level coordinating body for scientific research and medical problems related to national defense during World War II.

May 10, 1950

The National Science Foundation Act of 1950 was signed, providing for the establishment of a National Science Foundation to develop a national policy for the promotion of basic research and education in the sciences.

April 20, 1951

An 11-member Science Advisory Committee in the Office of Defense Mobilization, within the Executive Office, was established by President Truman "to advise the President and Mobilization Director Charles E. Wilson in matters relating to scientific research and development for defense."

March 9, 1953

President Eisenhower appointed Admiral Lewis L. Strauss as a Special Assistant to serve him as "liaison adviser on atomic energy matters." He occupied this post and shortly thereafter that of Chairman of the AEC until 1958.

March 17, 1954

President Eisenhower issued E.O. 10521, which clarified and defined Federal agencies' responsibilities for research and development, and specified a broader role for the NSF than that in its 1950 charter by providing that the Foundation "shall from time to time recommend to the President policies for the Federal Government which will strengthen the national scientific effort and furnish guidance toward defining the responsibilities of the Federal Government in the conduct and support of scientific research."

November 7, 1957

President Eisenhower announced the creation of the position of Special Assistant to the President for Science and Technology and the appointment of James R. Killian, Jr., to the post.

November 29, 1957

President Eisenhower announced the enlargement, reconstitution and transfer to the White House of the Science Advisory Committee of the Office of Defense Mobilization. The action was taken to provide a more direct relationship between the Committee, the President, and the Special Assistant for Science and Technology.

July 30, 1958

The National Aeronautics and Space Act of 1958 which established the National Aeronautics and Space Administration also established a 9-member advisory National Aeronautics and Space Council, consisting of the President and other named representatives.

March 13, 1959

By E.O. 10807, President Eisenhower established the Federal Council for Science and Technology, consisting of his Special Assistant for Science and Technology and representatives of the major science-oriented departments and agencies, to promote interagency cooperation and coordination in the planning and management of Federal scientific and technological programs.

E.O. 10807 amended E.O. 10521 of March 17, 1954, to limit the National Science Foundation's policy advisory role to basic scientific research and education in sciences, rather than "scientific research" in general as the 1954 E.O. had specified. A new section 10 of E.O. 10807 and coordination in the planning and management of Federal scientific information activities of the Federal Government.

E.O. 10807 also abolished the Interdepartmental Committee on Scientific Research and Development.

April 25, 1961

An amendment to the National Aeronautics and Space Act of 1958 revised the membership and functions of the National Aeronautics and Space Council and brought the Council into the Executive Office of the President, with the Vice President as Chairman.

June 8, 1962

In the absence of Congressional disapproval, Reorganization Plan No. 2 of 1962, establishing the Office of Science and Technology in the Executive Office of the President, became effective.

The Plan transferred certain functions from National Science Foundation to the new OST relating to the coordination of Federal policies for the promotion of basic research and education in the sciences, and those functions with respect to the evaluation of scientific research programs of Federal agencies.

June 17, 1966

P.L. 89–454 established a temporary National Council on Marine Resources and Engineering Development in the Executive Office of the President under the chairmanship of the Vice President to plan and develop a coordinated Federal program in marine science activities. The legislation also established a Commission on Marine Science, Engineering and Resources to make a comprehensive investigation and study of marine science and recommend an overall plan for a national oceanographic program.

The National Council on Marine Resources went out of existence June 30, 1971, following the submission of the Commission's final report.

March 5, 1970

By E.O. 11514, responsibilities of the Council on Environmental Quality in the Executive Office of the President, which had been established by P.L. 91–190, were set forth.

July 1, 1970

By Reorganization Plan No. 2 of 1970 and E. O. 11541, July 1, 1970, the Bureau of the Budget in the Executive Office of the President was redesignated as the Office of Management and Budget.

Reorganization Plan No. 2 also established a Domestic Council in the Executive Office of the President. Duties of the Council, including the developing for the President of alternative proposals for reaching national domestic goals, and providing policy advice to the President on domestic issues, were spelled out in E.O. 11541.

July 1, 1971

Domestic Council New Technology effort started.

September 13, 1971

William M. Magruder, named to head the New Technology effort in August, was appointed Consultant to the President.

December 1, 1972

Treasury Secretary George P. Shultz is named Assistant to the President for Economic Affairs and Chairman of a newly-established Executive Office Council on Economic Policy.

January 26, 1973

Reorganization Plan No. 1 of 1973 transmitted to the Congress.

February 22, 1973

Subcommittee on Reorganization, Research, and International Organizations of Senate Committee on Government Operations held a hearing on Reorganization Plan No. 1 of 1973.

February 26, 1973

Legislation and Military Operations Subcommittee of House Committee on Government Operations held a hearing on Reorganization Plan No. 1 of 1973.

April 4, 1973

In H. Rept. 93–106, the House Committee on Government Operations noted that since a disapproving resolution had not been introduced, it was not required to report for or against Reorganization Plan No. 1 of 1973. However, the Committee came to the conclusion that the Plan should not be opposed, despite the problems and uncertainties regarding its operation.

April 5, 1973

Sixty-day period for Congressional disapproval on Reorganization Plan No. 1 of 1973 ended this date. Plan to go into effect July 1, 1973, as specified therein.

May 14, 1973

Dr. H. Guyford Stever, Director, National Science Foundation, appointed Acting Chairman of the Federal Council for Science and Technology.

June 29, 1973

President Nixon announced the appointment of John A. Love to be an Assistant to the President for Energy and the Director of a new Energy Policy Office to be established in the Executive Office of the President. He also announced the creation of an Energy Research and Development Council, to consist of experts in the field from outside Government, to advise the Energy Policy Office.

July 1, 1973

Reorganization Plan No. 1 of 1973 went into effect.

July 1, 1973

International scientific and technical activities formerly performed by the Office of Science and Technology were transferred to the Director of the National Science Foundation.

July 2, 1973

NSF Director Stever established a Science and Technology Policy Office and named Dr. Russell C. Drew, Director. The Office will also provide staff support for the Federal Council for Science and Technology, now chaired by Dr. Stever.

July 5, 1973

House Committee on Science and Astronautics announced plans for a comprehensive inquiry into Federal policy, plans and organization for the support and utilization of science and technology.

July 10, 1973

President Nixon announced the designation of Dr. H. Guyford Stever, Director of the National Science Foundation, as Chairman of the Federal Council for Science and Technology and as Science Adviser to the President. The assignment of these responsibilities was made in a letter of July 1, 1973, from the President to Dr. Stever.

July 17–24, 1973

House Committee on Science and Astronautics held four days' of hearings on Federal policy, plans and organization for science and technology, with particular reference to how Reorganization Plan No. 1 of 1973 was being implemented by the Director of the National Science Foundation.

September 10, 1973

In his capacity as Science Adviser, Dr. H. Guyford Stever held the first meeting with representatives of a number of scientific and technical societies to discuss how scientific and technical advice from this community could be brought to the attention of the Federal Government.

December 4, 1973

OMB Associate Director for Natural Resources, Science, and Energy John C. Sawhill appointed Deputy Director of the newly-created Federal Energy Office in the Executive Office of the President.

January 3, 1974

With the signing of the Supplemental Appropriations Act 1974 (PL 93–245), a total of $4 million was approved to assist the Director, National Science Foundation to carry out responsibilities as Science Adviser. Included was $2 million to establish an Office of Energy R&D Policy and Science and Technology Policy Office, $1 million to fund grants and contracts to be awarded by the Science and Technology Policy Office, and $1 million for program development and management costs.

January 7, 1974

Former Oak Ridge National Laboratory Director Alvin M. Weinberg has been appointed director of R&D policy for the Federal Energy Office in the Executive Office of the President.

January 18, 1974

OMB Director Ash appointed Frank G. Zarb of Huntington, N.Y., as Associate Director for Natural Resources, Energy and Science.

February 1, 1974

The Council of the National Academy of Sciences announced the establishment of an ad hoc committee under the chairmanship of James R. Killian Jr. to look broadly at the relationships between science and technology with a view to assuring the best use of scientific and technical judgments in the development of public policy and in planning and management of Federal research and development. A report is expected within four to six months.

February 4, 1974

The Budget of the U.S. Government for fiscal year 1975 was transmitted to the Congress. The National Science Foundation has requested $1.5 million for science and technology policy research, $4.5 million for energy R&D policy research, and $250,000 for consultants' fees and staff and consultant travel for STPO and the Office of Energy R&D Policy.

April 17, 1974

Deputy Treasury Secretary and Federal Energy Office Director William E. Simon was nominated to be Secretary of the Treasury. The White House announced that Mr. Simon would not be designated Assistant to the President for Economic Affairs as was outgoing Treasury Secretary George P. Shultz. It was in this role that Dr. Shultz served as Dr. Stever's channel to the President.

April 30, 1974

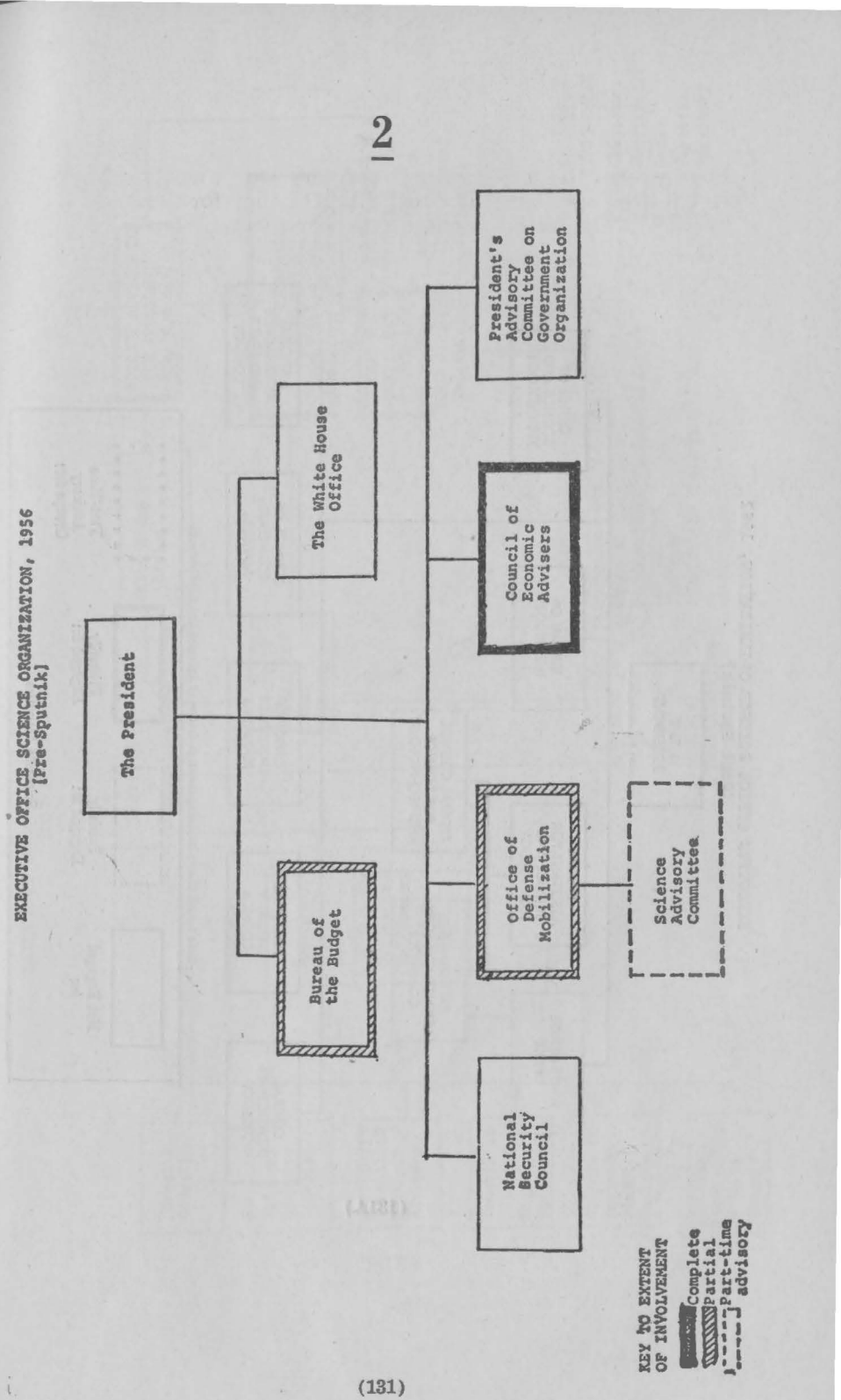
William E. Simon was confirmed to be Secretary of the Treasury.

May 2, 1974

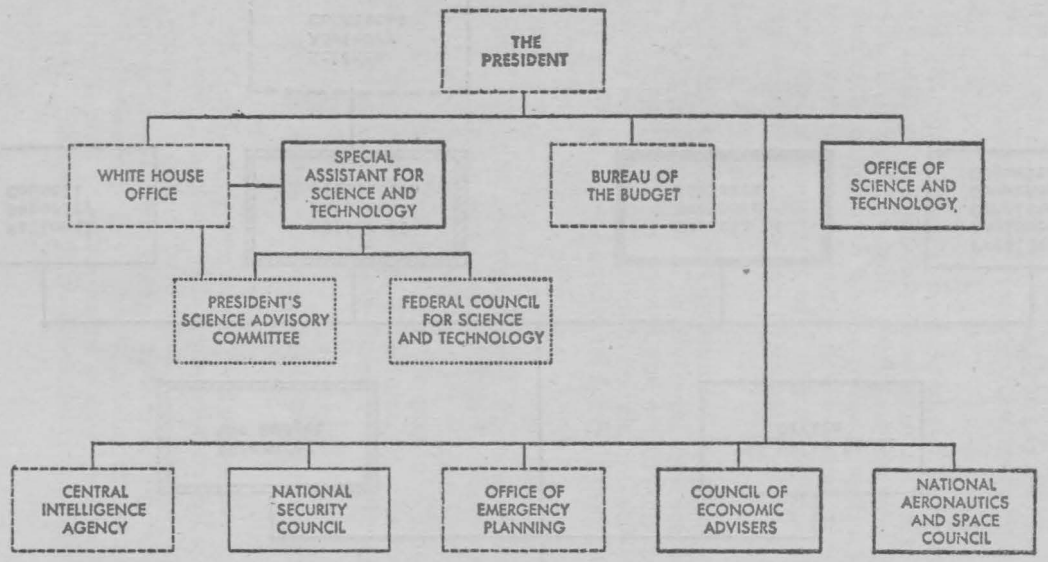
Dr. H. Guyford Stever in support of his duties as Science Adviser held the second meeting with representatives of a number of scientific and technical societies to discuss and receive input concerning the societies' actions on the energy problem; definition of and needs for a national science policy; role of scientific and technical societies in providing inputs to government policy decisions; an assessment of major policy issues; and the dissemination of the results of scientific research.

June 16, 1974

House Committee on Science and Astronautics announced that the second phase of the committee's inquiry into Federal policy, plans, and organization for science and technology will begin on June 20, 1974, and continue intermittently through July 18.



EXECUTIVE OFFICE SCIENCE ORGANIZATION, 1962
[Post Sputnik]



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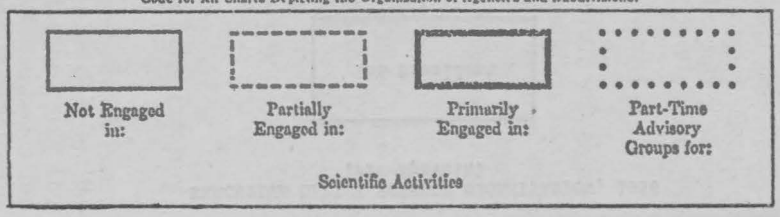
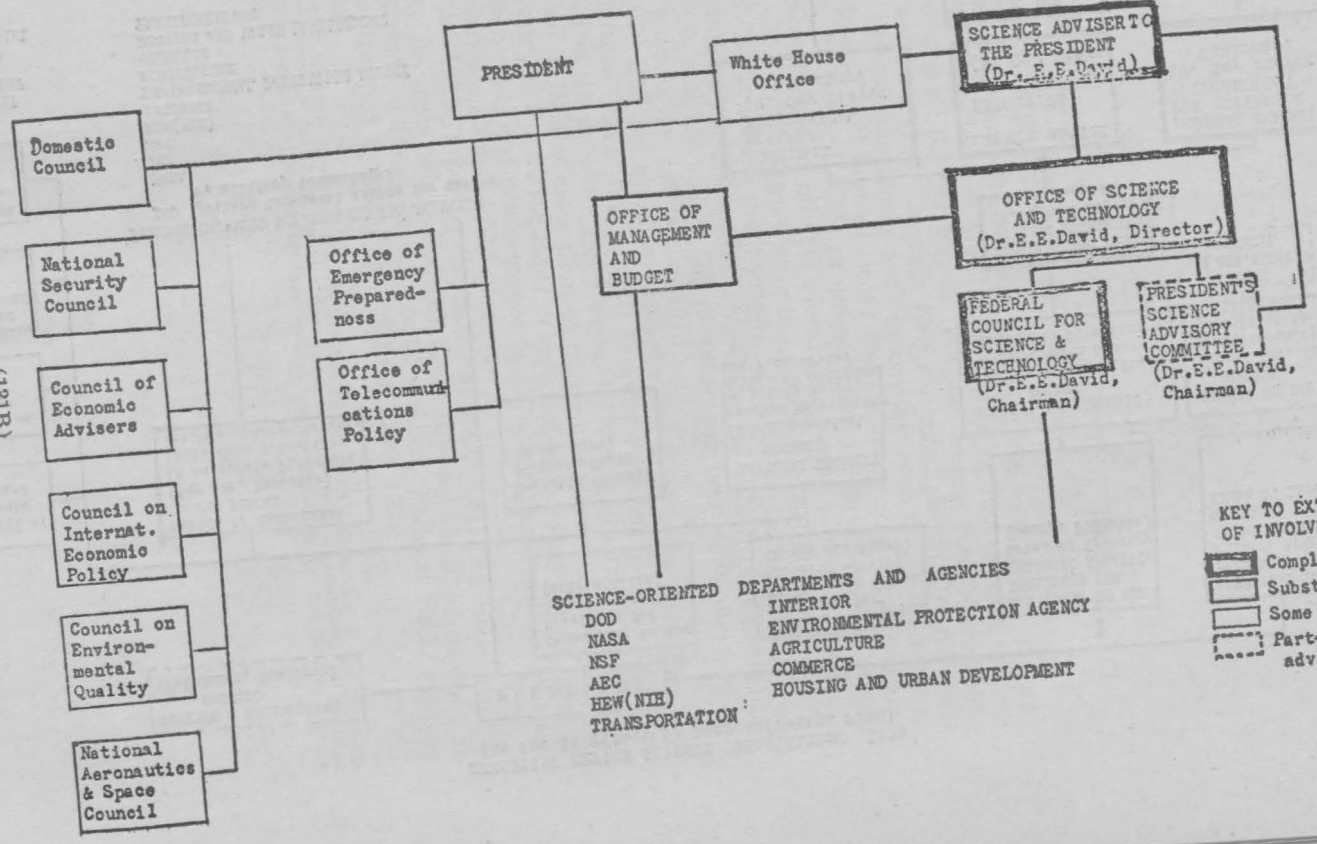
Code for All Charts Depicting the Organization of Agencies and Subdivisions:



EXECUTIVE OFFICE SCIENCE ORGANIZATION, 1972
[OST Still Active]



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3

RELATIONSHIP OF THE FOLLOWING TABLES TO BROADER TOTALS

- Federal R&D and R&D plant expenditures as a share of total budget outlays have declined from a high of 12.6 percent in 1965 to an estimated 6.5 percent in 1974, the lowest ratio since 1959.[1]
- In some years (1966 through 1968, for example) R&D and R&D plant expenditure totals were increasing even while the ratio to total budget fell because other Federal programs were growing faster. At present R&D programs have fallen somewhat behind the growth rate of other Federal programs taken as a whole.
- As a share of the gross national product, expenditures for Federal R&D and R&D plant programs have ranged between 1.5 percent and 2.4 percent in the 1963–72 period. The high was realized in 1964, and since then the decrease has been continuous to the 1.36 percent level shown in 1973.
- In 1973 Federal agencies are expected to provide 53 percent of all national R&D funds, with support supplied by industry estimated at 41 percent. The largest Federal support share was recorded in 1964 at more than 65 percent of the national total.
- Industry is the major R&D performer, accounting for 67 percent of total national performance in 1973, compared with a Federal performance share of 15 percent.
- In the 1963–73 period the national R&D total has risen steadily even in years when Federal R&D support declined at least in "current" dollars. In "constant" dollars, Federal R&D support has dropped by about $1.3 billion since 1968.

[1] Budget totals are given in terms of outlays rather than obligations, hence the R&D totals that are used for share computations must be in terms of expenditures rather than obligations. The only difference between outlays and expenditures is that outlays include net lending.

36-154—74——10

Federal obligations and expenditures, fiscal years 1940–73

[Dollar amounts in millions]

Fiscal year	Total budget outlays [2]	Research, development, and R. & D. plant [1]		
		Obligations	Expenditures	Expenditures as percent of total budget outlays
1940	$9,589	[3]	$74	0.8
1941	13,980	[3]	198	1.4
1942	34,500	[3]	280	.8
1943	78,909	[3]	602	.8
1945	93,956	[3]	1,377	1.5
1946	95,184	[3]	1,591	1.7
1947	61,738	[3]	918	1.5
1948	36,931	$691	900	2.4
1949	36,493	868	855	2.3
1950	40,570	1,105	1,082	2.7
1951	43,147	1,175	1,083	2.5
1952	45,797	1,812	1,301	2.8
1953	67,962	2,195	1,816	2.7
1954	76,769	3,361	3,101	4.0
1955	70,890	3,039	3,148	4.4
1956	68,509	2,745	3,308	4.8
1957	70,460	3,267	3,446	4.9
1958	76,741	4,389	4,462	5.8
1959	82,575	4,906	4,991	6.0
1960	92,104	7,123	5,806	6.3
1961	92,223	8,080	7,744	8.4
1962	97,795	9,607	9,287	9.5
1963	106,813	11,069	10,387	9.7
1964	111,311	13,663	12,012	10.8
1965	118,584	15,324	14,707	12.4
1966	118,430	15,746	14,889	12.6
1967	134,652	16,179	16,018	11.9
1968	158,254	17,149	16,859	10.7
1969	178,833	16,525	17,049	9.5
1970	184,548	16,306	16,348	8.9
1971	196,588	15,854	15,736	8.0
1972	211,425	16,161	15,992	7.6
1973 (estimate) [4]	231,876	17,155	16,743	7.2
1974 (estimate) [4]	249,796	17,817	16,628	6.7
	268,665	18,243	17,566	6.5

[1] Beginning in fiscal year 1953 amounts for both obligations and expenditures include pay and allowance of military personnel in research and development.

[2] "Outlays" include expenditures plus net lending. Data through fiscal year 1953 are in terms of the "Consolidated Cash Statement" and data beginning with fiscal year 1954 are in terms of the "Unified Budget." For purposes of providing trend information the data are considered to be reported on a generally comparable basis.

[3] Not available.

[4] These estimates are based on amounts shown in *The Budget, 1974* and do not reflect congressional appropriations or changes made by executive action subsequent to budget submission at the mid-point of fiscal 1973.

Source: Office of Management and Budget and Bureau of the Budget, *The Budget of the United States Government*, fiscal years 1940 through 1974. National Science Foundation, annual surveys of R. & D. programs of Federal agencies.

Relationship of Federal R. & D. and R. & D. plant expenditures to gross national product, fiscal years 1964–73

[Dollar amounts in millions]

Fiscal year	Gross national product	Federal R. & D. and R. & D. plant expenditures	Ratio
1964	$611,600	$14,707	2.40
1965	655,600	14,889	2.27
1966	718,500	16,018	2.23
1967	771,400	16,859	2.19
1968	827,000	17,049	2.06
1969	894,400	16,348	1.82
1970	953,200	15,736	1.65
1971	1,009,600	15,992	1.58
1972	[1] 1,097,500	16,743	1.56
1973	[1] 1,220,100	[1] 16,628	1.33

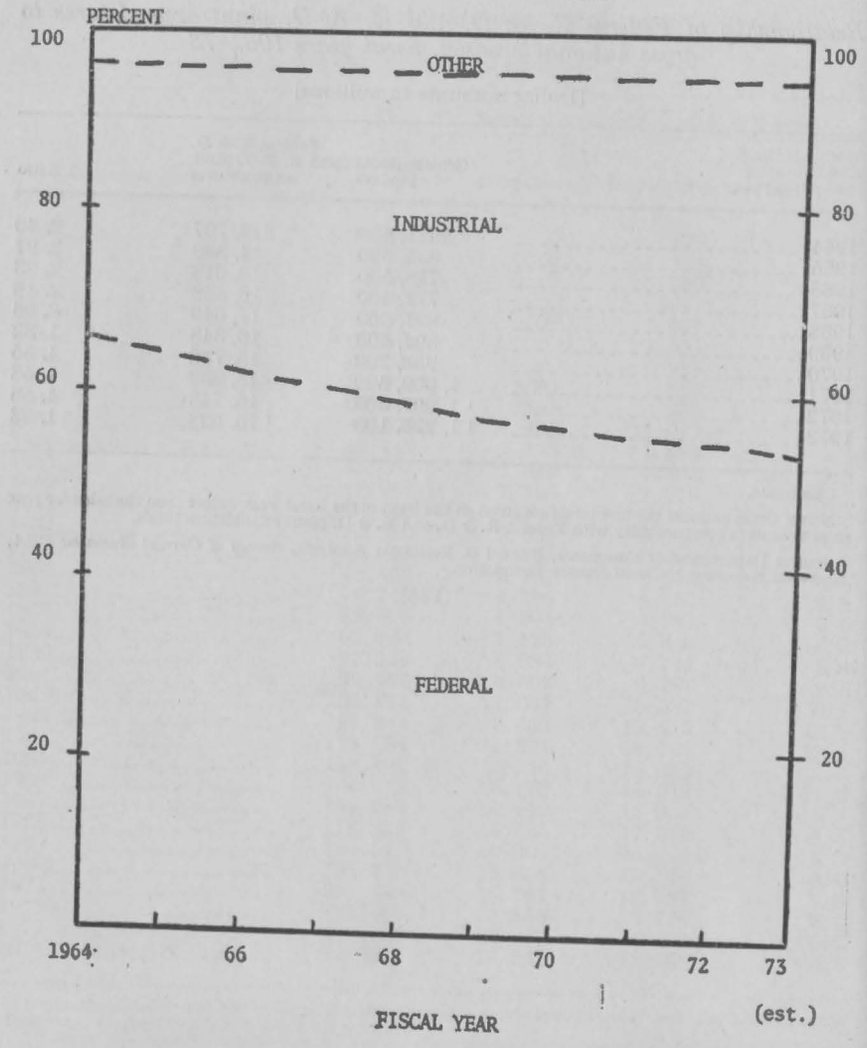
[1] Estimate.

NOTE: Gross national product totals are given on the basis of the fiscal year rather than the calendar year so as to achieve comparability with Federal R. & D. and R. & D. plant expenditure totals.

Source: Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business: CEA, Economic Indicators:* National Science Foundation.

TRENDS IN NATIONAL R.&D. FUNDING

BY MAJOR SOURCE



SOURCE: National Science Foundation

87th Congress
1st Session

COMMITTEE PRINT

ORGANIZING FOR NATIONAL SECURITY

SCIENCE ORGANIZATION AND THE PRESIDENT'S OFFICE

A STUDY

SUBMITTED TO THE

COMMITTEE ON GOVERNMENT OPERATIONS

UNITED STATES SENATE

BY ITS

SUBCOMMITTEE ON NATIONAL POLICY MACHINERY

(Pursuant to S. Res. 20, 87th Cong.)

Printed for the use of the Committee on Government Operations

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FOREWORD

Free institutions are now being challenged by resourceful and implacable adversaries. Their aim is no less than to write finish to freedom. As Mr. Robert Lovett told our Subcommittee:

> If the public statement "we will bury you" does not carry the message to us, then words have lost their meaning.

In today's world, the tide of political power flows with the tide of scientific and technical power. A decade ago we took our nation's scientific and technical leadership almost for granted. Today it is being effectively contested.

We must bestir ourselves, lest Sputnik and the Cosmonaut mark only the beginning of a long list of Soviet firsts, and lest we fall short of our best in putting science to work for peace and welfare and individual freedom.

From the start of its nonpartisan study of how our government can best organize to formulate and carry out foreign and defense policy, the Subcommittee on National Policy Machinery has given close attention to the impact of science and technology on national policymaking.

In April 1960, the subcommittee held a series of hearings, entitled "Science, Technology, and the Policy Process." During these hearings the subcommittee took detailed testimony from James A. Perkins, vice president of the Carnegie Corp.; James B. Fisk, president, Bell Telephone Laboratories; William H. Pickering, Director, Jet Propulsion Laboratory, California Institute of Technology; Ruben F. Mettler, executive vice president, Space Technology Laboratories, Inc.; Eugene P. Wigner, professor of mathematical physics, Princeton University; Edward M. Purcell, Nobel Prize winner and professor of physics, Harvard University; Herbert F. York, first Director of Defense Research and Engineering.

The subcommittee staff has profited from discussions and interviews with over 50 distinguished scientists and Government officials who have lived and worked with this problem. The list of those consulted includes scientists familiar with problems of top-level science organization, departmental technical experts, Nobel Prize winners, and outstanding authorities on science and the policy process.

This, the fifth in a series of subcommittee staff reports, makes certain suggestions for improving science organization at the summit of our Government.

HENRY M. JACKSON,
Chairman, Subcommittee on
National Policy Machinery.

JUNE 14, 1961.

ORGANIZING FOR NATIONAL SECURITY

SCIENCE ORGANIZATION AND THE PRESIDENT'S OFFICE

THE PRESIDENT'S PROBLEM

The continued high standing of our nation in the world demands that we maintain scientific and technological leadership. The state of our military defenses, our success in attaining our foreign policy objectives, the health and productivity of our economy—all depend in large measure upon making wise use of science and its applications.

The President bears the main responsibility for determining the broad direction and scale of the government's part in our national scientific effort. He establishes the priorities. He makes the key decisions that enlist science and technology in support of our foreign policy and defense goals. He is ultimately responsible for the wise employment of the over eight billion dollars our federal government now spends annually on research and development.

The President's task is formidable.

Eight departments and agencies support major technical programs, and almost all other parts of the government use science in varying degrees to help meet their agency objectives. This diffusion of science and technology throughout the government is not a sign of untidy administrative housekeeping. Rather, it reflects the very nature of science itself. Organizationally, science is not a definable jurisdiction. Like economics, it is a tool. It is an instrument for accomplishing things having nothing to do with science. Dr. James Fisk, President of Bell Telephone Laboratories, put it this way to the Subcommittee:

> To imagine that "science" as a whole could be abstracted from government departments and agencies and set up somehow as a separate department—a Department of Science—is, I believe, unrealistic. It would be somewhat analogous to abstracting "economics" from these departments and agencies and forming a Department of Economics.

It is a fact of life that many departments and agencies must conduct extensive technical activities. The President and his top assistants will always face the difficult problem of ordering and focusing these necessarily scattered programs.

Planning ahead in science is no less difficult. Scientific research, by its very nature, is uncertain in outcome. Ten years ago, the prevailing view held the intercontinental ballistic missile of little military value. The air-breathing missile was slated to supplant the jet bomber. Yet today, the ballistic missile is relegating air-breathers to museums.

The unforeseen roadblock, the unexpected shortcut, and the element of sheer caprice in research will always do violence to precise schedules and targets. The record of attempts to read the scientific future is notoriously poor. There is no Supreme Court of Science except the testing ground of nature itself.

This means that the President cannot afford to rely upon any one source of scientific advice. No single scientist, no one group, nor even the scientific community as a whole can be counted upon to foresee the unfolding course of research and technology. Even the most distinguished experts are from time to time bound to be wrong.

The proper use of scientific counsel poses further problems. Scientists are professional experts. Their technical judgments within their specialties merit closest heed. But as Mr. James Perkins of the Carnegie Corporation warned the Subcommittee:

> . . . we are inclined to translate important special authority into authority in general. A specialist on atomic energy does not necessarily speak with equal authority on infrared devices or jet propulsion. Even less does he speak with authority on problems of strategic deterrence or on the probable outcome of the cold war.
>
> We are in some danger, it seems to me, of repeating the mistakes of the thirties when the fears of depression produced an overvaluation of the general skills of the economist.

Scientists often have strong opinions about the morality or political utility of developments in the laboratory. They are not exempt from the human tendency to allow these beliefs to color their technical judgments, and to become ardent pleaders for special causes. A president needs as much sales resistance in science and technology as anywhere else.

Viewed from where the President sits, scientific counsel is inevitably parochial. It is only one of the many factors he must balance and weigh in arriving at policies covering the full span of our national needs. Measured against the perspectives of the President's office, scientific counsel is therefore like economic and military advice, and must in the same sense be subject to civilian control.

The President, in shaping and guiding our government's scientific and technical effort, is critically dependent upon able leadership and staffing within the departments and agencies. The departments are the great reservoirs of skill and experience; they are on the front line of decision-making; they have the planning realism which comes from actual involvement in operating problems.

The range of agency technical activities is immense. It goes from space to sonar, from microbiology to meteorology, from symbolic logic to systems engineering. No one person in the government, nor any one committee of directors, can have detailed knowledge across the whole spectrum of science. The departmental experts in each field, together with their agency heads, must bear the main planning burden on programs related to their departmental missions.

At the same time, a President can be greatly helped by having his own above-the-department science advisers. They can give him counsel "in the round"—from a government-wide, rather than departmental perspective. They can assist him in cross-agency coordination. They can alert him to promising developments lying outside of obvious agency missions and having no departmental home. They can call to his attention programs of high national priority, but low agency priority. They can help him in checking on agency performance.

THE PRESIDENT'S SCIENCE ADVISERS

Sputnik was a turning point in the history of government science organization. It brought science into the inner councils of the Presidency. President Eisenhower established the post of Special Assistant to the President for Science and Technology. He also appointed a President's Science Advisory Committee. President Kennedy has continued the pattern inherited from his predecessor.

The Special Assistant and the Science Advisory Committee have become the nerve center of government science organization.

These Presidential-level science arrangements have now been tested by almost four years of experience. How have they worked? How can they be improved?

The Special Assistant and the Science Advisory Committee are the Chief Executive's own staff aides for science and technology. Their job is advising the President. Their duties are not formally defined.

The Special Assistant, in addition to being the President's personal science aide, has also served as chairman of the Science Advisory Committee, through election by its members. The Committee is composed of eighteen distinguished scientists from private life, serving on a part-time basis. A small staff supports the Special Assistant and the Committee.

The President's science advisers have worked in close cooperation with the departments carrying on substantial technical programs, particularly the Department of Defense. They have also worked intimately with the National Science Foundation and the Federal Council for Science and Technology. The Foundation stimulates basic research and scientific education, but is in addition formally charged with larger responsibilities for developing national scientific policies and evaluating research programs of other agencies. The Council, chaired by the President's Special Assistant, is an interagency coordinating committee for departmental scientific and technical programs.

The Special Assistant and the Science Advisory Committee are a novel feature in the organization of the Presidency. Although they are now part of the White House, they are not across-the-board, general purpose counsellors and political intimates of the President. Rather they are experts in one particular area. They give the President professional advice on scientific and technical questions. Their role is thus akin to that of the Council of Economic Advisers in its special field. In the main, their responsibilities are much more like those of officials in the Executive Office of the President than like those of typical aides in the White House itself.

The President's science advisers have made themselves useful to their chief in many ways:

> They have been a scientific fire brigade. Two examples: At the outset they helped fill a vacuum created by the lack of a sufficiently strong research and development staff within the Office of the Secretary of Defense, and they still concern

themselves with a broad range of problems of military technology. They have also helped offset the failure of the Department of State to secure technical competence adequate for dealing with such problems as arms control, nuclear test cessation, international scientific cooperation, NATO technical problems, and the like.

They have made recommendations to the President in the area of long-term scientific planning. Three cases in point: Oceanography, meteorology, and materials research.

They have assisted the President in coordinating important programs cutting across departmental lines. Atmospheric sciences provide an illustration.

They have served the President as technical auditors of certain ongoing agency programs. Their counsel has been given on project-starting and project-killing.

They have served in some areas as a technical staff for the Bureau of the Budget. The Bureau itself has only a very small number of scientific experts on its own payroll.

Testimony and counsel given the Subcommittee clearly indicate that those who have served as Special Assistants and members of the Advisory Committee have rendered great service. The evidence also indicates that these arrangements can now be made into still more useful instruments of the Presidency.

The President's science advisers have not yet fully occupied a "no man's land" in forward planning for science.

In certain high priority areas the Special Assistant and the Science Advisory Committee have recommended steps for meeting long-term scientific needs. They have thus partly filled a gap left by the reluctance of the National Science Foundation to exercise the authority given it to "develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences" and to "recommend to the President policies for the federal government which will strengthen the national scientific effort . . . ."

The President's own science aides, however, have not been clearly charged with the initiative for sparking across-the-board forward planning. As a practical matter, in addition, they are not now staffed to handle the full span of scientific and technical planning problems requiring Presidential attention.

The science advisers have not yet done enough in helping the President and the Bureau of the Budget coordinate and monitor major government technical programs.

The President and the Bureau of the Budget, in auditing ongoing agency technical programs, now turn chiefly to the departments themselves in seeking technical counsel. Until recently, they also very largely relied upon departmental technical advice in coordinating activities cutting across agency lines.

The President and the Bureau, where major questions are at issue, can profit greatly by having a ready source of above-the-department technical advice. A President needs the protection of more than one channel of technical counsel. Also, departmental experts may become over-committed to their own agency program objectives. Program protagonists are not necessarily good program critics.

While the science advisers now give their chief and the Bureau of the Budget technical counsel in a number of areas, this Presidential-level staff assistance is needed on a broader front.

The Federal Council, as an instrument for assisting the President in monitoring agency programs, has been of only limited utility. It has worked under the limitations of all inter-agency coordinating committees of its kind. Where program stakes are high, and agency differences deep, departmental heads have traditionally tried to bypass Council-type mechanisms. The balance of bureaucratic power is weighted heavily against the Federal Council.

The President does not have enough full-time help from his science advisers.

Many of the members of the Science Advisory Committee, although serving only in a part-time capacity, spend large amounts of time in Washington on Committee business. The Special Assistant, however, is the only science adviser who regularly works full time. The absence of other regular full-time counsellors narrows the range and variety of technical judgment immediately available to the President.

The lack of full-time Advisory Committee associates handicaps the Special Assistant as well. He serves not only as adviser to the President but also as Chairman of the Science Advisory Committee and Chairman of the Federal Council. He needs more day-in day-out help.

The President's science advisers lack sufficient staff.

Today, a single staff of less than a dozen professionals serves the Special Assistant, the Science Advisory Committee and its many standing committees and panels, and the Federal Council. It has been hard pressed to stay on top of its steadily increasing workload.

Present arrangements create difficulties in Executive-Legislative relations.

As a personal Presidential adviser, the Special Assistant has not been available for testimony before Congressional committees. At the same time, he is the only Executive Branch official whose span of concern encompasses the full range of our government's scientific and technical programs. The Congress has thus been deprived of authoritative commentary on the government's scientific activities from an over-all, rather than departmental, point of view.

A SCIENCE UNIT IN THE EXECUTIVE OFFICE OF THE PRESIDENT

Moving science into the White House was a forward step. Two Presidents have profited from the help of their own science counsellors. It is now time to consolidate and build upon this advance.

The post of Special Assistant to the President for Science and Technology and the President's Science Advisory Committee should be made permanent parts of the government—with statutory underpinning. The Administration should now consider the desirability of creating an Office of Science and Technology within the Executive Office of the President.

The Office would be headed by the Special Assistant to the President for Science and Technology. He would continue as a Presidential adviser and Chairman of the Federal Council.

The President's Science Advisory Committee would continue in its valued counselling role.

The Office would provide staff support for the President's Science Advisory Committee and the Council.

A science unit in the Executive Office would ratify the institutional and professional advisory role of the Special Assistant and the Science Advisory Committee. It would confirm that their responsibilities to the President correspond to those of Executive Office officials like the Council of Economic Advisers.

Duties of the Office

Like any Presidential staff, the Office of Science and Technology would work on any tasks assigned it by the Chief Executive.

However, it could well be given formal responsibilities in two areas: First, it would be expected to make continuing recommendations to the President for meeting long-term national needs in science.

Second, it would be expected to help the President coordinate and evaluate agency programs by serving as technical counsellors to him and to the Bureau of the Budget.

In short, the Office would be a staff unit for helping the President "look ahead" and "pull together" in science and technology.

Vesting the Office with these responsibilities would involve amendments to the statutes and executive orders relating to the National Science Foundation. The undischarged planning and evaluation responsibilities of the NSF could be formally transferred in whole or part to the Executive Office science unit. The Foundation would in any event be a valuable collaborator of the Office. It could be asked to expand its activities in gathering and analyzing information about the nation's needs in science. The National Academy of Sciences and the National Research Council would be helpful partners in this essential job.

The new Office would provide the Bureau of the Budget with technical staff assistance across a broader front than is now the case.

The Federal Council for Science and Technology would continue to lend a hand in program coordination. Where the departments are in general agreement on program goals and agency assignments, the Council can help adjust lesser inter-agency disputes and encourage joint action by the departments. Also, the Council can be helpful in getting the word around and in serving as a clearinghouse for exchanging information about agency plans and programs.

Full-time science advisers

The President's Special Assistant, as Director of the Office, could be given one, or preferably two, full-time deputies. Serving perhaps for one or two years, they should preferably be drawn from among the members of the Science Advisory Committee.

Like any other Presidential staff aide, the director of the science unit would have the job of making sure that the President is never isolated from the full flavor of debate and controversy on important issues in dispute. He would be expected to see that many channels of scientific advice are open to the President, and to make sure that all significant points of view on major problems reach his chief.

The presence of full-time deputies, coming from different scientific disciplines and with different backgrounds and outlooks, would make this task easier. The deputies could at the same time take on part of the heavy workload of the Special Assistant.

Staffing

The new Office would require a somewhat larger staff than the one now supporting the Special Assistant, the Advisory Committee, and the Federal Council. But only a modest increase is desirable or needed. The additional staff might include outstanding younger men now working in universities, industry or other parts of the government, who could serve on leaves of absence from their regular employers. There would be a double dividend: The Office would profit from fresh perspectives, and the temporary staff members would receive a unique education in high government service.

The Congress

As members of the Executive Office of the President, the Director and his deputies could testify before Congressional committees. The experience of Directors of the Bureau of the Budget and Chairmen of the Council of Economic Advisers shows it is possible for Executive Office officials to appear before the Congress without endangering the privileged relationship that must necessarily obtain in their dealings with the President himself.

Many committees of the Congress would have a legitimate interest in the views of the Director and his deputies. The Congress would therefore wish to exercise restraint in the number of times it would ask these officials for testimony and counsel. The amount of time spent in preparing for appearances on the Hill should never reach the point where the President's science counsellors are hampered in assisting their chief.

The Departments

Efforts to fortify science organization at the Presidential level must be accompanied by measures to strengthen science arrangements in the departments and agencies.

There has been encouraging progress in improving department and agency technical staffs. The development of the Office of the Director of Defense Research and Engineering is a notable example.

Much remains to be done. The Department of State and the foreign aid agencies merit special mention. State, despite recent improvements, still does not have a satisfactory level of in-house technical competence. For their part, the foreign aid agencies have been tardy in taking advantage of the contributions which applied science and technology can make to their planning and operations. The new Agency for International Development provides a chance for a fresh start in meeting this problem.

The Importance of Flexibility

One of the great strengths of existing science arrangements at the Presidential level is their flexibility. The President's science advisers make effective use of *ad hoc* consultant panels, thereby benefiting from the counsel of the entire scientific community. So, too,

the President's science aides have concentrated on high priority questions, and have shifted their focus of attention in keeping with changing problems and priorities. It would be essential that the new Office also follow a flexible mode of organization and operation. Science at the Presidential level must never become bureaucratized.

THE NEXT STEP

The organizational improvements which have been suggested in this report lie well within the authority of the President to act through executive orders and the updated Reorganization Act. Proceeding under the powers of this Act, the Administration should submit to the Congress by next January its considered findings and recommendations for action.

[EXCERPTS]

CREATION OF THE OFFICE OF SCIENCE AND TECHNOLOGY

I. REORGANIZATION PLAN NO. 2 OF 1962; ITS ALLEGED ADVANTAGES AND DISADVANTAGES

A. ALLEGED ADVANTAGES

1. For the first time, science policies, of the executive branch; transcending agency lines, will be effectively coordinated and shaped at the level of the Executive Office of the President. The National Science Foundation (NSF), which it was hoped would perform this function, has been unable to do so, because it is at the same organizational level as other agencies whose work it was expected to coordinate.

2. There is urgent need for an agency with authority in the area of across-the-board forward planning of scientific needs. This function the Office of Science and Technology (OST) will be empowered to perform. The NSF has been reluctant to act in this area, and with their concurrence the OST will become the agency for such planning.

3. The transfer of functions from the NSF to the OST will enable the NSF to devote its efforts more intensively toward promoting its primary objective of furthering basic research and education in science. The OST will look to NSF for studies and information in these areas on which sound national policies in science and technology can be based.

4. The establishment of the OST will provide the President and the Bureau of the Budget with a ready source of above-the-department technical advice—a source now present in the White House Office—but not in a sufficiently adequate form. Insofar as the President and the Bureau have been dependent on the departments and agencies in seeking technical counsel, they may in some instances have received such counsel with a conscious or unconscious bias in favor of the department's own program objectives. In any event, no department nor agency is able to furnish advice from a governmentwide point of view.

5. Just as the Council of Economic Advisers has proven to be a valuable aid in advising the President on economic policy, so the OST will serve a similar function in the field of science policy.

6. The establishment of the OST will forestall the movement for a Department of Science which is seriously opposed in many quarters. On the other hand, it does not place an immovable barrier against establishing such a department at a later date, if such action seems advisable.

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7. The proposed OST will provide a coordinating mechanism for scientific activities in the various departments and agencies, without necessitating the costly and disruptive changes which would be caused in the departments and agencies if a Department of Science were to be created.

8. The Federal Council has been of limited usefulness in monitoring and coordinating agency programs because it has worked under the limitation of all interagency coordinating committees—namely, the more important the program and the greater the difference of opinion, the more marked has been the tendency to bypass the Council. The OST, with the authority granted to it in the reorganization plan, will be relieved of the limitations which hamper an interagency committee.

9. The OST will provide valuable and necessary staff services for the President's Science Advisory Committee, the Federal Council for Science and Technology, and the special assistant to the President for science and technology.

10. The establishment of the OST in the Executive Office of the President by reorganization plan will follow a precedent in that other units within EXOP have been established by statute.

11. While the savings in expenditures which will result from the establishment of the OST cannot be estimated with any degree of accuracy, it is reasonable to assume that more effective coordination of science activities in the executive branch will eliminate duplication and produce more efficient administration, resulting in savings.

12. Since the establishment of the OST is independent of other science units already in existence within the White House Office, the President is not thereby deprived of his independent authority to make such changes in these units as he may find desirable. The twin objectives of permanence combined with flexibility will thus be achieved.

13. If the reorganization plan is adopted, the Director of the OST will be available for testimony before congressional committees. For the first time an official of the executive branch will be able to furnish to the Congress authoritative information on the administration's scientific policies and programs from an overall, rather than a departmental, point of view.

14. "An organizational change may sometimes be justified not because the new pattern is inherently better than the old one but because the change provides an opportunity to bring in new blood and to accomplish the reinvigoration that in an ideal world would not be necessary. * * * [This is] a practical argument that should be considered along with the reasons for and against a particular change and the anticipated difficulties of bringing a new organization into being" (Dael Wolfle, in *Science*, May 13, 1960, p. 1415).

B. Alleged Disadvantages

1. Presentation of the proposals in Reorganization Plan No. 2 in that form was unwise, inasmuch as there is no opportunity for amending the proposals. If they had been submitted in a statute, Congress could have been helpful in perfecting the plan before adoption.

2. There is before Congress a proposal to establish a Hoover-Commission type of commission to consider the whole problem of the most effective organization of the Federal Government for carrying out its science functions. It would be better to establish this commission and receive its recommendations before making statutory changes in existing agencies.

3. There is rather general agreement among professional administrators that the structure of the White House Office should not be defined by statute, but that the President should have complete freedom to organize the Office as he chooses. The reorganization plan does not directly violate this principle but, by establishing the OST on a statutory basis in the Executive Office, it excludes one element of the structure of scientific agencies from the complete control which the President exercises over the nonstatutory elements in the White House Office.

4. Apparently the new arrangement, involving the use of the same individual in several capacities in the White House Office and the Executive Office of the President, has been worked out to suit the incumbent President and his science adviser rather than to accomplish more permanent purposes. Freezing temporary arrangements in a statute may cause later difficulties when the persons presently in office no longer occupy the two positions.

5. There is a general assumption that the President will appoint the same individual to the several different positions in the field of science in the White House Office and the Executive Office. Whether the burden of these offices—plus attendance at Cabinet and National Security Council and other meetings—can be effectively carried by one person is questionable. This person will also be subject to call before congressional committees.

6. Experience during the Eisenhower administration in two instances in which individuals were placed in a dual-status position of agency head and Presidential adviser did not warrant the continuation of the practice after the incumbent left his agency. While such limited experience cannot be regarded conclusively as negating the dual-status concept, it was nevertheless sufficient to bring to light numerous different kinds of administrative, political, and ethical problems which adversely affected relationships within the executive branch and executive-legislative relationships as well.

7. The transfer of functions from the NSF to the OST will weaken the NSF. It would have been better to strengthen the latter agency so that it would be able to perform these functions, rather than to create a new agency to undertake them.

8. If, as is contemplated, the special assistant to the President for science and technology is nominated for the post of Director of the OST, his present privileged status will be considerably reduced. The reorganization plan provides for senatorial confirmation of the Director and Deputy Director of the OST, and Congress will have more control than it presently has, through action on the OST budget and calling representatives of the OST as witnesses before committees.

9. The Central Intelligence Agency has been criticized on the ground that it makes policy and evaluates it. Possibly the OST will be subject to similar criticism for making and evaluating science policy.

10. It is very unlikely that any immediate economies will be effected through the operations of the OST, and it is probable that its own staff will be increased and its activities expanded, with resulting increases in administrative costs.

II. THE NATIONAL SCIENCE FOUNDATION

A. Relevant Provisions of Reorganization Plan No. 2 (1962)

EXCERPTS FROM PRESIDENT'S MESSAGE, MARCH 29, 1962

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Part I of the reorganization plan establishes the Office of Science and Technology as a new unit within the Executive Office of the President; places at the head thereof a Director appointed by the President by and with the advice and consent of the Senate and makes provision for a Deputy Director similarly appointed; and transfer to the Director certain functions of the National Science Foundation under sections 3(a)(1) and 3(a)(6) of the National Science Foundation Act of 1950.

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The ever-growing significance and complexity of Federal programs in science and technology have in recent years necessitated the taking of several steps for improving the organizational arrangements of the executive branch in relation to science and technology.

(1) The National Science Foundation was established in 1950. The Foundation was created to meet a widely recognized need for an organization to develop and encourage a national policy for the promotion of basic research and education in the sciences, to support basic research, to evaluate research programs undertaken by Federal agencies, and to perform related functions.

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The National Science Foundation has proved to be an effective instrument for administering sizable programs in support of basic research and education in the sciences and has set an example for other agencies through the administration of its own program. However, the Foundation, being at the same organizational level as other agencies, cannot satisfactorily coordinate Federal science policies or evaluate programs of other agencies. Science policies, transcending agency lines, need to be coordinated and shaped at the level of the Executive Office of the President drawing upon many resources both within and outside of Government. Similarly, staff efforts at that higher level are required for the evaluation of Government programs in science and technology.

Thus, the further steps contained in part I of the reorganization plan are now needed in order to meet most effectively new and expanding requirements brought about by the rapid and far-reaching growth of the Government's research and development programs. These requirements call for the further strengthening of science organization at the Presidential level and for the adjustment of the Foundation's role to reflect changed conditions. The Foundation will continue to originate policy proposals and recommendations concerning the support of basic research and education in the sciences, and the new Office will look to the Foundation to provide studies and information on which sound national policies in science and technology can be based.

Part I of the reorganization plan will permit some strengthening of the staff and consultant resources now available to the President in respect of scientific and technical factors affecting executive branch policies and will also facilitate communication with the Congress.

Part II of the reorganization plan provides for certain reorganizations within the National Science Foundation which will strengthen the capability of the Director of the Foundation to exert leadership and otherwise further the effectiveness of administration of the Foundation. Specifically:

(1) There is established a new Office of Director of the National Science Foundation and that Director, ex officio, is made a member of the National Science Board on a basis coordinate with that of other Board members.

(2) There is substituted for the now existing Executive Committee of the National Science Board a new Executive Committee composed of the Director of the National Science Foundation, ex officio, as a voting member and Chairman of the Committee, and of four other members elected by the National Science Board from among its appointive members.

(3) Committees advisory to each of the divisions of the Foundation will make their recommendations to the Director only rather than to both the Director and the National Science Board.

After investigation I have found and hereby declare that each reorganization included in Reorganization Plan No. 2 of 1962 is necessary to accomplish one or more of the purposes set forth in section 2(a) of the Reorganization Act of 1949, as amended.

I have found and hereby declare that it is necessary to include in the reorganization plan, by reason of reorganizations made thereby, provisions for the appointment and compensation of the Director and Deputy Director of the Office of Science and Technology and of the Director of the National Science Foundation. The rate of compensation fixed for each of these officers is that which I have found to prevail in respect of comparable officers in the executive branch of the Government.

The functions abolished by the provisions of section 23(b) of the reorganization plan are provided for in sections 4(a), 5(a), 6(a), and 8(d) of the National Science Foundation Act of 1950.

B. Selected Statements by the Director of NSF, Dr. Alan T. Waterman, Concerning the Policy and Coordinating Functions of the Agency

Alan T. Waterman. National Science Foundation: a 10-year résumé. *Science*, vol. 131, May 6, 1960, pp. 1341–1354, at pp. 1341, 1342–1343.

The National Science Foundation's first 6 years were analyzed with scholarly thoroughness by Dael Wolfle in *Science* in 1957 [1]. I shall not attempt to review the factual data concerning the organization and operations of the foundation that are given in detail in his article. I shall take up the narrative essentially where he left it, at the beginning of fiscal year 1958. Whatever I have to say concerning the earlier period will be from the special point of view of one who has been intimately involved in shaping the foundation's policies and operations during its formative years.

As visualized by Vannevar Bush in *Science, the Endless Frontier*, and as defined by Congress in the National Science Foundation Act of 1950, the foundation has two distinct sets of functions; one relates to the support of research and education through grants, fellowships, and other means, and the second involves the development of national science policy and the evaluation and correlation of the research activities of the federal government, as well as the correlation of its own program with those of other agencies, both public and private. There is a degree of difficulty in reconciling these two functions, because in planning and operating a research-support program the foundation becomes to some extent an interested party with respect to the policy prescribed. Congress obviated this situation somewhat by denying the foundation authority to perform research or to establish its own research laboratories.

In the first or operational category, planning and execution have been reasonably straightforward. Early in its history the foundation adopted the grant as being the most flexible and effective means of support for basic scientific research. In the field of education it was decided that the graduate fellowship was the device that would produce the most immediate results in terms of trained manpower. Within the budgetary limits imposed by Congress, the foundation immediately launched a graduate fellowship program and a research-support program which embraced all the natural sciences and, later, selected areas in the social sciences.

The policy-making functions, as well as the evaluation functions prescribed in the act were less susceptible of immediate and specific action, for reasons Wolfle pointed out.

In *Science, the Endless Frontier* Bush had visualized that a National Research Foundation would be the principal, if not, indeed, the sole, point of reference for federal support of basic or uncommitted research in the postwar period. In

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[1] D. Wolfle, *Science* 126, 335 (1957).

view of the brilliant success of the wartime Office of Scientific Research and Development, this was a logical plan for taking care of the nation's research needs in science. So urgent were these needs, however, particularly in the mathematics, science, and engineering departments of universities, and so urgent was the nation's need for scientific research that the provision of federal support could not await the outcome of the 5-year congressional debate over legislation to establish the National Science Foundation.

The foresight of Secretary of the Navy Forrestal in establishing the Office of Research and Inventions—which in 1946 became the statutory Office of Naval Research—made it possible for the Navy to provide critically needed support for basic research at universities. This program was followed in short order by the programs of the Federal Security Agency, notably those of the U.S. Public Health Service and the National Institutes of Health, and those of the Atomic Energy Commission. When the National Science Foundation began to operate in 1951, initial policy had been formulated and active support of science was under way and as a result there was pressing demand for (i) impartial support of basic research and training unrelated to such practical missions as defense and health and (ii) supervision, coordination, and policy determination among the growing and splintered research-support programs of the federal government.

Equipped with a broad charter, a limited but growing staff, and an operating budget of $3.5 million, the new foundation found itself under pressure almost immediately to start performing policy-making and evaluation functions. In addition, of course, it was expected to launch, as early as possible, programs in support of basic research and education in the sciences (p. 1341).

DEVELOPMENT OF NATIONAL SCIENCE POLICY

In this situation, the National Science Board and the director sought to define more specifically the role of the National Science Foundation in relation to other agencies. After extensive conferences between National Science Foundation staff members and the Bureau of the Budget and other agencies, the foundation made a series of recommendations which were incorporated in Executive Order 10521 of March 17, 1954.[2] The order states that the foundation "shall * * * recommend to the President policies for the promotion and support of basic research and education in the sciences, including policies with respect to furnishing guidance toward defining the responsibilities of the Federal Government in the conduct and support of basic scientific research."

The order further directs that the foundation shall be increasingly responsible for the support of general-purpose basic research but recognizes also the importance and desirability of having other agencies conduct their special basic research in fields closely related to their missions. The foundation is not expected to have responsibility for the applied research and development program of other agencies; each agency is accountable for the scope and quality of its development efforts.

The Executive Order of 13 March 1959 [section 6(b)] further clarified the foundation's role as applying only to *basic* research. Within this more specialized framework, the foundation has been steadily formulating national science policy in the course of day-to-day operations, frequently on the basis of agreement and understanding with other agencies. Those who insist that policy must be handed down "ready made" in the form of a proclamation or edict do not understand the nature of policy in the realm of science. To be workable, policy must evolve on the basis of experience; further, it must take fully into account the fundamental principles essential to the effective performance of research in science.

In carrying out its obligations regarding the development of national science policy, the foundation started from the premise that, in its broadest sense, national policy for science is a matter primarily to be determined by the scientists themselves. The scientists of the country are unquestionably the ones most capable of deciding what is best for progress in science, in the true meaning of the word. Policy in this sense should not be "master-minded" by the federal government or any single agency.

The foundation has advocated, and has itself adopted, the fairly general federal policy of providing support to basic research after consultation with leading scientists in their respective fields. This would appear to be the most direct way in which progress in science in the country can be determined by the scientists

[2] This executive order was later amended by Executive Order 10807, Mar. 13, 1959.

themselves. It is the method that is favored by the majority of working research scientists. In carrying out this policy, a given federal agency interjects its own interests and priorities.

In further development of science policy, the foundation's approach has been to examine particular issues and to develop recommendations through a variety of techniques and devices, as follows:

(1) The establishment of a special committee, followed by the issuance of a report. The principal example here is the foundation's study, through two different committees, of the problems of government-university relationships. This study availed itself of the assistance of outside individuals and groups, the foundation staff, members of the National Science Board, and representatives of other government agencies. Another example is the work of the foundation's Special Commission on Rubber Research, which made recommendations on the role of the government with respect to basic research in this field that were approved by both the President and Congress.

(2) Preparation of special reports on particular subjects—for example, the foundation report on "Basic Research—A National Resource" (1957).

(3) The use of experimental programs by the foundation as a means of acquiring information and experience to provide a basis for policy recommendations. The various experimental programs in science education, such as the Physical Sciences Study Committee, are examples of this approach.

(4) Conduct of studies and issuance of reports upon request of the Executive Office of the President. The Foundation's report on the role of the federal government in international science, its report on federal support of research facilities, and its recommendations regarding payment of indirect costs were prepared at the request of the Executive Office of the President.

(5) Sponsorship of legislation on particular problems. An outstanding example is the successful foundation sponsorship of legislation to extend to all agencies of the government the authority to make grants for the support of basic research and the authority to vest title to research equipment with educational institutions. In this and other similar administrative policy matters the Interdepartmental Committee for Scientific Research and Development was helpful.

In 1959 the foundation compiled a list of some 50 science-policy items of a government-wide, national character that it has recommended or stressed. Drawn from a variety of public statements and published reports, these include: (i) the need for increased support of basic research; (ii) the need for increased opportunities and funds for basic research at federal laboratories; (iii) greater stability and continuity in federal support of basic research at universities; (iv) the need for diversity of sources of support of basic research in the federal government and need for basic research in support of development; (v) avoidance, to the extent possible, of large classified developmental undertakings by the government at colleges and universities; (vi) payment of full indirect costs of federally sponsored research at universities and colleges; (vii) reasons for questioning the advisability of establishing a Department of Science and Technology; (viii) policy concerning loyalty of investigators on basic research grants.

Studies in support of policy.—As background data for its own research programs and for policy formulation concerning the role of the federal government in the support of science, the foundation established a continuing series of studies of the nature and extent of the national effort in research and development. Comprehensive surveys are made of the research and development effort of colleges and universities and other nonprofit institutions and of industry. Initiated for the year 1953–54, these surveys measure research and development in terms of (i) dollars expended, (ii) professional personnel employed, and (iii) apportionment of effort between basic research, applied research, and development. With 1953–54 as the base year, future surveys will afford data to indicate trends and for other analytical purposes. These surveys are in addition to the foundation's analyses of the support of research and development by federal agencies, published annually in *Federal Funds for Science*. The whole series carries out the executive order "to make comprehensive studies and recommendations regarding the Nation's research effort and its resources for scientific activities * * *."

EVALUATION OF RESEARCH PROGRAMS

A problem that matches in complexity the policy function is that of evaluation. The National Science Foundation Act makes the foundation responsible for the evaluation of scientific research programs undertaken by agencies of the federal

government and for a correlation of the foundation's scientific research programs with those undertaken by individuals and by public and private research groups. The foundation has consistently pointed out, however, that it is unrealistic to expect one federal agency to render judgment on the over-all performance of another agency or department.

The foundation has chosen, instead, to approach the problem through close liaison and exchange of information with other science agencies. The idea is to gain a comprehensive idea of the federal programs and over-all support of fields of science such as physics, mathematics, and biology. The adequacy of federal support in each field may thus be considered. This procedure is implemented by the general technique of basing research support upon selection among applications or proposals received. By these measures the foundation has endeavored to identify areas that are receiving inadequate support or which require attention for other reasons (pp. 1342–1343).

National Science Foundation. *Eleventh annual report for the fiscal year ended June 30, 1961.* U.S. Government Printing Office, Washington, D.C. 325 pages. The Director's Statement (pp. ix–xxi, at pp. xii–xxi)

With these projections in mind, the ultimate question is: Who needs to do what, and how? A first reaction is that science and technology are in need of better overall planning and management. Because these are national issues, the tendency is again to turn to the Federal Government.

One approach that is frequently mentioned is the setting up of some central organization designed to analyze the country's effort in science and come up with specific plans for the research objectives of the future, with special emphasis upon proper apportionment of funds and manpower in the light of necessary and desirable goals and their feasibility. Such a solution is simple in conception but runs at once into formidable difficulties.

In the first place, as related to basic research, such an enterprise tends to rely upon a highly managed form of economy inconsistent with our national policies and practices and one quite foreign to the best interests of progress in science. It is the sort of thing we criticize, in principle at least, in totalitarian countries. The attitude of the scientific community on this issue is specific and emphatic: The progress of science depends upon the personal initiative and independence of the individuals and groups involved in research. It thrives on variety and originality of approach in different environments—educational, governmental, and industrial. Support and a certain amount of leadership are required of the Federal Government, but not centralized direction and control. Diversity in the agencies furnishing support is highly desirable.

In the second place, if such planning is intended to analyze in detail the content of basic research in science and to determine in advance the most significant areas for support, its feasibility may be questioned. A continuing survey for subject content can only be handled effectively in decentralized fashion. To do it in a centralized way is an elaborate job which would require the continuous services of several thousands of persons. By the time such an organization reached its conclusions they would be largely out of date; the practical impossibility of keeping such review current is obvious. The reason for this difficulty is that decisions as to program content and priorities in science are not only continually changing but have to be dealt with in a subjective manner based on the current judgment of active research scientists. In a sense, it would be as unprofitable to attempt such forecasting for basic research as to prescribe for music or art the most promising themes for development. One should avoid at all costs the attempt to dictate for creative work. The best way to insure intelligent planning in basic research is to provide every encouragement and support for rapid and complete availability and exchange of research information, such as by research publications, abstracts, conferences, and personal contacts.

Of course, in certain respects a degree of management does have to be exercised. Any institution has to plan and, to an extent, manage the programs that it feels it can undertake and even an individual often finds it necessary to choose the most feasible of several research opportunities. The larger the organization, however, the more important it is to broaden and generalize the perspective in order to permit independence of judgment and action; otherwise, planning and policy are in grave danger of becoming rigid and mechanical.

When it comes to development, however, the situation is different. Here it is entirely possible and indeed important to compare needs and priorities with trends and potentialities with respect to manpower, facilities, funds, and research findings. Excellent work of this sort is going on in many technical industries, and the Government has made progress in this direction through studies in the field of science and technology by the National Science Foundation, and in special areas by the President's Science Advisory Committee and the Federal Council for Science and Technology and by other Federal agencies.

It is considerations of this kind which have led the Foundation to undertake intensive fundamental studies of the country's resources for science and technology—in consultation with the President's Science Advisory Committee and the Federal Council for Science and Technology—in the setting up of its Science Resources Planning Office.

Let us examine how the planning function is presently performed in the U.S. Government. At the highest level, science is now represented in the post of the Special Assistant to the President for Science and Technology and in the President's Science Advisory Committee, which is composed of outstanding scientists from outside the Government. In order to coordinate the research and development activities of the Federal agencies and departments, the President, acting upon the recommendation of the President's Science Advisory Committee, in 1958 created the Federal Council for Science and Technology. Membership on the Council consists of high-ranking officers of each of the agencies with major research and development programs.

The Special Assistant to the President for Science and Technology is available to the President at all times for firsthand advice, and thus he is in a position to know the situations in which science and technology are likely to have important bearing upon national policy. The President can turn to the President's Science Advisory Committee to provide advice on important questions in science and technology that relate to national issue of all kinds.

The function of the Federal Council for Science and Technology is to provide a forum for discussion among the agencies on matters of common interest, to achieve coordination on scientific programs involving more than one agency, and to exercise planning and policy roles in connection with governmentwide science and technology matters. For consideration of overall budgetary problems in research and development, the Federal Council and each individual agency can contribute its advice and counsel to the Bureau of the Budget and the President. Under present circumstances it appears that this administrative arrangement will be able to deal responsibly with the issues that arise, and to do so in a more satisfactory manner than would a single department. In any event, the arrangement has hardly been in operation long enough to permit a judgment as to its ultimate effectiveness or whether further change may be needed.

The National Science Foundation, through its 24-member National Science Board, consisting of individuals distinguished in research, education, or public affairs, has responsibility for developing national science policy. Its deliberations are especially valuable to the Government in the area of government-university relations.

It should be noted, too, that the Government constantly has available to it on scientific questions the advice and experience of the National Academy of Sciences-National Research Council. The Academy-Council has always enjoyed close and friendly relations with the Federal Government and has worked cooperatively with it on a wide variety of projects in times of peace as well as war.

The question of central coordination and planning inevitably raises the question of policy—concerning which there has been much discussion. The insistent question is, What is our policy with respect to science and technology? Since one of the statutory functions of the National Science Foundation is the development and recommendations of national science policy, a statement may appropriately be made here regarding policy on the part of the Federal Government.

But, before answering that question, let us examine what is meant by policy.

What is the meaning of a national policy for science? Is it the same as policy for scientific research and education? If not, with what is it concerned? Does national policy mean the policy of the Federal Government, for the country, or in terms of its own activities?

Webster's New International defines policy as "A settled or definite course or method adopted and followed by a government, institution, body, or individual." By extension, this means the principles under which an organized group con-

sciously and deliberately operates or aims to conduct itself and its activities. An essential element is awareness, that is, the planned and purposeful nature of the theory and practice of the activities of the organization. Thus, policy may run all the extremes between complete laissez-faire and rigid autocracy, but neither is policy unless planned and encouraged.

The programs of the National Science Foundation and its recommendations for the Federal Government incorporate policy in this sense; they have received careful and full consideration by the National Science Board, based upon staff studies, with frequent consultation elsewhere in government. A common practice has been to precede policy or program formalities with experimental or pilot projects to determine the most effective approach.

The major policies for the support of research and development are recognized throughout the Federal Government, and the National Science Foundation has taken a leading part in their formulation. For example:

The present policy of the Federal Government with respect to the support of basic research was formally announced in 1954 by Executive Order 10521. This establishes the degree of responsibility of Federal agencies for the conduct and support of basic research; in particular, it specifies that the National Science Foundation shall not be the sole source of support for basic research in the Government. At the same time that it encourages other agencies to conduct and support basic research, however, it limits their activities to basic research related to their missions, i.e., research that can be logically defended in their budgets.

As a next major policy point, responsibility for the planning, organization, and management for research and development is assigned to each Federal agency in line with its mission.

Research and development contracts with industry are clearly designed to assist the supporting agencies in meeting their objectives, but when the support of research at educational institutions is involved, it is general policy to define the research objectives in broad terms and to administer these contracts and grants in such a way as to permit the maximum degree of freedom and initiative on the part of the individuals or groups supported. This is generally true where the support is provided to an integral part of the college or university; it does not apply with the same force to the so-called research centers which are, in general set up to accomplish a specific mission of interest to the Federal Government and managed by a university or other establishment.

The Foundation is unique in that it has no defined mission other than to support and encourage the progress of science in the national interest. Within the limit of available funds, it has, as a matter of deliberate policy, undertaken to support all the fields of science in a comprehensive way, the criteria for support being primarily the experience and competence of the research investigators and the significance of their research in the overall scientific effort.

In the conviction that most effective progress in science takes place when it is essentially determined by the nation's scientists, the Foundation's policy is to encourage and consider applications from individual scientists or groups of scientists for support in defined areas of research that may be broad or narrow. Then liberal use is made of individual reviewers, advisory panels, together with the statutory Divisional Committees, in order to obtain the best advice from the scientific community regarding the merit of the proposed research. Finally, the recommended projects under consideration are weighed from the standpoint of national interest and the degree of support by the other Federal agencies.

In terms of the progress of science and the factors involved in overall planning, the first essential is to provide to the fullest extent possible for the needs of competent research workers in all fields of science and for the increasingly important interdisciplinary areas of science. In addition to advancing the progress of science on all fronts, such provision assures a steady stream of scientific manpower, fully equipped to meet general needs.

Superimposed on this broad coverage, particular areas of science may prove to be critical at a given time, either from the standpoint of progress and national interest in science, or because a more thorough knowledge and understanding of a field is important for planning purposes or for solving important developmental problems. Periodically certain areas of science require special attention in the form of symposia or conferences by research workers in the field, or in critical cases, a special study by leading experts whose purpose is to determine the need, feasibility, and scope of coordinated programs. Such critical areas may form the basis for study and special emphasis by the Foundation or other appropriate

agency. Recent illustrations are the fields of oceanography and the atmospheric sciences.

In cases where a number of Federal agencies are involved, reports of such studies come up for consideration by the Federal Council for Science and Technology. The Council may then recommend as to the degree of government interest, the scope of the effort, the apportionment of responsibilities, and budget allocation for collaborative effort in an overall Federal program.

Special emphasis may also be necessary for the exploitation of certain fields in order to further the progress of applied research and possible development.

In the latter category belong, for example, the scientific research that underlies the development of weapons and devices of war, provision for the care and cure of disease or, possibly, the establishment of a new field of research important to the national economy. However, the problem of establishing priorities throughout all of research is feasible only through the current identification of a limited number of the most critical areas. This type of management planning depends upon such surveys and analyses of data and trends as may be practicable, coupled with a process of selection by scientists and science administrators in their own organizations.

At the present critical stage of our knowledge and understanding, selections have to be made upon basis that is mainly subjective, i.e., by suitably chosen study groups for critical areas. The process is often most simply carried out by an organization or agency which is continuously occupied in the support of research and in following research accomplishments. Both of these characteristics are possessed in basic research by the Foundation and, also, in their fields of interest, by other agencies which support research.

The subject of national science policy and its supporting organization is and will continue to be a most important and challenging problem. A number of devices, including careful study methods for improving the speed and accuracy of survey analysis, modern techniques for dealing with masses of detailed information, and the use of methodology borrowed from statistics and communication theory, offer promise of even more effective solutions for the future.

Considerations of this nature have led the Foundation to set up an Office of Science Resources Planning which, in addition to coming to grips with short-range objectives, will start concentrated studies directed toward a solution of the more general problem. The objective is to determine what bits of information concerning science research activities, such as research in progress and the disposition of scientific manpower, are required and how these can be analyzed and presented in optimum form to serve as the basis for planning decisions. Such a system must include as an essential element provision for individual and local initiative and independence within appropriately restricted areas of research, and—in the realm of industrial activity—allowance for private initiative and competition.

CONCLUSION

Viewed in broad perspective, the whole matter of national science policy may be summed up as follows: For any nation, science and technology constitute an essential element of progress and, in particular, of national security and economic strength. For this country to exercise leadership in a competitive world, it is essential that policies and practices be developed along the following lines:

(1) The vigorous cultivation of science not only along the paths of foreseen objectives but also throughout its breadth and depth. In particular, this means thorough attention to the education and training of the scientists and engineers that will be needed. Fortunately, the present trend indicates that this goal is realizable, but only if as a nation we are prepared to provide funds and whatever is essential for the task.

(2) Among the possible developments that may result from science, careful attention must be paid to those that offer greatest promise in the accomplishment of our objectives. Such selectivity is important in maintaining a sound economy.

(3) A strong effort should be undertaken to educate our people to a general understanding of the purposes of science and technology, their potentialities, and their limitations in order that wise and intelligent use may be made of these capabilities.

But we cannot stop here. In an age where science has given us the key to unlock the energy of the atomic nucleus and has shown us the feasibility of escaping our planet and exploring the universe, we must understand that the

capital discoveries of science are only just beginning and that science and technology will inevitably raise issues of the deepest social significance. All nations are convinced that their future is bound up closely with their progress and capability in science and technology. Among modern nations this capability is becoming general. Grim competition has developed along both military and economic lines. Onto this scene there enters a host of emerging nations, small and large, impatient to acquire the standards of living and the independence associated with science and technology. To solve these major problems and maintain any kind of equilibrium will require the utmost of all participants. Whether future developments take the form of stupendous power over nature's resources, of influence and control over life or over man's minds, or of traffic with our sister planets, they will certainly create problems of such concern to the human race that mankind must learn to cooperate in their solution.

Outstanding breakthroughs should not be permitted to become the subject of hostile competition nor to be exploited without adequate study of the possible consequences. The emphasis that has been given to nuclear development foreshadows potentialities of other possible undertakings, such as the ability to alter climate materially or to apply genetic research findings without proper safeguards and control. Although these developments have not yet been realized, they are well within the realm of possibility. This nation and all nations have a solemn obligation to maintain an awareness of such possibilities and to make certain that new developments are used constructively and in the interests of mankind.

ALAN T. WATERMAN,
Director, National Science Foundation.

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E. Comparison of the Organizational Arrangements Recommended by the Jackson Subcommittee With Those Contained in Reorganization Plan No. 2 of 1962

SIMILARITIES

1. Both plans recommend that permanent arrangements for science and technology at the Executive Office level be made.
2. Both recommend the creation of an Office of Science and Technology in the Executive Office of the President (OST).
3. Both look to the proposed OST to strengthen the staff and consultant resources now available to the President with regard to scientific and technical matters.
4. Both consider it the duty of OST to make recommendations to the President for long-term planning needs and to coordinate and evaluate agency programs for science and technology.
5. Both suggest transfer from the National Science Foundation to the OST of long-term planning and evaluation responsibilities which it has been unable to meet.
6. Both specify a Director to head the OST.

DIFFERENCES

1. Jackson plan recommends making permanent by "statutory underpinning" the post of Special Assistant to the President for Science and Technology and the President's Science Advisory Committee; Reorganization Plan No. 2 does not recommend any change in the organizational basis of any of the units now existing in the White House—neither the Special Assistant, the Science Advisory Committee, nor the Federal Council.

2. Jackson plan recommends that the Special Assistant to the President for Science and Technology be made head or Director of the OST; Reorganization Plan No. 2 makes no specific mention of the Special Assistant in connection with its organizational recommendations.
3. Jackson plan spells out proposed relationships of the Director and deputies of OST with Congress; Reorganization Plan No. 2 says only that the establishment of an OST "will facilitate communication with the Congress."
4. Jackson plan proposes that the OST provide the Bureau of the Budget with technical staff assistance; Reorganization Plan No. 2 makes no mention of this specific role.
5. Jackson plan views the proposed OST as occupying a position corresponding to that of the CEA; Reorganization Plan No. 2 does not mention the CEA, although the functions of the proposed Office parallel those of the CEA.
6. Jackson plan recommends that the deputies to the Director of the OST "should preferably be drawn from among the members of the Science Advisory Committee" to serve "perhaps for 1 or 2 years"; Reorganization Plan No. 2 specifies that neither the Director nor the Deputy Director may engage in any other business, vocation, or employment while holding office.
7. The Jackson plan does not contain any recommendations for organizational changes in the constituent parts of NSF, such as those contained in part II of Reorganization Plan No. 2.

SUMMARY

The major point of difference between the two plans appears to be that the Jackson plan would put on a statutory basis the post of Special Assistant to the President for Science and Technology and the President's Science Advisory Committee, both of which were established by Executive orders, and both units would be integral parts of the proposed OST. The Reorganization Plan, by simply mentioning these units but not defining their role in connection with the proposed Office, provides for a greater degree of flexibility in the science arrangements, within the Executive Office and the White House, by leaving the way open for modification of individual units, through administrative action, after the establishment of the OST is approved.

6

[COMMITTEE PRINT]

TOWARD A SCIENCE POLICY FOR THE UNITED STATES

REPORT

OF THE

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT

TO THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS
U.S. HOUSE OF REPRESENTATIVES
NINETY-FIRST CONGRESS
SECOND SESSION

Serial S

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[Excerpts]

INTRODUCTION

This study has not been undertaken to make a case for science or to prove a point for technology. Science and technology have long since been established. Like Mallory's mountain, they are "there". Everyone today is keenly aware of the fact. Our choice in dealing with science and technology—and thus our policy—is predicated on two basic questions:

(1) Do we ignore them or use them?

(2) If we use them—how?

At this point in history it is quite clear that our Nation is committed to the use of science and technology. In fact, the Federal Government is implicitly so charged by the Constitution which entrusts to it the responsibility to "establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare"—none of which, however imperfectly innovated, could be possible without reliance upon science and technology.

From the long-rifle to the laser, this has been so.

But even if, to this point, it had not been so, the future would require it. There is no need to reiterate the many critical problems facing modern society by way of proof. We need only take note of the fact that when, in conjunction with these problems, we are called upon to handle hard, specific questions—our answer more often than not is "I don't know." It makes little difference whether we are dealing with pollution, transportation, unemployment, crime, education, health care or international trade, all too often we do not have sufficient accurate information on which to base rational decisions for the years ahead.

We have a plethora of questions but a dearth of answers. Answers come with knowledge. Knowledge comes with research. Research means scientific investigation—physical and social. Solutions require the appropriate application of research results.

This brief but conclusive bit of syllogistic reasoning forms the basis for meeting the initial inquiry with the following response:

There is no alternative to making continued use of science and technology.

Questions to be answered

So how do we go about it?

How does the Government organize to cope with science and technology? How should Federal science policy be set? What should the overall policy be? How should we go about carrying out that policy?

In view of the foregoing, the committee started with the premise that some policy is necessary and indeed exists. Even a cursory examination, however, disclosed the nonexistence of any formal or

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structured policy with regard to the use, support or management of science and technology. It further disclosed that the Congress had never made a sustained inquiry into the question of a national science policy per se—although it has many times considered isolated facets of science policy, usually in conjunction with some specifically defined problem, program or mission.

This, then, is what the committee's hearings on national science policy, held over a recent 3-month period, were all about. They were a comprehensive effort to accumulate the best possible thought and creative suggestion with regard to science policy.

They were focused directly on the question of whether or not the United States had reached a point in its affairs where a structured science policy was desirable—and, if so, what the major components of that policy ought to be.

It appeared to the committee that if the government has needed declared viable policy on such matters as environment, welfare, space, labor, consumer protection, public health and the like—and if the Congress has gone to considerable lengths to develop such policies and convert them into public law—it needs no less some kind of defined policy toward the major instrument on which it must depend in contending with these and other matters.

We have, therefore, after consultation and study of the record, made certain findings and drawn certain conclusions which we believe should be useful in the construction of a national policy for science and technology. We make no attempt at this time to separate the two; that is a refinement which, if need be, can be achieved later. Nor do we profess to have uncovered all the problem areas or reached satisfactory answers to every challenge. We have not.

But the committee is satisfied that it has made a start; it has constructed a foundation of thought and ideas on which to build a workable national science policy.

RATIONALE FOR A NATIONAL SCIENCE POLICY

In considering the establishment of a national science policy, a cardinal question which must be answered is whether a suitable rationale exists for making the attempt.

As indicated in the introduction, in the committee's view the answer here is an unqualified "yes".

At the outset, two particular conditions must be recognized as inherent.

- A national science policy can be promulgated only by the Federal Government in collaboration, of course, with other government and nongovernment communities engaged in scientific activity. But no other entity, public or private, has the purview, scope, or authority to undertake the task.
- Any national science policy cannot be considered separate and apart from national policy itself. That is to say, science policy must be part of and blend readily with the overall goals, objectives and priorities which are established by the American public through its duly constituted governmental process. Each policy is dependent upon the other.

A third condition which is not at once apparent but which is linked with the previous ones concerns the *demonstrated* need for a new National Science Policy. Does such a need exist?

Here again, our answer is "yes".

To see why, it is necessary to review what our policy toward science has been up to the present and to take a clear, uncolored look at the relationship between science and the current state of the Nation.

General current policy

At this time and, according to the committee's various studies and inquiries, at all prior times in our national history, the Government's science policy has been a patchwork response of attempting to apply some sort of scientific know how in order to help solve particular issues or problems which could not be ignored or which seemed to have political appeal.

That policy can be described in elementary terms about as follows:

First.—The continuing development of science and technology at an optimum rate is vital to the Nation.

There are at least three major reasons for this.

(A) Improved science and its applications can help us solve the severe problems which afflict our society. These include our national security; it includes our efforts to deal with deteriorating physical environments, with crime, with urban decay, with automation, with congested traffic, with medical care, with racial unrest, with the economy, with overpopulation, and, perhaps most of all, with understanding the ecology of the planet.

(B) Improved science and its support is necessary in order to supply new muscle and intellect for our educational system—without which the future would, indeed, look bleak. Government has come to depend on the educational institutions of the Nation for a large part of its research needs. Those institutions have similarly come to depend on the Government for aid in developing their science facilities and research projects. It is a reciprocal relationship and, in spite of some existing difficulties, one now rather freely acknowledged on both sides.

(C) Improved science is valuable for its own sake. It is a significant part of the evolution of human civilization. There was a time, and not so very long ago, when few officials in any of the three branches of Government construed science in the pure pursuit of knowledge as a very proper object of the taxpayer's dollar. The scales probably began to tip in the post-World War II era when Americans became aware of the debt they owed to the "pure" science of Europe. Even though the real political motive behind even such acts as creation of the National Science Foundation was hope of practical gain of one sort or another, some in Government had progressed to the point where they recognized the intrinsic value of science not alone for what it provides materially, but for its promise in letting man live in harmony with and understanding of the natural world around him.

Second.—Our Federal science policy has been—in view of the foregoing reasons—to support science and technology where and when it appears promising. With the universities, with industry, with the nonprofits—within Government itself.

Accordingly, in the past two decades Government has evidenced a willingness to put taxpayers' money to uses which would not have been dreamed of, let alone tolerated, three decades ago. Prior to World War II federally sponsored research was aimed almost solely at agriculture and public health, with a little on the side devoted to aeronautics and certain aspects of transportation and defense. Today a dozen or more Federal agencies are putting about $16 billion into R. & D. of all types—by far the greater portion into applied research and development.

Third.—Federal science policy has thus far been based on the principle that control of the support for science and technology should not be centralized.

No one or two agencies should be responsible for federally sponsored research—nor should all those whose chief mission is research, such as the National Aeronautics and Space Administration, National Science Foundation, National Institutes of Health, Atomic Energy Commission, National Bureau of Standards, Environmental Science Services Administration, Coast and Geodetic Survey, etc., be regrouped and housed under a single administrative roof. The premise has been that federally sponsored science ought not be under the thumb of a single super-bureau which might prove orthodox, biased, or unimaginative in its role as comptroller of all science support.

Ad hoc system

None of this appears to be very complex, structured or detailed policy. It is not an enunciated or necessarily a permanent policy. It is mostly an ad hoc system, an implied "modus operandi." And it does not begin to explain how things work with regard to priorities, the relationships between administrators and scientists, the problem of the poor versus the rich university or of geographical distribution. It does not attempt to describe the scientific estate or the "establishment," so-called—if there is such a thing. It does not deal with the proper role of mission agencies in funding basic research. It does not describe in measured political terms what the Government thinks of science and technology, or how it intends to treat them.

All of these matters are fuzzy. It is very difficult to pull out a formula or observation which can be stated as a uniform, predictable policy with respect to any one of them.

New factors introduced

Since the evolution of the policy matrix just described, important influential new conditions have materialized—each of which is having a profound effect on the Government-science relationship.

Relying on the extensive information provided in the recent hearings, these include:

- A pronounced drop in the rate of increase of Federal support of science from a positive maximum annual rate of around 12 percent in the mid-1960's to a negative 5 percent for fiscal 1971.
- A drop of about half a billion dollars each year in actual dollar numbers since fiscal 1968.
- In terms of relative Federal budgets, a decline from a maximum effort of almost 13 percent of the total budget to a present level of about 7 percent.

- An overall recession in value, when measured against inflationary factors and when viewed in terms of current purchasing power—of from between 20 and 25 percent from the peak years 1965–1968.
- Congressional moves to curb science support along two lines: (1) a general tendency to consider research as a partially expendable item with regard to overall budget reductions, and (2) specific efforts to move the mission-oriented agencies away from basic research unless some sort of "relevancy" can be demonstrated.
- A public disenchantment with technology of uncertain dimension, induced by environmental, social, and educational factors, among others.
- A movement away from science as the glamourized activity to which government, scientists, and businessmen alike had responded favorably during the nuclear and space-engendered excitement of the past quarter century.
- Preoccupation of Government with seeking solutions to immediate demanding crises—such as unemployment, crime, environment, welfare, urban decay, military, and foreign exigencies and the like—using "off-the-shelf" technology.

The effects of these and other forces upon the scientific and academic communities have been pronounced. And, to only a slightly less degree, they have affected a sizable portion of industry and most of the nonprofit research institutions.

Research teams have been decimated or disbanded. Promising projects have been slowed or shelved. Science and engineering enrollments at academic institutions are down. Medical schools, particularly the non-State schools, are in serious financial straits. Graduate student-teachers have had to postpone their schooling and often abandon their research fields. Planning of any kind for the future by the research community is difficult and in some instances impossible. Research industry stocks are down disproportionately. Small companies are disappearing. Most serious of all, many of the Nation's brightest young people who would otherwise enter the science arena are passing by without any real exposure to its attractions and potential.

There is little question that the morale of the scientific community is at a low ebb.

No doubt it can be said that conditions such as these are not limited to science and technology, that other endeavors, other interests, other industries are in a similar state of distress and for quite similar reasons. What makes the status of science so acute, however, is that it is a tool which, once dulled, is not easily or readily resharpened. Scientists and technicians are neither motivated nor trained quickly; and their facilities, if permitted to grow obsolete, can be made useful again only with great cost and the lapse of much time.

Risk of decay

In today's world, with its rapid change, inordinate social pressures, and many demands for the "quick fix", decay of our scientific estate entails a very high risk indeed. This committee is not inclined to accept it with complacency.

We concur with the subcommittee chairman, Mr. Daddario, that the present situation contains the two essential elements which form the basis of need for a legally established national science policy.

(1) The existence of severe problems which require the application of science and technology as at least part of their solution, to supply and manage such applications with wisdom and dispatch.

These facets were duly noted by Mr. Daddario on the floor of the House [1] earlier in the year.

Probably the greatest single force for both good and evil which is abroad in the land today is technology. In large part the destiny of the human race depends on what use we choose to make of science and its handmaiden, technology.

The problem does not lie in the intrinsic nature of technology, however. Never was the old adage more applicable: "nothing is ever good or bad, but thinking makes it so." Technology is simply the ability to apply knowledge. Its worth depends on how men handle it.

There is scarcely a major existing ill which cannot in some manner be traced to technological application—nor is there one whose solution does not lie, at least in part, with better managed and better used technology.

The most glaring example at the moment is environment. But the effects and uses of technology go far beyond environment. They apply also to the great economic, social, moral, legal, and political issues of our time. Until we learn really to understand technology—how and when to apply it; how and when not to apply it—we shall never overcome the many, complex difficulties that beset us.

Money and good intentions alone will never do the job. That is like trying to complete a triangle with only two points from which to work. There has to be a third; the third is improved scientific research—physical and social—and the proper application of its results.

Statutory base

Policies governing virtually all the missions and purposes of the United States Government are spelled out in either the Constitution, enabling legislation, organic acts or Executive orders—or any combination of these.

Thus we have explicit statutory language directing the Federal hand on such matters as national defense; the promotion of trade, agriculture, and labor; international relations; the provision of communications; the conservation of resources; the improvement of education and health; etc.

Each of the foregoing, of course, can be distinguished from Science and Technology in that they are intrinsically goals or objectives while the latter represent disciplines or modes of operation. Like law, economics, history or philosophy—Science is a *way* of looking at things, of studying and handling them. It may or may not be a goal in itself, depending on one's point of view.

Yet we have long since identified law and economic theory as social tools of such importance as to require the establishment of national policies concerning them through a variety of public laws and formalized administrative acts. They are too numerous to bear repeating here.

[1] April 16, 1970.

With regard to Science, however, we have almost no crystallized policy structure as a basis for our utilization of this equally important social tool.

In March of 1954 President Eisenhower issued an Executive Order [10521, amended in 1959 by E. O. 10807] on the "Administration of Scientific Research by Agencies of the Federal Government" which recognized the great dependence of modern government upon Science and, to an extent, codified the multimission approach to support of basic research. But it was couched in generalities and tended to concentrate on the liaison role of the National Science Foundation. Probably the closest Congress has come to enunciating such a policy was in the National Science Foundation's Organic Act of 1950 when NSF was enjoined "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the Sciences."

The Foundation never followed through on this charge in a significant way.

Subsequently, this function was transferred to the Office of Science and Technology by President Kennedy in 1962. OST's response to the duty has not been much different from that of the Foundation.

The foregoing observation is not intended to be critical since neither NSF nor OST has occupied a position within the Federal structure of sufficient authority to make its actions and/or directives effective on a governmentwide basis.

We believe it is time for Congress and the Administration to join in the development of science policy—not merely in regard to basic research, but all scientific research and its applications.

RECOMMENDATIONS

In response to its activities in the government-science field over a period of years and in recognition of the testimony provided to it during the July–September 1970 hearings on National Science Policy, the subcommittee makes the following categorized recommendations:

Basic philosophy

The Federal Government should formally recognize its debt to and dependence on science and technology and establish herewith a national policy for their support and furtherance.

In this regard we are recommending fundamentally three things.

- That a National Science Policy be stated and maintained as public law.
- Such policy be incorporated into the operations of every department or agency of the U.S. Government which utilizes science and technology in its mission.
- Such policy be flexible and subjected to continual review and reevaluation in light of changing national goals and priorities.

It is important to note that every administration since World War II has given some evidence of understanding this need, beginning with the Steelman Commission in 1947.[2] Of particular significance are two White House statements issued in 1958 and 1959.

[2] "Science and Public Policy," report of the Scientific Research Board, Aug. 27, 1947.

In the first of these [3] the following commentary was made by the President's Science Advisory Committee:

> Scientific research has never been amenable to rigorous cost accounting in advance. Nor, for that matter, has exploration of any sort. But if we have learned one lesson, it is that research and exploration have a remarkable way of paying off—quite apart from the fact that they demonstrate that man is alive and insatiably curious.

This we take for truth, and hence, an indispensable part of every endeavor of Government. It has long been recognized as a truism that policy decisions are made on the basis of incomplete information; more complete information in the hands of policymakers usually results in better decisions; and science is an important route for adding to our store of information.

The second pronunciation [4] was issued by President Eisenhower to the heads of all Federal agencies and, among other things, set out the following propositions.

> The security and welfare of the United States depend increasingly upon the advancement of knowledge in the sciences; * * *
>
> Useful applications of science to defense, humanitarian, and other purposes in the Nation require a strong foundation in basic scientific knowledge and trained scientific manpower; and * * *
>
> The administration of Federal scientific research programs affecting institutions of learning must be consistent with the preservation of the strength, vitality, and independence of higher education in the United States; * * *

Most important, the White House specifically recognized that:

> The conduct and support by other [than the National Science Foundation] Federal agencies of basic research in areas which are closely related to their missions is recognized as important and desirable, especially in response to current national needs.

We conclude that this philosophy should be spelled out in the statutory history of the American Government.

A formalized policy statement

In order to effect the foregoing, the administration should form a special task force, the sole duty of which shall be to submit a draft national science policy no later than December 31, 1971, for consideration by the Congress as part of its legislative agenda in 1972.

The subcommittee is aware that a Presidential commission on Science Policy has already done a considerable amount of work in this direction. But in our judgment the excellent, but abbreviated, report of the commission issued this year [5] represents a beginning, not a concluding, effort.

We suggest, therefore, that the proposed task force use as a platform:

- That effort by the previous White House study group on science policy;
- This report and subsequent science policy reports by the House Subcommittee on Science, Research, and Development—with special attention to the recommendations set forth therein; and

[3] "Introduction to Outer Space," Mar. 26, 1958.
[4] Executive Order 10807, Mar. 13, 1959.
[5] "Science and Technology—Tools for Progress," April 1970.

- The record of national science policy hearings compiled by this subcommittee, which includes a number of imaginative and unique propositions and innovations which merit particular consideration.

It is the view of the subcommittee that neither the executive nor legislative branch of Government can, alone, formulate a credible, viable national science policy. As was the case with the development of our recent national policy on the environment—and many other policy declarations—joint effort and joint belief in the objective is needed.

We make no suggestion as to the composition of the task force except to urge that it include members from all branches of the Federal Government, from State and local governments, from the private sector, from the scientific community, and from the field of the arts and humanities.

Federal organization

The Office of Science and Technology should be strengthened both as to staffing and mission. It should be separated from any direct administrative connections with the President's science adviser or the President's Science Advisory Committee.

OST could and should be the focal point for the coordination, sponsorship and status of the Government's science and technology activities. Testimony and observations indicate to the subcommittee that it is not. Instead, OST is fragmented as to mission and badly overburdened as to operation. It is presided over by the same individual who serves as Presidential science adviser, chairman of the President's Science Advisory Committee, chairman of the Federal Council for Science and Technology and, for a time, Secretary of a Cabinet Committee on the Environment. Much of the OST staff is similarly employed in a wide variety of duties.

Moreover, it appears to be true that OST is frequently used for tackling immediate crises—brushfire operation, if the term is preferred—which makes its function as a patron, planner, and overseer of Federal science a minimal one. Like a number of other "no man's land" staff groups, OST all too often finds itself pressed into service to meet the various demands of the Executive Office—scientific or otherwise.

As a consequence, OST does not fulfill even its few existing statutory obligations. It does not attempt and never has attempted, for example, to perform the legal duties transferred to it from the National Science Foundation by President Kennedy in 1962.

One of these is to take the lead in formulating basic Government science policy within a continuing framework. The other is to evaluate and report on overall Government research efforts and activities. OST does not perform either function in an adequate fashion. Indeed, under existing circumstances it cannot.

But the subcommittee feels OST should be responsive not only to the law but to new policy which assigns to it the fundamental responsibility for assuring that science and technology, as a critical tool in the Government's mission chest, is always up to date and in the best possible working condition.

For these reasons, we believe OST should be provided additional statutory backing, staffing, and funding. It should be relieved of the

time-consuming, often delicate, often classified, support function it now provides the Presidential science adviser. This is not to say that OST should be removed entirely from the PSAC arena, if the President wishes to call upon it; but it should not be one of the chief components through its Director and staff.

OST should submit an annual report to the President and the Congress setting forth (1) a comprehensive review of the status of research and development in the United States and (2) a recommended program of scientific research and development for the coming year.

The utilization and value of such reports are obvious. They would be especially useful to the Congress which could well use more lead-time than it usually gets in considering requests for support or regulation regarding scientific and technological ventures. If submitted at the same time as the Federal Budget, the utility of the reports would be particularly strong.

Such reports would not conflict with the annual reports required of the National Science Board which tend to scrutinize one facet of the scientific endeavor as it relates to a special need of society.

The proposed National Institutes of Research and Advanced Studies [NIRAS] should be inaugurated at the earliest feasible time.

In 1969, this subcommittee, in collaboration with its Research Management Advisory Panel and four former Presidential science advisers, developed the concept of a National Institutes of Research and Advanced Studies—the so-called NIRAS model. The reasons for the effort were the badly understood and poorly coordinated Federal programs aimed at enhancing academic research and relating it to similar programs in support of higher education. Such programs were scattered throughout a number of agencies; they operated in such a variety of ways and according to such a variety of policies as to result in confusion and occasionally waste.

Moreover, since research and advanced study are so much a part of each other, and since no one in government is really minding this particular store, it is clear that some appropriate action is called for—and quickly.

Subsequent to hearings on NIRAS, the subcommittee made a strong recommendation [6] in favor of its establishment. The recent hearings on national science policy have given a further resounding endorsement to the idea and from a broad category of sources—not merely the academic world.

The subcommittee reaffirms its position on the desirability of NIRAS—noting that, according to current budgetary allocations, a NIRAS-type administrative organization would place responsibility for about 60 percent of all federally supported basic research within NIRAS, a level which the subcommittee believes would prove effective on a governmentwide basis in improving coordination and efficient use of funds.

[6] "The National Institutes of Research and Advanced Studies," report of the Subcommittee on Science, Research, and Development, Apr. 15, 1970.

The suggestion we would add here is that additional study be given the status of the National Institutes of Health in respect to NIRAS. The original NIRAS model envisioned most NIH activities other than its inhouse medical research ones as transferred to NIRAS. The factor is one on which cogent arguments exist on both sides. The fact that NIH is essentially a research activity lends weight to the argument for its inclusion in NIRAS. The fact that NIH research is so pointedly a mission-oriented type of research, however, favors the argument against its inclusion. Our science policy hearings indicate that it might be preferable to include only the institutional grant and training functions of NIH, leaving the balance according to the current NIH status within the Department of Health, Education, and Welfare.

(For details of the NIRAS model, see the subcommittee's report as footnoted.)

In the legislative branch, the Congress should seek a centralized Senate jurisdiction over science and technology, and establish an Office of Technology Assessment as recommended previously by the committee.

In the House of Representatives responsibilities for the Nation's scientific and technological activities in a general way and for overview of Federal scientific research and development in particular are, by House rule, centered in the Committee on Science and Astronautics. The Senate has no such counterpart, no science focal point.

While we make no suggestions as to how or where this sort of responsibility might be lodged in the Senate, our experience over a decade convinces us not only of the improved efficiency which would result from such a move but of the continuing and, indeed, increasing need for it.

With regard to the establishment of a new independent arm of the Congress to assess the impacts, good and bad, of existing and developing technology, the subcommittee and full committee have recently reported legislation to this effect.[7] We shall not repeat the rationale for a legislative Office of Technology Assessment, but we incorporate it here by reference to the legislative report.[8]

Funding

Pending the establishment of NIRAS, responsibility for basic research should center in the National Science Foundation, which should provide approximately a third of all Federal support in this area.

At the present the National Science Foundation which is supposed to function, among other things, as the Government's "balance wheel" to assure reasonable and stable support for basic research, is providing 15 percent of the total of such research.

Testimony adduced by the subcommittee indicates that this is far too low a figure if the Foundation is to perform its balancing function with any degree of efficiency. The fact is that the ups and downs of research support by the mission agencies—which support is large percentagewise compared with NSF's resources yet highly susceptible

[7] H.R. 18469, Aug. 6, 1970.
[8] H. Rept. 91-1437, Sept. 9, 1970.

to the shifting winds of the budget process—really decide whether basic research in the United States proceeds in deliberate fashion or is reduced to flighty confusion. NSF's, relative ability to provide balance and continuity carries too little weight when its resources are no larger than they are.

The recent controversy over Defense Department research brought on by the "Mansfield amendment" concept has served to highlight the problem. The subcommittee concurs in the validity of the questions raised by the Mansfield approach even though "relevance" is an elusive element to prove; it agrees that basic research sponsored by mission agencies should not be capricious as it has sometimes been. We note, however, that cutting back research funds of the mission agencies does not, *ipso facto*, increase those of the Foundation.

In other words, the danger of research depletion is still there, despite congressional expressions of willingness to transfer added funds to the Foundation's budget. We urge the administration to note this danger well as the budgetary process unfolds in the future and to guard against it.

The Office of Science and Technology should develop criteria for the support of basic research by the mission-oriented agencies.

As the various mission agencies have evolved programs for the support of research and development, many have initiated and continued broad support for basic research. Some confusion has resulted, within the agencies as well as without, as to whether this basic research is "relevant" to the mission of the agency. Senator Mansfield has done an important service in calling this situation to the attention of the Congress and the Nation with respect to one mission agency, the Department of Defense.

Mission agencies should be involved in the support of basic research. This is important not only to help assure the generation of knowledge to carry out their missions, but in order that the applied research and development programs in the agencies have adequate access to highly innovative scientists and ideas operating throughout the basic research spectrum.

Admittedly there is great difficulty in ascertaining the relevance of basic research to an agency's mission. This is almost impossible to do with respect to a specific research project of an individual researcher. At the same time, it does seem possible to identify broad scientific areas of basic research which do have some relation to some technological requirements important to the mission agency funding the inquiry.

OST should develop general criteria which the Federal departments might reasonably use as a guide for their decisions as to which areas of basic research should be supported. The OST criteria might assign primary responsibility for individual basic research areas to a mission agency, or NIRAS after its establishment, and indicate the limitations which might govern support of basic research in an area over which the agency does not have primary responsibility. Such a procedure could greatly improve the administration and coordination of research within our pluralistic system, and provide guidance to the various private performing organizations in seeking the appropriate agency to support their proposed projects.

The subcommittee is of the opinion that statutory provisions which require basic research to be "relevant," or have a "direct or apparent relationship" to an agency mission cannot be made administratively efficient. It is preferable that OST determine such criteria within the context of the scientific requirements of the Nation and the technological needs of the agencies. We suggest that, in the future, legislative committees deal with this matter in their reports and not in statutes which may cause grave administrative problems. The end results, under such circumstances, should be far more satisfactory to all parties concerned.

The Office of Management and Budget should develop a "stable funding" procedure with regard to basic research which will avoid seriously disruptive funding fluctuations.

One of the most serious problems encountered by Federal agencies in their support of research is the extreme vulnerability of the research dollar when it is forced into headlong competition with, say, the weapons dollar, or the crop support dollar, or the welfare dollar, or the veterans' dollar, or the postal dollar, or the hot-lunch dollar—even the foreign aid dollar. Anything with a humanitarian, security, service or other popular-appeal tag on it is apt to take priority over scientific research.

We do not argue that this is invariably wrong. On the contrary, for the short term it is often right. Our point is that effective science and technology, the critical nature of which we have tried to show in this report, cannot be turned on and off like a water spigot.

It does not make sense, in fact it is enormously expensive and dangerous, to dissolve good research teams, dismantle first-rate facilities, fire research professors, discourage graduate students and "turn off" prospective science education majors through sudden budgetary downturns—just as it is wasteful and inefficient to increase research budgets too rapidly.

It is recommended, therefore, that the Budget Office study ways and means of considering the science research and education phase of the Federal Budget, as an entity—that this be regarded as an integral program of prime importance—and that policies be adopted which will assure a minimum of fluctuation over any consecutive 5-year period. Perhaps anything beyond a 5 percent change per year (adjusted for inflation) during this period should be avoided even if other, apparently more "critical" programs must absorb the difference. It is emphasized that any percentage change should be viewed as a relative one which takes into account growth factors, cost-of-living trends and other inflationary components.

Education and manpower

Emphasis on science education should be a first priority of the NIRAS, when established, with undergraduate science added to the proposed institute of education.

The subcommittee views the continued and increased support of science education as one of the most crucial sectors of the total science and technology undertaking. The hearings on national science policy made it plain that many Government officials and academicians are more concerned with graduate education and Ph. D. production than

with undergraduate science. While we concur in the extreme importance of first-rate advanced education in the sciences and feel that this should be the first order of business for the NIRAS, we are none the less mindful of the advanced education sources—the undergraduate schools and secondary schools—at which point most students decide whether or not science is what they want.

In the original NIRAS model, the subcommittee recommended that undergraduate and lower education programs now supported by NSF be transferred to the Office of Education. Testimony adduced during the recent hearings on national science policy, however, provided further information which indicates the wisdom of retaining these programs within the NSF and eventually the Institute of Education of NIRAS. The close association between advanced research and undergraduate research, plus the rapid fluctuation of curricula which makes what is graduate work today become undergraduate work tomorrow, seems reason enough for this revision.

Since many of the mission oriented agencies have either dropped or curtailed their science education support programs, this factor assumes even greater importance. We shall not solve our serious social problems without adequate trained manpower. Hence our science training programs offered to students at their most impressionable ages should be of first-class quality and adequate quantity.

Moreover, we should have more reliable projections on what the demand for them is likely to be. In this connection the subcommittee believes that, with the help of the National Science Foundation and the National Academy of Sciences, such manpower projections should be an essential part of the OST annual report.

The subcommittee is not impressed, however, with the expressed worry of an oversupply of scientists and engineers. This is a risk any individual takes when he decides on a career—and a high percentage of all graduates end up working productively in fields other than those in which they are trained. Scientists and engineers are no different. Those who do not find employment precisely in line with their training are no less valuable in different fields of endeavor. We may at some point have too many scientists and engineers, but we shall never have too many good ones.

The United States must strengthen its support of institutional science grants with a corresponding upgrading of the National Science Foundation's institutional grants program and assumption by NSF of this responsibility.

For the past 3 years the subcommittee has listened to the pleas of educators for grant assistance to their institutions, as such, as distinguished from project research grants or the scholarship-fellowship type of grant.[9] We are convinced of the merits of such pleas for two basic reasons.

• First, today's colleges and universities are faced with almost impossible financial situations due to the great numbers of students they must handle under the educational doctrines placed upon them by contemporary philosophies and the contemporary American public. So long as such doctrines are in effect, we must pay for them.

[9] H.R. 11542, accompanied by H. Rept. 91-490, Sept. 15, 1969.

• Second, it has been shown to our satisfaction that the cost of educating the science-inclined student runs from six to 25 times higher than training his non-science counterpart. Thus every added dollar made available through institutional science grants carries particular financial significance for the economic stability of the recipient institutions.

It is our judgment that the Executive memorandum[10] issued by President Johnson in 1965 placing responsibility for the emergence of more academic "centers of excellence" upon all Federal agencies engaged in research should be rescinded and the duty levied primarily upon the National Science Foundation with secondary responsibility upon other units in the NIRAS.

Communications and information

In order to assure that the Federal Government has timely and adequate information available to those who must formulate science policy, a real-time management information system should be inaugurated and utilized by all Federal agencies engaged in research.

For years we have foreseen the need to structure the NSF in such a manner as to permit it to assume an increasingly larger proportion of the responsibility for the support of academic science, especially basic research. Over the past few years we have seen a slackening of commitment on the part of various mission agencies to basic research. The result has been increased pressure upon the NSF to support many research projects being cut off by the mission agencies. But increased funding for the Foundation has been slight, and we have seen the war in Vietnam and the demands for the solution of social problems receive higher priorities in the Federal budget.

The subcommittee addressed this problem in hearings on the fiscal 1971 NSF authorization bill. Before a solution could be worked out to this problem of research projects being transferred to the NSF, the subcommittee needed to obtain from the Federal agencies an answer to the following question: "For fiscal 1970 and fiscal 1971 what academic science activities will end because of budget reductions in your agency?"

This would seem a simple question to ask of any agency that uses an up-to-date information system with nano-second switching times and giga-bit memories. But what answer did we receive? The 1968 data were available and complete, 1969 data were beginning to be available, and some agencies were able to provide them. With regard to 1970–71 data we were asked to wait a couple of years.

The information systems which we now use in research management may be excellent repositories for historical information, but they have not been as useful as they should be in furnishing information for policy decisions. What we need is a "real-time management information system" for coordination and management of the Federal science research and development enterprise.

There is widespread feeling that the information in the system is for "someone else", not the middle management official who generates

[10] "Strengthening Academic Capability for Science," Sept. 14, 1965.

the data and manages the research and development programs. Furthermore, there is a reluctance to trust the accuracy of the information, because of its degradation during the input process. Finally there are subtle pressures not to use the system because of the cost of the hard copy output and the bother of going through channels.

We propose for consideration a real-time information system which would overcome some of these drawbacks. It would be basically an in-house system, one for the use of the Federal Government in managing its resources devoted to research and development.

The details of implementation we would leave to the experts in such matters, but the ideal system would be Government-wide in scope. It would include both research and development activities. It would contain both technical and fiscal information. It would contain both "hard" and "soft" data useful in the decisionmaking process. For instance, tentative budget levels, quality judgments, and decisions to support, continue, or end projects should be included, even though subject to abrupt changes and revisions.

With regard to science-information systems and techniques and the need to assure their compatibility within the Federal Government, central responsibility should be assigned to the Smithsonian Institution with essential backup from OST's Committee on Scientific and Technical Information.

For some years the subcommittee has worked with a special Communications Council, operating under the aegis of the Smithsonian Institution but composed of science information experts from many sectors, public and private, in order to unify the Federal science communications system so that it can be useful to all.

This is a particularly difficult and thorny problem, but we do not view it as insoluble.

Because it has had experience with the problem and has maintained a Science Information Exchange for a number of years, we believe the Smithsonian Institution should be given an Executive mandate to proceed with research leading to compatible information systems and provided with sufficient funding to get the job done. Some of the staffing and funding might well come through COSATI since it is a somewhat parallel OST effort with broad liaison characteristics.

Social and economic

The role which science and technology have to play in promoting solutions for the major problems of the day should be explained forcefully to the public with particular help from the National Academies of Sciences and Engineering.

The reasons for this recommendation are obvious. They have been explained in the foregoing rationale section of this report.

Fulfilling the need to explain what is at stake and how science can help is everybody's job, including that of the Congress. However, the subcommittee feels that a particular responsibility in this matter should lie with the National Academy of Sciences and the National Academy of Engineering. Both of these organizations consist not only of many of the best scientists and engineers in the land, but they are charactered specifically by the Congress. Each owes some duty to function as liaison between the national Government and the public. Few,

if any, organizational entities are better designed or equipped to perform this task—difficult and ephemeral as it may seem—than the Committee on Science and Public Policy and the Committee on Public Engineering Policy which have been organized by the two academies respectively during the past few years. Indeed, their very creation is tacit admission of this responsibility.

By the same token, the explanatory and demonstration functions just described run not only from the scientific community to the public, but likewise in the reverse direction. That is to say, we believe that the academies have a corresponding duty to let the science and engineering world know what the public needs, wants and expects of them. Performance in one direction only is likely to result in frustration and stalemate.

The subcommittee recognizes that the original congressional interest in chartering the academies was to provide a source of competent, technical advice to the Government. That need clearly will always exist. If the new duties suggested here indicate the need, then the academies should petition Congress for a revision of their charter in order to comply more readily.

Consideration should further be given to Federal funding of the academies, on a contract basis through OST, for this purpose.

In consideration of the close reliance of trade, national and international, upon scientific and technological development, the Department of Commerce should report to the Congress annually on technological trends and needs in relation to the economic health of the Nation.

The science policy hearings held by the subcommittee were replete with discussion of the close relationship between science and commerce, particularly for the future. Testimony emphasized the increasing reliance of American economic well-being upon the continued innovations produced by research, basic and applied. We have no reason to doubt the truth and force of this statement, and we were especially struck by the following allegations:

- The economic well-being of the country from the technological point of view is just as involved—perhaps more so—on an international basis as on a national one. This stems from the fact that the United States faces serious technological challenges from abroad, particularly Germany, Japan, France, and the Soviet Union, each of which has made comprehensive scientific strides in the past decade.
- Economic growth can no longer be considered the chief preserve of the consumption industries. Resources, American and global, are too vulnerable to extinction, if subjected to unrestrained exploitation, to permit this. Emphasis, therefore, must increase on the so-called service industries of upon "high-technology" production, both of which make use of larger numbers of people and fewer carloads of materials. In our view, the custom-built article represents a primary economic symbol of the future.

Concomitantly, this potential change in emphasis by American industry requires increased support of the social sciences and a willingness to regard them as genuine scientific disciplines—which the public, up to now, has not always been ready to do.

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This proposed function of the Commerce Department should be undertaken through and with the help of the Federal Council on Science and Technology. Its special reports should be made available promptly not only to the President, but to the Congress and the public at large. Consideration should be given to the feasibility of making this report a part of the OST annual report.

International relations and general welfare

The National Science Foundation should begin planning the establishment of a small, rotating foreign service corps to assist the Department of State in its international scientific liaison activities.

The subcommittee has made somewhat similar recommendations in the past. In fact, our legislative report on NSF's 1971 authorization bill carried the following notation:

> The Subcommittee recognizes the important international aspects of scientific research, and the valuable role which the NSF can play in this regard . . . It therefore proposes that the Foundation and the Department of State give further detailed study to this issue during the coming year. The Subcommittee has no intention of recommending a system of dual scientific representation of this country in foreign countries by NSF and the State Department. It feels strongly, however, that the Science Foundation and its personnel can make a valuable contribution to the existing science attache program.

What we now propose is a small group of scientists, employed by NSF, who would be assigned to a foreign service post for not less than 3 years to function as part of the Embassy teams. They would not supplant State's current science attachés, but work as assistants to them in areas of scientific liaison and reporting which are now badly understaffed.

The State Department's Bureau of International Scientific Affairs takes the position, quite properly in our opinion, that the first duty of its science attachés is to provide general technical advice to their respective Ambassadors in pursuit of the diplomatic mission. But this not only leaves the attaché with little time to study foreign science and technological trends per se—but it takes the attaché so far away from modern developments in his discipline that he may soon lose the keen scientific edge which qualified him for his job in the first place. He is in fact a policy adviser and only secondarily a science reporter.

It is this latter function which, we propose, an NSF Foreign Service Corps might help perform with highly useful results. We believe such a corps should be funded by NSF with arrangements for professional refresher training at the end of a corps member's foreign tour.

As a crucial aid to the Nation's general welfare and security, the Office of Management and Budget should make 5-year projections of scientific and technological trends, probable national needs for scientific resources during such times, plus indications of probable levels of Federal support for meeting the needs.

As a matter of fact the Office makes multiyear projections now which approximate this recommendation. But they are done by reliance mainly on inhouse capacity and are held so tightly that they are of little use outside the Executive Office.

It can be argued that further exposure might be damaging in some ways—or that some other agency, not an arm of the White House, could be called upon to fulfill this task. Admitting the validity of these arguments, we nonetheless believe that no unit other than OMB has the basic information, intuition, and talent to make such projections valuable. In collaboration with the aid which a much strengthened OST and Federal Council for Science and Technology might provide, projections of the nature described—even though marked deviations would inevitably occur—would be of genuine benefit to the Congress in helping it acquire a long-range planning capacity that presently does not exist.

It is important to distinguish between these projections and the annual report recommended for OST. As we view it, the OST report is essentially a status report of the health of scientific research and development in the Nation, plus a forecast of the likely needs in this area in the near future. The projection suggested for OMB should relate the scientific and technology trends to social and other factors which may affect them, such as availability of resources, priorities of other programs, the relative exigencies of the national economy, and so forth.

Consideration might be given, however, to making such projections a part of the OST annual report.

State and local development

The scientific method and technological research should be increasingly utilized by regional, State, and local organizations in seeking solutions to societal problems.

For some years it has been recognized that the most effective application of science and technology to certain problems such as crime and pollution abatement can be made on a regional or local basis. Progress in implementing this concept has been slow, and the State Technical Services program in the Department of Commerce has been dropped. We must not cease our attempts, however, to provide the necessary support for this important area, and at the same time increase the ability to utilize such support by State and local officials.

We recommend that the present NSF State and local intergovernmental policy planning program be expanded under NIRAS. NIRAS should not only support appropriate individual projects of the type which would increase the utilization of science and technology in solving local problems, but it should explore utilization of formula grants for this purpose also. The latter could be controlled with restrictions on their use as well as requirements to upgrade local ability to utilize technological programs, in order to avoid inefficiency in expenditures.

We further recommend increased development and experimentation with innovative administrative mechanisms by which Federal laboratories can bring their expertise to bear on the solution of problems at the regional, State and local levels.

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7

THE WHITE HOUSE

Fact Sheet

Message on Science and Technology

March 16, 1972

BACKGROUND

The Message being sent to Congress today is the first Presidential Message on Science and Technology in the nation's history.

Scientific research and development account for some $27 billion worth of goods and services in this country. Approximately $17.8 billion worth will be paid for by the Federal government.

As the President pointed out in the State of the Union Message, the nation has a special bent for science and technology and our ability to harness it for the purposes of man. He is presently evolving a long term strategy "outlining ways in which the Federal Government can work as a more effective partner in this great task."

That strategy's key elements are:

- The maintenance of strong, sensible research and development programs in space and defense;
- The application of our scientific and technological genius to domestic opportunities;
- The stimulation—in an area in which we lack full understanding—of the processes of research and development through both public and private sources;
- The employment of our technologically-oriented agencies in support of agencies with social missions;
- The focusing of our resources on clear targets where breakthroughs are most likely.

Accordingly, the President has asked for $17.8 billion in the FY '73 budget for Research and Development, an increase of $1.4 billion (more than 8 percent) over FY '72. He has also asked for more than $700 million in new money for civilian R&D programs, a growth of 65 percent—from $3.3 billion to $5.4 billion—in civilian sector R&D since 1969.

Today's Message to the Congress resulted from *continuing* studies by the Office of Science and Technology, the White House R&D arm; special studies by the Domestic Council to identify new areas amenable to technological opportunities; *recent* consultations with industry, academic, business, scientific and other professional groups; thorough soundings of major Federal agencies and departments; and *ongoing* reviews of R&D related issues by White House task groups.

THE MESSAGE IN BRIEF

The President calls for new actions, relationships and legislation designed to enhance research and development in all sectors—government, universities and private industry—with the Federal government playing a catalytic role wherever possible.

The President today proposes actions aimed at enhancing the application of the nation's R&D capacity to civilian needs. "We must appreciate that the progress we seek requires a new partnership in science and technology—one which brings together the Federal government, private enterprise, state and local governments and our universities and research centers in a coordinated, cooperative effort to serve the national interests," he told the Congress.

As part of a multi-faceted approach to such efforts, he pointed out that:

"Even the most important breakthrough will have little impact on our lives unless it is put to use—and putting an idea to use is a far more complex process than has often been appreciated.

"We must see that the environment for technological innovation is a favorable one," one without "impediments of excessive regulation, inadequate incentives or other barriers . . .

". . . We must realize that the mere development of a new idea does not necessarily mean that it can or should be put into immediate use . . . By realistically appreciating the limits of technological innovation we will be in a better position fully to marshal its amazing strengths.

"Creative, inventive dedicated scientists and engineers will surely be in demand in the years ahead . . . I am convinced that they will find ample opportunity to serve . . .

". . . We must continue to give an important place to basic research and to exploratory experiments . . . Basic research in both the public and private sectors is essential to our continuing progress tomorrow. All departments and agencies . . . should support basic research so as to provide a broader range of future options."

The President recognizes that the Federal government is in a position to exert substantial leverage on the entire R&D enterprise since it employs 45–50 percent of the R&D personnel and finances 55 percent or more of all R&D.

ACTIONS ANNOUNCED IN THE MESSAGE

Actions to stimulate support for R&D and innovation in the private sector:

- The development of plans for a more active patent filing and licensing program for government-owned inventions both at home and abroad.
- The support, through the National Science Foundation, of applied research in industry when its use would be advantageous to accomplish NSF objectives. (Under section 3(c) of the National Science Foundation Act of 1950, as amended.)
- Studies by the NSF of the effects of Federal tax, patent, procurement, regulatory and antitrust policies on technological innovation.

- Submission of legislation soon to increase the ratio of government support to Small Business Investment Companies; to increase the limit on Small Business Administration Loans to SBIC's; to permit Federally regulated commercial banks to achieve 100% ownership of an SBIC.
- New programs in the NSF and the National Bureau of Standards to determine effective ways to stimulate private investment in R&D and its application.
- A program of research and development prizes awarded by the President for achievements in key areas of public concern.
- Designation of the Department of Commerce as the Executive Branch focal point for policy development concerning industrial R&D.

Actions to strengthen collaboration between the Federal agencies and State and local governments:

- Designation of the President's Science Advisor and the White House Office of Intergovernmental Relations as the focal point for Federal agency discussions with representatives of State and local governments in order to examine ways:

  To communicate the priority needs of State and local governments to guide Federal R&D planning.

  To assure State and local government access to the technical resources of major Federal R&D centers concerned with domestic problems.

  To encourage aggregation of State and local markets to stimulate innovation and economies of scale.
- Experimental programs in the NSF and NBS to stimulate the use of R&D by State and local governments and to strengthen their ties to local industry and the universities.

Actions to strengthen cooperation between the United States and other nations in science and technology:

- Direction to Federal agencies to identify new opportunities for international cooperation in R&D;
- Invitation to other countries to join research efforts in the U.S. in cancer research at NIH and Fort Detrick, Maryland, and in research on the health effects of chemicals and pollutants at the National Center for Toxicological Research at Pine Bluff, Arkansas.
- Initiation of a broad review of U.S. involvement in international scientific and technological organization programs.

BACKGROUND ON FEDERAL R&D

In his State of the Union Message and in his budget, the President initiated the key elements of his strategy. Here are the highlights as taken from those documents:

Defense and space programs

The Department of Defense will increase its research and development funding by $767 million in FY 1973. This includes an increase of $123 million for research. The Navy R&D budget is up 14%, the Army 11% and the Air Force 9%.

Oceanography, biomedical research, atmospheric sciences, electronics and materials are important areas of research interest. Significant

development thrusts are stronger sea-based strategic deterrents and new capabilities and increased effectiveness for general purpose forces.

He also proposed a new National Aeronautics and Space Administration budget for space sciences research—an all-time high—up 25% to $554 million. The space agency's applications research program increased $17 million to $201 million. Funds are requested for a new generation Orbiting Solar Observatory, and National Aeronautics and Space Administration will launch missions to Mars in 1975 and to Jupiter and Saturn in the 1977–78 period.

Manned Apollo missions 16 and 17 are to take place as scheduled this year. In 1973, Skylab, a three-man reusable space station, will be visited by three separate teams of astronauts for periods of up to 56 days. The Space Shuttle program for the late '70's was approved by the President on January 5. The overall cost of developing the reusable, two-part launch vehicle/orbiter is estimated at $5.5 billion over the next six years. Alternative advanced propulsion technologies will also be examined, including a small nuclear engine, for possible unmanned outer planets missions and other applications in the 1980's.

Utilizing the capabilities of high technology agencies

The President in the State of the Union message announced the decision to draw more on the capabilities of the high technology agencies such as the National Aeronautics and Space Administration, the Atomic Energy Commission and the National Bureau of Standards to deal with domestic problems and meet long-range national goals, but without diverting them from their primary missions. For example, our outstanding capabilities in space technology should be used to help the Department of Transportation develop better mass transportation systems.

Targets for research and development

Of the total civilian R&D increase of more than $700 million, almost $400 million of the increase is focused in five technology opportunity areas identified by the President in the State of the Union Message. As the President stated, these are areas where an extra effort in R&D is "most likely to produce a breakthrough and where the breakthrough is most likely to make a difference in our lives," but they do not represent our total civilian R&D effort.

(1) *Abundant and clean energy sources.*—An additional $88 million is being obligated for work on clean, abundant energy sources, a total of $480 million and some $392 million more than last year. *This is an increase of more than 22 percent.*

A broad research and development program is crucial to balance environmental and energy needs. Further effort will be devoted to the development of pollution control technologies in order to provide additional options for meeting air quality standards at lower costs. Research and development programs identified in the Energy Message of June 1971 will be expanded, including the fast breeder reactor for nuclear power, coal gasification, magneto-hydrodynamics controlled thermonuclear fusion power, solar energy and mapping and basic assessment of the resources of the Outer Continental Shelf.

The 1973 budget also provides for research by the Atomic Energy Commission on advanced dry cooling towers and large scale energy storage batteries, cryogenic power generation and transmission in the AEC and National Bureau of Standards, greater use of laser technology in fusion power research under the AEC, and research by the Department of the Interior on the uses of low-BTU gas produced—with less pollution—from coal.

(2) *Safe, fast pollution-free transportation.*—Obligations for R&D in transportation are *being increased 46%*, from $456 million in FY '72 to $666 million in FY '73.

New and expanded research and development programs will explore systems which are not only safer and more efficient but which reduce adverse environmental impacts. Programs will be initiated or expanded to attack the problem of truck and aircraft noise, develop more attractive and economical mass transit vehicles, and provide for safer automobiles.

Work will be accelerated on personal rapid transit, which provides individualized, nonstop service for commuters; and new work will be undertaken on dual-mode systems for metropolitan areas which might combine the convenience of the automobile with the efficiency of a rapid transit system and on new tunneling technologies to reduce the cost of underground excavation for mass transit. Work on advanced air traffic control concepts, a short takeoff and landing (STOL) aircraft, and quiet aircraft engines will continue at higher levels to provide more efficient, safer air transportation with reduced environmental impact. In these more advanced fields of both ground and air transportation, the capabilities of NASA will assist in meeting R&D program objectives. Similarly, the technical talent of AEC will be utilized in advanced work on tunneling.

(3) *Reducing losses from natural disasters.*—Funding in this area is *being increased from $93 million in FY '72 to $136 million in FY '73, or 46%.*

Natural disasters take an unwarranted toll on human life and property. In 1969, 12,000 people died from fires alone and $2.4 billion in property was destroyed. While increased warning time has significantly reduced deaths from hurricanes, property damage has increased dramatically to some $2.4 billion during 1965 through 1969.

Research efforts will be accelerated to diminish losses of lives and property from these and other hazards and natural disasters. Particular attention will be focused on research in hurricane modification to reduce damage from surface winds; on the prediction—and ultimately control—of earthquakes and on engineering to design safer structures; and on fire research—including forest fires.

(4) *Effective emergency health care.—An 88% expansion in funding*, from $8 million to $15 million, is proposed for new demonstration projects.

One health need that has yet to be properly addressed is the provision of adequate emergency medical service. New technologies are available which can help in this field. The problem is to pull together these technologies into a system which effectively links communica-

tion, transportation of victims, ambulance equipment and services, trained manpower, and emergency room hospital service.

Full-scale demonstration of such integrated emergency treatment systems—as planned in the 1973 budget—can be undertaken with relatively small amounts of added Federal funds to act as a catalyst.

(5) *Curbing drug traffic and rehabilitating users.*—Funds amounting to $60 million have been requested for FY '73, *an increase of 20% over the 1972 amount of $50 million.* This year's budget provides for an overall fourfold increase in research budgets of a number of agencies over the two-year period since 1971.

The June 1971 message to the Congress on drug abuse prevention and control recognized the need for a major effort to curb a problem that is assuming the dimensions of a national emergency. This message called for the creation of a Special Action Office for drug abuse prevention. The search for new ways to curb drug trafficking and to rehabilitate drug users has been stepped up in both 1972 and 1973.

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[Reorganization Plan No. 1, 1973]

THE WHITE HOUSE

January 26, 1973

To the Congress of the United States:

On January 5 I announced a three-part program to streamline the executive branch of the Federal Government. By concentrating less responsibility in the President's immediate staff and more in the hands of the departments and agencies, this program should significantly improve the services of the Government. I believe these reforms have become so urgently necessary that I intend, with the cooperation of the Congress, to pursue them with all of the resources of my office during the coming year.

The first part of this program is a renewed drive to achieve passage of my legislative proposals to overhaul the Cabinet departments. Secondly, I have appointed three Cabinet Secretaries as Counsellors to the President with coordinating responsibilities in the broad areas of human resources, natural resources, and community development, and five Assistants to the President with special responsibilities in the areas of domestic affairs, economic affairs, foreign affairs, executive management, and operations of the White House.

The third part of this program is a sharp reduction in the overall size of the Executive Office of the President and a reorientation of that office back to its original mission as a staff for top-level policy formation and monitoring of policy execution in broad functional areas. The Executive Office of the President should no longer be encumbered with the task of managing or administering programs which can be run more effectively by the departments and agencies. I have therefore concluded that a number of specialized operational and program functions should be shifted out of the Executive Office into the line departments and agencies of the Government. Reorganization Plan No. 1 of 1973, transmitted herewith, would effect such changes with respect to emergency preparedness functions and scientific and technological affairs.

STREAMLINING THE FEDERAL SCIENCE ESTABLISHMENT

When the National Science Foundation was established by an act of the Congress in 1950, its statutory responsibilities included evaluation of the Government's scientific research programs and development of basic science policy. In the late 1950's, however, with the effectiveness of the U.S. science effort under serious scrutiny as a result of Sputnik,

the post of Science Adviser to the President was established. The White House became increasingly involved in the evaluation and coordination of research and development programs and in science policy matters, and that involvement was institutionalized in 1962 when a reorganization plan established the Office of Science and Technology within the Executive Office of the President, through transfer of authorities formerly vested in the National Science Foundation.

With advice and assistance from OST during the past decade, the scientific and technological capability of the Government has been markedly strengthened. This Administration is firmly committed to a sustained, broad-based national effort in science and technology, as I made plain last year in the first special message on the subject ever sent by a President to the Congress. The research and development capability of the various executive departments and agencies, civilian as well as defense, has been upgraded. The National Science Foundation has broadened from its earlier concentration on basic research support to take on a significant role in applied research as well. It has matured in its ability to play a coordinating and evaluative role within the Government and between the public and private sectors.

I have therefore concluded that it is timely and appropriate to transfer to the Director of the National Science Foundation all functions presently vested in the Office of Science and Technology, and to abolish that office. Reorganization Plan No. 1 would effect these changes.

The multi-disciplinary staff resources of the Foundation will provide analytic capabilities for performance of the transferred functions. In addition, the Director of the Foundation will be able to draw on expertise from all of the Federal agencies, as well as from outside the Government, for assistance in carrying out his new responsibilities.

It is also my intention, after the transfer of responsibilities is effected, to ask Dr. H. Guyford Stever, the current Director of the Foundation, to take on the additional post of Science Adviser. In this capacity, he would advise and assist the White House, Office of Management and Budget, Domestic Council, and other entities within the Executive Office of the President on matters where scientific and technological expertise is called for, and would act as the President's representative in selected cooperative programs in international scientific affairs, including chairing such joint bodies as the U.S.–U.S.S.R. Joint Commission on Scientific and Technical Cooperation.

In the case of national security, the Department of Defense has strong capabilities for assessing weapons needs and for undertaking new weapons development, and the President will continue to draw primarily on this source for advice regarding military technology. The President in special situations also may seek independent studies or assessments concerning military technology from within or outside the Federal establishment using the machinery of the National Security Council for this purpose, as well as the Science Adviser when appropriate.

[Remainder of plan not applicable.]

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TRANSFER OF OST FUNCTIONS TO DIRECTOR OF NSF

[News Release, National Science Foundation, January 26, 1973]

In keeping with the President's announced intention of reducing the overall size of his Executive Office and making greater use of Departments and Agencies, the President has proposed to Congress to abolish the Office of Science and Technology and transfer its functions to the Director of the National Science Foundation.

Setting forth the Reorganization Plan, the White House said, "With a growing range of capability in the NSF, the President will now look to its Director as a principal advisor in science and technology matters."

In his message to the Congress transmitting the Reorganization Plan, the President further said, "It is also my intention, after the transfer of responsibilities is effected, to ask Dr. H. Guyford Stever, the current Director of the Foundation, to take on the additional post of Science Advisor. In this capacity, he would advise and assist the White House, Office of Management and Budget, Domestic Council, and other entities within the Executive Office of the President on matters where scientific and technological expertise is called for, and would act as the President's representative in selected cooperative programs in international scientific affairs, including chairing such joint bodies as the U.S.–U.S.S.R. Joint Commission on Scientific and Technical Cooperation."

The Director of the Foundation would, with respect to civilian research and development:

—Appraise the overall effectiveness of ongoing Federal and National R&D efforts to advance national goals through science and technology.

—Make recommendations on policy and program actions necessary to achieve these national goals through science and technology. The Director of the Foundation would form an Office of Science Policy to consider such matters. The Director would report to the President through George P. Shultz, Assistant to the President. The NSF would continue OST emphasis on the science and technology base for national domestic R&D in such fields as energy, natural resources, health, social systems, transportation, communications, education, and participation in international programs in which science and technology are vital elements.

—The Director of the National Science Foundation, Dr. H. Guyford Stever, would serve as a focal point for the President in interaction with the academic and industrial science communities on broad matters of science policy, as well as in selected coopera-

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tive programs with the international science community. He would serve as Chairman of the U.S.–U.S.S.R. Joint Commission on Scientific and Technical Cooperation.

—A Science Policy Council within the Federal Government would be formed to consider policy problems in science and technology, which affect more than one Federal agency or which concern the overall advancement of the Nation's science and technology.

The Chairman of the Science Policy Council would be the Director of the National Science Foundation. Membership of the Council would be composed of policy level individuals from Federal departments and agencies.

The dedicated efforts of the many outstanding scientists and engineers, who, as members and consultants of the President's Science Advisory Committee and the Office of Science and Technology, over the years, have worked to help shape the directions of science and direct the efforts of science and engineering to the solution of national problems are widely recognized and appreciated. It is expected that many of these outstanding individuals will continue to be called upon to render their valuable advice and services.

[News Release, National Science Foundation, July 2, 1973]

NSF DIRECTOR ESTABLISHES SCIENCE AND TECHNOLOGY POLICY OFFICE: DR. RUSSELL C. DREW APPOINTED DIRECTOR

Dr. H. Guyford Stever, Director of the National Science Foundation, today announced the establishment of the Science and Technology Policy Office (STPO) and the appointment of Dr. Russell C. Drew as head of the new office.

The STPO will provide central staff support to Dr. Stever in carrying out responsibilities under Reorganization Plan No. 1 of 1973, which transferred the functions of the Office of Science and Technology (OST) to the Director of the NSF.

Dr. Stever said, "I am especially happy to announce the establishment of the Science and Technology Policy Office and the appointment of Dr. Drew, since this means that we can now move forward rapidly to help advance national goals in science and technology through those new functions assigned by the President. Dr. Drew's expertise and experience will be most helpful in this regard."

Dr. Drew, a physicist, served in OST from 1966–1972 as Technical Assistant to the President's Science Adviser, organized and guided a series of OST and President's Science Advisory Committee panels dealing with a variety of subjects including air traffic control, space science and technology, biomedical R&D as it relates to aerospace activities, and telecommunications. He also worked closely with the State Department and National Security Council staff in developing policies for international cooperation in space.

In his new position, Dr. Drew will head a professional staff to assist Dr. Stever in the following:

Providing advice, consultation, and recommendations on national civilian science and technology policy.

Developing technical options related to the solution of national problems in the civilian area.

Appraising the overall effectiveness of ongoing Federal and national R&D efforts and recommending policy and program action toward the achievement of national goals through civilian science and technology.

Serving as the focal point for coordinating Federal R&D programs (STPO will provide staff support for the Federal Council for Science and Technology and assist the Director in the formulation and coordination of FCST activities).

Interacting with academic and industrial science communities on broad matters of science policy so as to further their participation, in every appropriate way, in strengthening science and technology in the United States.

Providing advice and assistance in furthering U.S. international science and technology objectives.

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[Letter to Dr. Stever as Reorganization Plan No. 1 Became Effective]

The Western White House,
San Clemente, July 1, 1973.

Hon. H. Guyford Stever,
Director, National Science Foundation,
Washington, D.C.

Dear Mr. Stever: Today marks a significant milestone in the way that the Federal Government is organized to evaluate and coordinate science and technology programs. In accordance with the provisions of Reorganization Plan No. 1 of 1973, activities formerly vested in the Office of Science and Technology are transferred to you as Director of the National Science Foundation. I am especially pleased that you have already taken preparatory steps to carry out these new responsibilities and that you have established a new Science and Technology Policy Office to assist you with your increased duties.

As I indicated in January, I also want to take this occasion to designate you as my Science Advisor. In this post, I would like you to advise and assist the White House, the Office of Management and Budget, the Domestic Council and other entities within the Executive Office of the President on matters where scientific and technological expertise is needed, and to act as my representative in various international scientific undertakings. I believe this designation should significantly strengthen the science policy machinery of the Administration.

I also designate you as Chairman of the Federal Council for Science and Technology, a role which you have already undertaken in an acting capacity.

This Administration is committed to continuing a strong national effort in science and technology, and I know you will carry out these responsibilities in a manner consistent with this objective. I look forward to working with you in meeting this goal.

With every best wish,

Sincerely,

Richard Nixon.

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OFFICE OF SCIENCE AND TECHNOLOGY

Officers and Staff at Time of Reorganization, January 1973

Director, Edward E. David Jr., who is also science adviser to the President, chairman of PSAC, and chairman of the Federal Council on Science and Technology.

Associate Director and Assistant Director for National Security Affairs, John D. Baldeschwieler.

Assistant Director for Natural Resources (life sciences, health programs, etc.), Leonard Laster.

Assistant Director for Civilian Technology, Lawrence Goldmuntz.

STAFF MEMBERS

David Z. Beckler, Executive Assistant to the Director.
F. Gilman Blake, atmospheric, marine, and earth sciences.
Edward J. Burger, Jr., ecology.
William S. Butcher, water resources research.
Billy Caldwell, population and food.
Daniel V. DeSimone, industrial research and development.
Russell C. Drew, space.
Stephen J. Gage, (White House Fellow) energy.
Paul M. Gertman, human resources and medical affairs.
Jack I. Hope, civilian technology, transportation and urban development.
John H. Lannan, press relations.
David Luenberger, civilian technology, urban affairs.
John J. Martin, national security, intelligence.
John Mays, education.
William T. McCormick, human resources.
Vincent McRae, national security, nuclear affairs.
Gordon Moe, national security, nuclear affairs.
Norman P. Neureiter, international cooperation.
A. Michael Noll, computers.
Frank R. Pagnotta, administrative officer.
John Walsh, national security.
J. Frederick Weinhold, energy.
Carl M. York, academic and basic science.

[STATUS OF SCIENCE AND TECHNOLOGY POLICY OFFICE]

NATIONAL SCIENCE FOUNDATION,
Washington, D.C., May 9, 1974.

Memorandum for the Science and Astronautics Committee.

In response to the requests made by the committee staff, May 2, 1974, the following information is supplied:

1. The attachment, "STPO, Major Areas of Interest," lists the current staff of the Science & Technology Policy Office and areas of responsibility.

2. The STPO, established in July, 1973, has been engaged in staff selection and problem identification during the early months of Fiscal Year 1974.

With the receipt of supplemental FY 74 program funds, the outside grant and contract support efforts have begun.

Some of the major areas of interest being addressed by STPO are: world food study, materials, social R&D, industrial R&D, technology transfer, international S&T issues, health and environment, high energy physics facilities, and selected space program issues.

Brief highlights of the activities in which STPO has provided advice and support to the Science Adviser and science policy input to the overall policymaking process within the Federal establishment follow:

- STPO represents the Science Adviser on White House Domestic Council studies, providing a source of technical inputs on a range of domestic questions such as materials policy and environmental quality issues.
- On behalf of the Science Adviser, STPO has been involved in the annual budget review process, assisting and advising the Office of Management and Budget on selected agency R&D budget issues.
- STPO provides staff support for the Federal Council for Science and Technology. This Council was established by Executive Order in 1959 and includes as members the senior policy-level science and technology officials of the Federal Government.

Further detail of progress to date and plans for FY 1975 is contained in the attached statement of mine, before the Subcommittee on Science Research and Development, March 14, 1974.

3. Regional Science Policy Meetings:

Planning is in progress for the first of a series of regional science policy meetings. The first meeting had been planned for May, 1974, but due to scheduled conflicts of the proposed participants has had to be postponed to mid-June. Topics to be addressed will include major emerging science policy issues such as the world food situation, materials, and social R&D for policy. Also to be discussed will be budget

support of basic science. The non-Government participants will be called upon to respond and provide their assessment of problems and issues as perceived by this segment of the S&T community.

RUSSELL C. DREW,
Director, Science & Technology Policy Office.

MAY, 1974.

Attachment.

SCIENCE AND TECHNOLOGY POLICY OFFICE MAJOR AREAS OF INTEREST

Deputy Director-Health Science, Vacant.

Health of Science-Academic Research, Dr. Goetz Oertel.

International S&T—DOD, NSC Liaison, Dr. Hylan B. Lyon, Jr. (Detail).

Materials Science, Dr. S. Victor Radcliffe.

Intergovernmental S&T-Technology Transfer, Mr. Thomas C. Wellington.

Earth, Atmospheric and Ocean Sciences, Dr. F. Gilman Blake.

Social Sciences, Transportation, and Housing, Dr. Ernest F. Powers and Mr. Joel A. Rosenblatt.

FCST Executive Secretary Productivity, Conflict-of-Interest, Vacant.

Modeling and Forecasting, Patents, and Standards, Mr. A. Wade Blackman.

World Food-Agricultural, Productivity, Dr. A. Carl Leopold, (June 1).

Administration, Mr. Douglas N. Howe.

Industrial R&D, Stimulating Innovation, Mr. James E. Carpenter.

Health Care—Biomedical R&D, Dr. Edward Burger, MD.

Life Sciences—Environmental R&D, Vacant.

Communications—Planning and Policy Development, William F. Herwig.

Quality of Life, Four Vacancies.

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Statement of Russell C. Drew, Director of the Science and Technology Policy Office

Mr. Chairman and Members of the Committee, on my first appearance before this Committee in July of last year, the Science and Technology Policy Office was only a few weeks old and, at that time, the emphasis was primarily on plans for the future. I am pleased to have this opportunity to appear again today in the context of the National Science Foundation FY 1975 authorization hearings to report on the progress that has been made since that time and to outline some of the future directions for my office.

You will recall that Dr. Stever established the STPO to assist him in carrying out his new responsibilities as Science Adviser and Chairman of the Federal Council for Science and Technology. Dr. Stever also established an Office of Energy R&D Policy as a special staff to assist him in dealing with the many urgent national issues related to our current national energy situation. Supplemental appropriations have been requested and subsequently granted by the Congress to enable these offices to complete staff plans and to begin a program of supporting activity. These funds have very recently been made available so that the pace of activity will be accelerating in the remaining months of this fiscal year.

Before going on to describe some of the specific activities of the Office, I should emphasize the special character of the responsibilities and tasks assigned to the Science and Technology Policy Office as compared with program offices within the National Science Foundation. For example, STPO for the most part deals with issues which are interagency in nature or for which specific agency responsibility is not clearly defined. In addition, the office provides a source of advice and counsel on scientific and technical matters to various elements of the Executive Branch where we supply a unique broad perspective with no vested interest in an operational role in the issue at hand. A particularly important responsibility of the Office is our charge to look ahead and determine potential future problems which may have implications for new directions or priorities for federally sponsored R&D. In this latter area, there are several good examples that can be taken from our FY 1975 program plan.

An emerging issue which will be receiving continued high priority attention is that of materials. In his recent State of the Union Message, the President stated:

> "It is also imperative that we review our current and prospective supplies of other basic commodities. I have, therefore, directed that a comprehensive report and policy analysis be made concerning this crucial matter so that governmental actions can properly anticipate and help avoid the damaging shortages."

The U.S. today is wholly or in great part dependent upon foreign sources of supply for many of the basic raw materials necessary for

our industrialized nation. Among the major elements of this subject to be addressed are conservation, substitution, recycling and exploration of new sources of supply.

The world food situation is another issue which provides the potential for serious national concern. As a nation, we enjoy the most productive agricultural enterprise in history, but demands upon our ability to produce for a worldwide market have escalated sharply and may continue to increase—stressing our ability to meet these demands. STPO will be concerned with identifying priorities for research and application of technology to a wide range of problems, such as increased productivity, expanding the use of alternative sources of protein, and the impact of shortages such as energy on the production of food and fertilizers necessary to meet anticipated future needs.

As you are aware, this Nation has increasingly moved toward a service-oriented economy. Over 60 percent of our labor force is employed by service industries and yet, public dissatisfaction with many services is a well known phenomenon of our times. It is clear that there are a wide range of services for which improved productivity and improved quality are needed, and these improvements will depend in part on contributions of science and technology. We shall be examining a number of key service areas such as transportation, health care, and State and local government to determine ways in which the Federal and private sector R&D investment can be more productive in meeting the needs of the service sector.

In each of the above areas, the National Science Foundation has program activities that will contribute to our analysis. This illustrates the complementary nature of the STPO work with respect to existing NSF grant and contract programs and staff expertise. In areas where there are unique policy requirements, the STPO staff will require additional outside grant and contract support.

Mr. Chairman, with this brief explanation of some ways in which the STPO role differs from other parts of NSF, I would like to return to some of the activities that have occupied the office during its formative months. In beginning the task I outlined last July—that of bringing science and technology matters into the decisionmaking process throughout all levels of society—special attention was given to two major points: (1) the problem of problem identification; and (2) staff selection. It is particularly important to insure that these two aspects are well matched so that STPO can be responsive to perceived needs on a timely basis and with high quality inputs. I wish to emphasize the importance of careful selection of the in-house staff in view of the leadership role they can be expected to play on a wide range of issues, requiring an unusual breadth of understanding, expertise, and analytical capability.

In the course of its brief existence, STPO has become increasingly active in its role in the national policymaking process and in its interface with the science and technology community. I should emphasize that I view both of these aspects—working within the Federal structure and expanding our avenues of communication with the producers and users of science and technology outside of the Government—as important tasks for STPO. Specifically, with regard to our expanded communications role outside Government, we have taken some defini-

tive steps and have a number of actions in the final planning stages that I will touch upon later in my testimony. I remain strongly committed to the importance of a continuing dialogue among Federal and non-Federal interests.

At this time, I would like to cite briefly just a few of the activities in which STPO has provided advice and support to the Science Adviser and has provided science policy input to the overall policy-making process within the Federal establishment:

STPO represents the Science Adviser on White House Domestic Council studies, providing a source of technical inputs on a range of domestic questions such as materials policy and environmental quality issues.

On behalf of the Science Adviser, STPO has been involved in the annual budget review process, assisting and advising the Office of Management and Budget on selected agency R&D budget issues.

STPO provides staff support for the Federal Council for Science and Technology. This Council was established by Executive Order in 1959 and includes as members the senior policy-level science and technology officials of the Federal Government. Its responsibilities include interagency relationships in science and technology, improved planning and administration of Federal S&T programs, identification of research needs, better utilization of Federal facilities and resources, and furtherance of international cooperation in science and technology. From this broad charter, it is obvious that the FCST has an important role to play and it is our intention that it become a more effective mechanism for achieving these objectives. To aid in strengthening the FCST, STPO staff members have been designated to monitor and assist activities of the FCST and its many existing subcommittees. In addition, we have taken the lead in developing plans to establish new FCST committees to deal with emerging issues such as intergovernmental technology transfer and materials sciences.

As part of our program of enhanced communications, the office has participated in organizing the first two of a continuing series of meetings with leaders of the scientific and technical community to enable direct dialogue with the Science Adviser on issues of national science policy. One meeting involved professional societies and the other, major representatives of R&D in industry.

It will be the policy of this office to bring our major study activity into the public domain expeditiously so that the information produced will be available to all interested parties. In this regard, we have recently published several reports which were begun under the previous science advisory structure. These include the PSAC panel report on "Chemicals and Health" and the "FCST Annual Report of Water Resources Research."

Mr. Chairman, I would now like to call attention to some of the key areas of activity for the remainder of FY 1974 and continuing into FY 1975 in which outside support programs are beginning or are about to begin.

The nature of many of the problems we face in the domestic arena such as housing, transportation, health care, poverty, urbanization and others, requires that we bring together the contributions of science and technology with the perception of social values and structures

that can be provided by the social sciences. The Federal Government sponsors over $800 million in social R&D in more than 8 agencies. We will be looking into ways in which these funds are being spent and how programs might be more productively related to mission agency goals and national needs. We will be giving special attention to the role of such social experiments as those on income maintenance and housing allowances and to evaluation as an aid to design of better programs.

Studies to provide improved inputs to what constitutes the U.S. "technology base." These will provide long-term policy needs of the U.S. in the international arena.

Modeling and forecasting programs. Studies to identify and rank-order problems which will be of future importance to the Nation.

Programs to provide analytical tools necessary to perform evaluations of the impact of various policy options.

The application of analytical models to evaluate the policy options relating to near-term and future problems of national importance.

Study of priorities in relevant materials research.

Renewable resources study.

Seminar series on issues of science and technology policy.

These are some of the outside grant and contract programs which are to be funded by the FY 1974 Supplemental Appropriations. For FY 1975 I plan to continue this base and to build upon and broaden it to encompass new issues which I believe are important to our national interests. I have outlined some of these earlier in my statement and others are identified in the FY 1975 program budget request which has been presented to the Congress.

As you can see from just these few major issues, common threads of interdependence—as in the case of energy—can be traced through these major problems facing the Nation. The policy analyses provided by STPO have their basis in the science and technology aspects of a problem where solution will ultimately involve a reconciliation among a number of national objectives such as economic well being, environmental quality, favorable balance of international trade, improved quality of life, and the maintenance of competitive advantage in the world marketplace. Our input will be one of many on these questions. I am pleased to report that we have encountered no lack of receptiveness to this input within the Executive Branch. On the basis of developments thus far, I am optimistic that as both the Office and its program of activity matures in the coming months, we will be in a position to contribute to the enhanced application of science and technology to our Nation's needs.

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[EXCERPTS]

93D CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
1st Session } { No. 93-106

REORGANIZATION PLAN NO. 1 OF 1973 (OFFICE OF EMERGENCY PREPAREDNESS, OFFICE OF SCIENCE AND TECHNOLOGY, AND NATIONAL AERONAUTICS AND SPACE COUNCIL)

APRIL 4, 1973.—Committed to the Committee of the Whole House on the State of the Union, and ordered to be printed

Mr. HOLIFIELD, from the Committee on Government Operations, submitted the following

SECOND REPORT

together with

ADDITIONAL VIEWS

BASED ON A STUDY BY THE LEGISLATION AND MILITARY OPERATIONS SUBCOMMITTEE

On March 29, 1973, the Committee on Government Operations approved and adopted a report entitled "Reorganization Plan No. 1 of 1973 (Office of Emergency Preparedness, Office of Science and Technology, and National Aeronautics and Space Council)." The chairman was directed to transmit a copy to the Speaker of the House.

I. INTRODUCTION

This report deals with Reorganization Plan No. 1 of 1973, which would abolish certain components of the Executive Office of the President and transfer designated functions to two departments and two agencies. The plan was transmitted to the Congress by President Nixon with an accompanying message on January 26, 1973 (H. Doc. No. 93–43). These documents were referred to the Committee on Government Operations and assigned to the Subcommittee on Legislation and Military Operations for review and analysis.

The plan will take effect on July 1, 1973, unless rejected by a majority of either House acting upon a disapproving resolution within 60 days from the transmittal date, in accord with the provisions of the Reorganization Act of 1949, as amended. The 60-day period (not counting a congressional adjournment of 10 days) will terminate on April 5, 1973.[1]

As of this date (March 29, 1973), no disapproving resolution has been introduced in either the House or the Senate. Consequently, no formal committee action presently is required by way of reporting on any resolution and thereby bringing the reorganization plan to the floor. This report is presented for the information of the Congress. It outlines the scope and intended effects of the plan and makes pertinent observations.

V. OFFICE OF SCIENCE AND TECHNOLOGY

The Office of Science and Technology was established by Reorganization Plan No. 2 of 1962, which became effective June 8, 1962.[10] The purpose of the plan was to transfer to the new office those functions of the National Science Foundation relating to the development of national policies for basic education in the sciences and to the evaluation of scientific research programs undertaken by the Federal Government. A comprehensive study of this earlier reorganization and related developments is contained in a 1967 report prepared for the committee by the Science Policy Research Division of the Legislative Reference Service (now Congressional Research Service) in the Library of Congress.[11]

The OST marked a high point in the development of a scientific advisory apparatus for the President. This process had been started in the late 1950's by President Eisenhower, when orbiting space vehicles and long-range missiles were urgent national issues. Since 1957 each President has had a science adviser and a President's Science Advisory Committee (PSAC). The creation of OST in 1962 gave a statutory underpinning to this arrangement, in part to make it possible for the Congress to have more access to scientific information at the Executive Office level.[12] The Director served simultaneously as head of

[1] The Reorganization Act of 1949, as amended, provides (5 U.S.C. sec. 906) that adjournments of more than 3 days to a day certain are excluded in the computation of the 60-day period; also, that provisions of a plan may take effect at a time later than the 60-day period, if so specified in the plan.

[10] 76 Stat. 1253.

[11] "The Office of Science and Technology," a report prepared by the Science Policy Research Division, Legislative Reference Service, Library of Congress, for the Military Operations Subcommittee of the House Committee on Government Operations, 90th Cong., 1st sess., March 1967 (committee print).

[12] See H. Rept. No. 87–1635, Apr. 19, 1962, p. 9.

OST, Science Adviser to the President, Chairman of PSAC, and Chairman of the Federal Council for Science and Technology (FCST), which was established in 1959.[13]

Reorganization Plan No. 1 of 1973 abolishes the OST, including the Offices of Director and Deputy Director. PSAC was abolished, in effect, when President Nixon accepted the resignations of all its members and made no new appointments. Abolished in a similar manner was the Office of Science Adviser to the President, last held by Dr. Edward E. David, Jr (also Director of OST), who resigned on January 3, 1973.

The functions of OST are to be reacquired, not by the NSF as such, but by its Director, a position now held by Dr. H. Guyford Stever. He will have a two-hat role as NSF Director and Science Adviser. However, the language of the plan and the supporting testimony indicate that the Science Adviser will not be exclusively the Science Adviser to the President. He will give science advice to the OMB, the Domestic Council, and other Executive Office components as required. His channel of reporting to the President will be through Dr. George P. Shultz,[14] who has been designated Assistant to the President for Economic Affairs in addition to his other duties as Secretary of the Treasury, Chairman of the Council on Economic Policy, and Chairman of the Cost of Living Council.

The testimony and announcements by Dr. Stever indicate that he will have a reconstituted science advisory apparatus below the level of the Executive Office of the President. An Office of Science Policy is to be established within NSF to help the Director make recommendations to advance national goals through science and technology. That office and other advisory staff presumably will do for the NSF Director (also Science Adviser) what PSAC and OST used to do for the President.[15] The new policy group will coexist, within NSF, with the National Science Board, a 25-member policymaking and advisory group established by the National Science Foundation Act.[16] The Board stands apart from the reorganization, since the transferred OST functions are vested exclusively in the NSF Director, who is the agency's general manager. Dr. Stever told the subcommittee that the National Science Board generally favored the reorganization plan.[17]

The Federal Council for Science and Technology, a longstanding interdepartmental unit for consultation and cooperative studies in science and technology, may be replaced by a Science Policy Council. Dr. Stever suggested to the subcommittee that he wanted to reevaluate the role of FCST in the interest of getting a more dynamic and effective group.[18] This again is not part of the formal reorganization plan, since FCST was created by Executive order.

The administration rationale for the OST part of the reorganization, stated in the President's message and developed in testimony by Mr. Malek and Dr. Stever, is that a central office in the White House orbit is no longer needed to energize and coordinate Government

[13] Executive Order 10807, Mar. 13, 1959, 3 CFR, 1959–1963 Comp., p. 329; amended by Executive Order 11381, Nov. 8, 1967, 3 CFR, 1966–1970 Comp., p. 690.

[14] Hearings, pp. 4, 9, 10, 20–21, 27, 69 et passim.

[15] Hearings, pp. 72, 116.

[16] 42 U.S.C. sec. 1681 et seq.

[17] Hearings, p. 74.

[18] Hearings, p. 71.

activities in science and technology. The argument is made that in the decade since OST was established, the departments and agencies have built up their own resources and capabilities for planning and executing research and development programs addressed to the Nation's high priority needs. The presumption is that whatever catalytic and coordinating actions still are required can be performed through the NSF at a lower level in the Government hierarchy.[19]

The committee recognizes that the environment for science and technology has changed in many ways during a decade, and that each President views the organization of his Executive Office and utilizes advisory resources in his own way. There are differences of opinion in the scientific community and elsewhere as to whether OST has performed well or lived up to expectations given by its mandate in 1962. The following observations do not pass upon OST's performance; rather they point up some institutional problems in Government science organization which this reorganization plan raises anew:

(1) The rationale, in part, for a scientific advisory apparatus in the Presidential orbit originally was to enable the President to have independent, objective, and sophisticated advice as against the special pleading, empire-building, and parochial interests of the departments and agencies. This need is greater, not less, today as scientific and technological programs become more complex and costly and involve multiple agencies and interests.

(2) Dissolution of OST, PSAC, and the Office of Science Adviser to the President, and transfer of OST functions to the NSF Director will be regarded inevitably, in scientific circles, as a downgrading of science in Government policymaking and execution because association with the President and his Executive Office has an aura of prestige and importance which cannot be duplicated elsewhere in the Government. Dr. Stever, in testimony before the subcommittee, said that whether there is downgrading or not depends upon what the NSF Director does with his new assignment.[20] This is true to an extent, but the NSF cannot match the prestige of the former arrangement.

(3) An independent agency, such as NSF, always will have difficulties in drawing together the policies and programs of other agencies at the same (or higher) levels in Government. Specialized technical agencies such as NASA and AEC, and departments such as DOD and Commerce, with large research and development components, have far more resources and operating responsibilities than NSF. In such cases, there are many who believe that coordination and policy direction are better achieved when the coordinating agency stands above rather than equal to or below the others. In our scheme of government, they see no alternative to the Executive Office of the President for elevating an agency and giving it a commanding presence.

(4) The problems of cross-agency coordination and policy direction are the more aggravated by the civil-military dichotomy in the Government sponsorship of research and development. In earlier years the Science Adviser to the President, PSAC, and

[19] Hearings, pp. 4, 9, 64 et passim. Dr. Stever stated in his testimony that "the Director of the NSF now has the capability to satisfy the continued need for an overview and for coordination of our Federal and national efforts in science technology" (at p. 64).
[20] Hearings, p. 67.

OST were deeply involved in evaluation of defense programs and assisting the President to make informed decisions in this field. Dr. Stever testified that, after the reorganization plan takes effect, technical advice on national security matters, formerly given by OST, will be given not by NSF but by DOD and the National Security Council.[21] In a sense, NSF will become the center of science policy for the civilian agencies rather than for the Government as a whole. Considering the military-civilian interaction in so many scientific and technical programs, such as in oceanography, weather prediction and modification, arms limitation, nuclear test bans, satellite communications, and other important programs, a central source of coordination and policy direction, close to the President, would seem to be imperative.

Those who are concerned that the plan may signify the downgrading of science in Government must recognize, on the other hand, that the plan also can work to upgrade the status and role of NSF. In its original concept, NSF was to be the Government's primary agency for science. It became essentially a grant-dispensing agency in support of university science. Its policy functions in promoting, assessing, and coordinating Government science, which had lain dormant,[22] were transferred to OST by the 1962 reorganization plan. Now the 1973 reorganization plan recaptures these functions for NSF, acting through the Director, and provides additional opportunities for that agency to play a broader and more effective role in Government science.

The Congress itself has sought to expand the agency's horizon, emphasizing applied science and practical uses of technology in solving domestic problems. The 1968 amendments to the National Science Foundation Act, as Dr. Stever pointed out in testimony, authorized the agency to support applied research, reemphasized its role in national science policies, gave more attention to the social sciences, and authorized additional executive personnel to strengthen the agency's management structure.[23] The 1968 amendments also initiated the requirement for yearly authorizations to precede appropriations for NSF, thereby broadening the congressional area of interest and involvement in the agency's activities.[24]

The NSF potential as a key Government center for applied science and technology again is reflected in a bill which passed the Senate in August 1972.[25] This bill (S. 32, 92d Cong.), reported by Senator Kennedy from the Committee on Labor and Public Welfare,[26] proposed, among other things, to establish within NSF a Civil Science Systems Administration, emphasizing research and planning in a wide range of public service concerns. The bill was not taken up by the House of Representatives in the 92d Congress. In the meantime, an NSF program, Research Applied to National Needs (RANN), established in fiscal year 1971, has evoked considerable congressional interest and support.

[21] Hearings, p. 64.
[22] See report cited in footnote 11, p. 4.
[23] 42 U.S.C. 1862(c).
[24] 42 U.S.C. 1875. See also a 1969 amendment which placed a general expiration date on all outstanding unfunded authorization (close of second fiscal year after that for which the authorization was enacted), 42 U.S.C. 1873(i).
[25] Cong. Rec., Aug. 17, 1972 (daily ed.), pp. S13868–S13922.
[26] S. Rept. No. 92–1028, Aug. 9, 1972.

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SCIENCE ADVICE FOR THE WHITE HOUSE

[From *Technology Review*, January 1974]

On Oct. 4, 1973, M.I.T. brought together the six American scientists who have been members of the White House staff as advisers to the President of the U.S. What follows are selections from their discussion of U.S. science policy and the past, present, and future roles of the President in its formulation.

The participants (with the dates of their service as Science Advisers to the President in parentheses) were:

—James R. Killian, Jr., *Honorary Chairman of the M.I.T. Corporation (1957–59)*

—George B. Kistiakowsky, *Professor Emeritus of Chemistry, Harvard University (1959–61)*

—Jerome B. Wiesner, *President of M.I.T. (1961–64)*

—Donald F. Hornig, *President of Brown University (1964–69)*

—Lee A. DuBridge, *President Emeritus of California Institute of Technology (1969–70)*

—Edward E. David, Jr., *Executive Vice President and Director of Gould, Inc. (1970–73)*

There ensued a general discussion among the six principals which gradually was extended to members of the audience; contributions from two of the latter are also included in what follows:

—Pierre R. Agrain, *former General Delegate for Research and Technology in the French government, who is this year Henry R. Luce Professor in Environment and Public Policy at M.I.T.*

—H. Guyford Stever, *Director of the National Science Foundation*

Though this is not a verbatim transcription, the effort in editing has been to preserve as much as space permits of both the language and spirit of the evening.

Dr. Killian: The six of us who have borne the title "Special Assistant to the President for Science and Technology" may be an extinct species, on our way to Madame Tussaud's Wax Museum as those curious specimens to whom Presidents of the United States turned when they recognized that, for their eras, no White House staff dare be scientifically illiterate. But one may also take the view that the *recent dismantling of the White House science advisory arrangements is but part of an evolutionary process* out of which may come an opportunity to construct new and better ways for the federal govern-

ment to manage its own scientific enterprises and to formulate policies that will insure that American science continues to prosper. If this is to be so, I suggest that some of the past is important to give us a base line from which to move toward the future. It is for this reason that I turn tonight to recall the early days of the President's Science Advisory Committee and my experiences as the first to bear the formal title and serve full time as Science Adviser to President Eisenhower.

Let me begin by recalling that *Presidents other than Eisenhower, Kennedy, Johnson, and Nixon had science advisers.* There was Thomas Jefferson, who had by far the best science adviser any American President ever had—himself. Together with other Founding Fathers—notably Washington, Franklin, Madison, and John Quincy Adams—he infused into the American system the concept that there should be a true marriage between science and politics. While they were thwarted in their hopes to establish a national university to promote "useful knowledge and discoveries for the new republic, they still succeeded in introducing into the American system an intellectual outlook that, in Hunter Dupree's words, "made science a formative factor in making both the federal government and the American mind what they are today."

The other great period when science and engineering served our society and the whole Free World with decisive brilliance was, of course, World War II. The superb accomplishments of American science through the Office of Scientific Research and Development was facilitated by the fact that Vannevar Bush, in influence if not in title, was science adviser to President Roosevelt. This wonderfully effective relationship, aided and abetted by Harry Hopkins, was a major factor not only in the winning of the war but in devising new ways for our government to insure the prosperity of American science after the war.

We six here tonight must recognize that our collective role must be measured against those past arrangements when great Presidents had great advisers.

I was launched into what was for me the outer space of the White House in October, 1957, when the Soviets orbited Sputnik I. This technological feat, received with stunned surprise and shock by Americans, produced apprehension throughout the Free World. Many jumped to the conclusion that the Soviets had surpassed the United States in its science and technology and that they had achieved a guided missile capability that posed a fearful threat to our security. The near-hysteria of those days revealed how psychologically vulnerable were the American people to this event. Edward Teller, in a television program, remarked that the United States had "lost a battle more important and greater than Pearl Harbor," by falling behind the U.S.S.R. in scientific achievement. On another occasion, when queried about what might be found on the moon, he replied, "Russians." The *New York Times*, gripped by the emergency, editorialized about national survival. And the *New Yorker* ran a cartoon which noted, in effect, that the Soviets had the ballistic missile and we had the Edsel.

Among the actions taken by President Eisenhower as he sought to allay fears and reassure the American people was to summon scientists to advise him personally on our space and defense programs, on ways

to insure the general health of American science and technology and to improve the quality of our education in science. He called on the President of the National Academy of Sciences for advice, and he asked the Science Advisory Committee of the Office of Defense Mobilization to meet with him; it was this Committee which he was later to reconstitute as a committee directly advisory to himself.

When the O.D.M. Committee, then chaired by Dr. Isidore Rabi, met with the President on October 15, he afforded the group a full opportunity to air their views and to make proposals, which they did with frankness and vigor. The President wanted to know whether American science was being outdistanced by Russia (1). Dr. Rabi responded that the United States had great strength; but he warned that the Russians had gained impressive momentum and were effectively mobilized steadily to build their scientific and technological strength. They could possibly pass us, Rabi emphasized, if we were so inept as to permit it to happen. Edwin Land then made one of his eloquent speeches in which he said that American science needed the help of the President. Better than anyone else, Dr. Land said, the President could kindle among young people an essential enthusiasm for science and lead people to understand it as a joyous, creative, rewarding adventure. The President clearly was impressed by Land's plea that he could, through active intellectual leadership, seek to create a more widespread understanding of science. It is interesting to note that he thereafter undertook a series of speeches on science and defense that were partly inspired, I think, by this discussion.

Dr. Rabi then made a specific proposal. There was no one around the President, he pointed out, who could help him be aware of any scientific component that might exist in the important policy matters coming before him. Science was not represented on his staff. He should have a full-time science adviser—a person he could live with easily. I then carried Rabi's proposal one step further and urged that there be a strong Science Advisory Committee reporting directly to the President who could back up his adviser.

This is the story as I know it of the discussions which, a few days later, led the President to appoint the first Special Assistant to the President for Science and Technology, and to the designation of the President's Science Advisory Committee (P.S.A.C.)

Actually, the Eisenhower Science Advisory Committee was not the first to bear the presidential title. President Truman had appointed such a committee in April, 1951, and the late Oliver Buckley became its Chairman and, in effect, science adviser to Truman. Continuing into the Eisenhower administration, when Lee DuBridge was its Chairman, this group was presented with a really major opportunity worth its mettle. Meeting with them the President, in effect, challenged the Committee to help him get a hold on the military problem of surprise attack. These meetings with the President were really extraordinary events. I doubt if there has been under any other President an opportunity comparable with this for a group of outsiders to come and without—or—have a free-for-all discussion of a problem without feeling in any way held back or embarrassed. This group did it, and P.S.A.C. was able to do this repeatedly, with Eisenhower, who seemed to enjoy it.

The result was the appointment of a task force known as the Technological Capabilities Panel, consisting of about 40 scientists and engineers; this group presented its conclusions on the status of our military and intelligence technology at an expanded session of the National Security Council in February, 1955, which Robert Cutler was to describe in his memoirs as the high point in the deliberations of the Eisenhower National Security Council.

This study did much to re-establish confidence between the scientific community and the administration, a confidence which had been badly damaged by the Oppenheimer case and the tensions of the McCarthy period. It brought to the attention of the President a group of scientists and engineers who had fresh contributions to make to national policy and who began to command his confidence.

There was still another scientific group, the brilliant and decisively influential von Neumann Missile Committee, of which both Dr. Wiesner and Dr. Kistiakowsky were members, that helped in establishing a relationship of confidence between scientists and top policy makers. I am certain that these two panels were important factors in the President's decision to have what he came to call "his scientists,"—which was the Eisenhower P.S.A.C.

There is no need to review in detail the first years of P.S.A.C. Clearly it was not possible for 18 members to cover all of the ground which was involved in the items in which the President and his cabinet were interested, so P.S.A.C.'s first move was to appoint a group of panels to deal with specific problems. Actually, at one time more than 100 scientists and engineers from all over the U.S. were members of these panels, and these scientists and engineers had the opportunity of coming to know intimately those issues in which the President and his cabinet were interested and—while doing so—of coming into the highest levels of government. Many of the chairmen of these panels, who were not members of P.S.A.C., from time to time met with the President. We had the unique situation in which the President himself was drawing upon advice and comment stemming from deep roots in the American scientific community.

Among these panels was one which recommended that the National Advisory Committee on Aeronautics (N.A.C.A.) be converted into the National Aeronautics and Space Administration (N.A.S.A.), and the whole advisory group resonated with the President in insisting that our space program be in civilian and not military hands. (2) It fought a steady battle in opposition to building a nuclear-propelled aircraft. P.S.A.C. secured the acceptance of a proposal for the processing of scientific information in government that avoided the creation of a center where all scientific literature would be processed by a computerized behemoth. It brought to the President and the Secretary of State information and recommendations which led them to move to reopen discussions with the Soviets on the limitation of nuclear tests, and this led to the Geneva Conference of Experts. Indeed, the Eisenhower P.S.A.C. in general brought into government views and analyses which led to more open-minded discussion of disarmament issues. P.S.A.C. strongly supported curriculum reform in education, and it played a role in the formulation of the National Defense Education Bill. It presented to the Cabinet a proposal for a Federal

Council for Science and Technology which was promptly authorized by the President.

The Eisenhower P S.A.C. felt strongly about the futility of trying to achieve additional security by the unlimited pursuit of weapons technology. They recognized the importance of advancing weapons technology in order to prevent the United States from becoming a second-rate power, and they felt a deep obligation to assist in the strengthening of our military position; in fact, perhaps their most useful role with Eisenhower was to advise him on weapons systems and the military budget. But there was a preponderant view in the Committee that the security of the country could best be served by moderating the arms race. There was also a preponderant view that we were enmeshed in too much secrecy and that every effort should be made to achieve a more open society as a way to a more open world.

The importance of P.S.A.C. goes far beyond the specific outcomes of its studies and recommendations because of the relationships of confidence and free discussion that P.S.A.C. enjoyed with the President and the President's associates. There was no holding back. There was no fear that someone might differ with someone else, including the President. There was never any difficulty in seeing the President or bringing matters before him for decision. (3) Indeed, after his retirement from the Presidency, General Eisenhower told a friend that some of the best experiences he had at the White House were the meetings that he had with P.S.A.C. These meetings, in which there was free-for-all discussion, were memorable events for P.S.A.C. itself. They made it possible for a group of scientists to come to understand the President's problems, views, and goals, and to learn how to make themselves useful in the light of this understanding. So it was that the Committee found many ways to express its belief in the values of a free society not only for the advancement of science but for the good of mankind.

It must be said that the Committee served under highly advantageous peace-time conditions that were almost unique to the Eisenhower years. It had free access to a President who knew he needed their help. The military establishment had not matured in its use of science and technology, and there was, of course, no agency with ability (or vested interest) in space technology. The National Security Council, because of its small staff, had little capacity for in-depth studies of weapons technology. Under these conditions it was inevitable that the President would look to P.S.A.C. for advice on both weapons and space technology. He also found in P.S.A.C. a source of objective advice that he felt was not always available from other branches of government; especially did he seek help in dealing with the competitive claims of the three military services.

(4) P.S.A.C. had another important characteristic. A majority of the members had no political ambitions and no career objectives in government. In giving advice, they sought to be nonpartisan, whatever their private political beliefs might have been. They sought never to embarrass the President by differing with him publicly. (5) They would have rejected as repugnant and ridiculous any idea that they could appropriately be described as a "priesthood," a term which some political scientists have used to describe this particular group. They were motivated primarily by a feeling of obligation to make their

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specialized learning and skills available to the government in time of need, and by a confident feeling that they had important contributions to make. This absence of political ambition made it possible for them to work with the elective, appointive, and career people in government in a way that did not arouse antagonism or fears of territorial aggression.

P.S.A.C. was fortunate in its relation to the National Security Council. As Special Assistant for National Security Affairs, Robert Cutler had played a key role in the appointment of the Special Assistant and in bringing P.S.A.C. in direct association with the President. He was cordial to P.S.A.C. and was responsive to its proposals and recommendations. This provided a coupling that has not always existed in successive administrations.

Finally, this group of science advisers had a deep sense of responsibility to science, along with an unshakable faith in its importance both to the individual and to the nation. They loved science and wanted others to share their enthusiasm for it and to discover its inner power to make men and women a little more creative, a little more civilized, and a little more humane. These convictions about the values of science brought to their advisory work for government an additional meaning and zest that made the experience memorable. I think they found that these views and values were shared by the President with whom they worked.

(6) One final note—a very personal one. I went to see General Eisenhower in the hospital a month before he died, in order to ask him to accept the Atoms for Peace Award. He wanted to talk; we talked for an hour or so. He agreed to accept the award and said that any money would go to Eisenhower College. And then, as I was leaving, he said, "Jim, tell me about my scientists." And then he ran down the names of the whole group that he had come to know as individuals, and wanted to know where they were and how they were; and finally he said, "Jim, you know in my experience in Washington that group seemed, more than almost any other with which I worked, to be there more for the good of the country than for themselves." This to me was a very memorable and moving example of the kind of relationship that the first P.S.A.C. had with its boss.

Dr. David: (7) Dr. Killian has described the genesis of the White House apparatus and the issues which animated it. Over the years those issues changed quite profoundly, and the White House apparatus responded accordingly. There are *several dimensions to this change*—both of substance and environment; the most discussed in the *decreasing concentration on science and technology for military and space objectives and a corresponding increase in emphasis on science and technology applied to other areas, such as energy*, which is perhaps the most vital to the country. Indeed, the energy thrust seems to me likely to be the Apollo of the 1970s and 1980s.

Shifts in funding for research and development very clearly indicated this trend. Of the $30 billion which will be spent this year, nearly 60 per cent will go for pursuits other than military and space. In addition to this shift in federal funding towards the civilian side, there has been a significant thrust in industry, where there has been a 30 per cent increase in research and development funding since the

middle 1960s. Though this shift in emphasis has not been rapid enough to suit many people, it is in fact occurring and I believe it will continue in the 1970s.

Another aspect of change is a *shift from opportunity orientation to problem orientation* in research and development—that is, a change from emphasis on research and development opportunities which arise from new technological possibilities to those which arise from social needs. The cancer program is a very clear example; (8) another is the space shuttle, which has been tied to an economic justification. We speak critically these days of solutions which look for problems—another way of expressing the increasing interest in problem orientation in comparison with opportunity orientation. (9)

In some ways, problem orientation is a natural extension of military research and development as described by Dr. Killian. Many, if not most, of the military programs of the 1950s and 1960s were problem-oriented; but there are differences. In the military case, the Office of Naval Research and other agencies created fundamental research enterprises to go along with and to lead directed development programs. In the case of cancer, the opposite seems to be happening. Fundamental and directed work seem to have become antagonists, at least on the surface. There are other dimensions of change in science and technology, as well—among them, the changing relationship of universities and government.

My point in this is simply to say that the issues and motivations for the White House science apparatus were very different in the end than at the beginning.

If we look to the future, we may propose that the *new organization* which has been put in place will have to cope with a number of still different *challenges*, and *I'd like to list a few of them.*

Many new national programs of research and development—primarily problem-oriented—are in the offing. At the Office of Science and Technology we categorized them into six areas: energy, health, transportation, education, social systems, and renewable and non-renewable resources. In each of these areas there is substantial federal funding. The challenge for the new science apparatus is to assure that these programs are coherent and coordinated across the departmental lines in government, and that government efforts are properly related to industrial efforts.

Concerning coordination, it is clear that one of the most influential accomplishments of the former White House office was successfully encouraging civilian departments—such as the Department of Transportation, the Department of Housing and Urban Development, the Interior Department, and the Commerce Department—to establish their own research and development organizations and programs, just as the White House apparatus had earlier encouraged the establishment of the Office of the Director of Defense Research and Engineering and N.A.S.A. But with that success in establishing research and development capability in many civilian agencies came the inevitable territorial competition, for cooperation and coordination are simply not the norm between departments of government. (10) However, we know that coherent programs across the boundaries can be attained with some encouragement and leadership. The Federal Council for

Science and Technology (F.C.S.T.) was established with the Science Adviser as its Chairman for this purpose.

For example, the research in environmental health that goes on in the government today is the business of the National Institutes of Health, the Environmental Protection Agency, the Food and Drug Administration, the Atomic Energy Commission, and several other agencies. An F.C.S.T. Committee has been actively working with representatives from each of these agencies to create an overall program having both an adequate basic, long-range side located in the National Institute of Environmental Health Sciences and the A.E.C. and an applied side to tie to the regulatory needs of the Environmental Protection Agency, the Food and Drug Administration, and the A.E.C. One particular effort, for example, was to achieve balanced funding of the new National Center for Toxicological Research in Pine Bluff, Ark. Efforts such as these are becoming an ever-more essential function, since most of the new civilian-oriented national programs cut across the interests of several operating agencies and departments of government.

Another issue arising in these civilian, program-oriented research and development programs concerns the proper roles in them of industry and government. Industrial funding in these fields exceeds federal funding by about the ratio of $12 billion to $5 billion. Furthermore, in general it is industry which must ultimately develop, manufacture, install, and service the equipment and the software which derives from both government and private research. Coordination between diverse elements is essential; but with the exception of the A.E.C. Power Reactor Programs we have had very little experience with this sort of relationship between industry and government. In the case of power reactors, the A.E.C. did the fundamental research, the demonstration and the initial development was cost-shared between the A.E.C. and industry, and final development was left principally to the industry. Some such arrangements will undoubtedly be essential in many other fields of civilian technology.

Many other policy issues—for example, the question of whether direct funding by the government or incentives for private funding should be used, and how to manage patents and licenses—are coming very rapidly to the forefront and will be the concern of the new science advisory apparatus.

An increasingly important challenge for today's science adviser lies on the international scene. There have been promising signs that science and technology—and civilian technology particularly—may have a dominant role to play in improving international relations and aiding other countries to realize their domestic ambitions. Capitalizing on this new role for science and technology is a vital task for the new science organization. Yet this is becoming increasingly difficult as international science and technology become entwined with international politics and affairs, as typified by the recent furor over the treatment of Andrei Sakharov and his associates; or by the coupling of emigration from the U.S.S.R. to U.S. high-technology trade policy.

Many other tasks also lie in wait for the new science advisory apparatus. Perhaps the most important of these is acting as the science and technological beacon for the government. New science and new

knowledge have a way of opening new horizons for society. The possibilities are first seen by scientists and engineers. The alerting function is essential for any government.

The new apparatus will have a full plate indeed.

Let me conclude by commenting briefly on how the former White House office responded to these matters. The growing concern for civilian areas of science and for problem-oriented issues was made clear when O.S.T. sponsored the Tukey report on the need for environmental research and action, "Restoring the Quality of Our Environment," published in 1965. The energy situation and the need for new sources and conservation of energy were implicit in the report by Ali Cambel published by O.S.T. in 1966; O.S.T. had an energy policy office from that year onward—well before the current concerns were seen. As a result, when the environmental and energy crises were proclaimed, O.S.T. was ready to address them constructively.

Over the years, the membership of P.S.A.C. evolved from being oriented solely to the physical sciences and engineering to include the life sciences, the medical sciences, and finally the social sciences. Its panels and studies similarly diversified, as did the staff of the Office of Science and Technology. An obvious recent example is James Coleman's panel on youth, which reported concerning the maturation process during the ages from 14 to 24. That report is, in my opinion, a landmark document of educational practice for the 1970s and 1980s, drawing heavily on the life and social sciences. (11)

If this apparatus was in fact predicting new areas of concern and effectively responding to the changing scene, why then did it go out of existence? The answer I think is straightforward. (12) Science and technology were the controlling factors in military and space programs; they animated the whole decision process. But civilian research and development—for energy, transportation, health resources and so on—involve much more. In these cases, science and technology must share the driver's seat with economic, legal, and social factors, political considerations, and—most of all—human sensitivities. Science and technology are only part of the story.

Who is to leaven the technical with the human? Here is where the breakdown has occurred. The issue has been most clearly raised, in my opinion, by Philip Handler, President of the National Academy of Sciences, in his letter to President Keldysh of the Soviet Academy concerning the condemnation of Academician Sakharov. Dr. Handler refers to Sakharov as "having expressed in the spirit of free scholarly inquiry social and political views which derive from his scientific understanding." Will society and governments listen to scientists and engineers in this spirit? Certainly they are much less inclined to do so today than before. Society and government are far more receptive to technical views from our community than they are to our broader views. This I think is the crux of the current situation.

Dr. Kistiakowsky: The current report of the National Science Board contains a very different assessment of the present situation in the United States as compared with other advanced nations from that which seems to me implied by Dr. David. Relative to other nations our use of technology has gone down, the interest of our youth is less in science than elsewhere, our foreign trade has suffered in high-technol-

ogy goods. How does Dr. David respond to this melancholy report in the framework of his optimistic assessment?

Dr. David: I'm not sure that the assessment which I made was optimistic, but I believe the National Science Board's report, if you read it carefully, is somewhat equivocal. As the Board points out in the report itself, most of the indicators of scientific health are input indicators: they concern funding and manpower on the input side of the input-output matrix. Very little is said about the output. It is true that the U.S.S.R., for example, has more scientists and engineers per 10,000 of population than the United States. But I believe the output—the useful and reputable output—of U.S. science is far and away beyond that of the Soviet Union despite its larger number of scientists. If you visit the Soviet Union it's very clear why. It's not because their people are not as capable as ours; many of them are just as capable. In part at least it is a lack of equipment upon which to build the productivity of scientists. In addition, the Soviets tend to substitute people for capital investment in their research—a very different way of going about it. This is proved very clearly if you look at the number of scientific articles that are published in the world: the U.S. leads in all except one of the eight principal fields of basic research.

Dr. Kistiakowsky: The numbers quoted by the National Science Board comparing the U.S. with Japan are misleading because in Japan almost everybody is working on civilian problems. In the United States a large percentage in numbers, and an even greater percentage in talent, has been signed up to work on military and space problems. (13)

Dr. Wiesner: Though I think we would all share Dr. Kistiakowsky's view of the effect of military work on the civilian applications of science and technology, I have a concern about accepting too lightly what's implied in what we've been saying—that the government has gone out of the military research and development business and that the White House no longer needs scientific advice and judgment in that field. The military research and development budget which just went through the Congress—for $21-plus billion (14) was considerably bigger than any which any of us had to contend with. And there is no counterforce of the kind that P.S.A.C. used to offer.

In spite of his strong military background, President Eisenhower learned to depend very heavily on P.S.A.C. for the technical advice he needed in trying to counter the monolithic pressure of the Defense Department. President Kennedy once told a newspaperman that the thing that P.S.A.C. did for him was to keep the government from going all one way. I believe we're overlooking a major problem that's been created by the disassembly of the science advisory apparatus.

Dr. Killian: I agree with you wholeheartedly. One of the problems the country faces is to reconstruct a method providing at the top level of policy making, the White House, the kind of counterveiling, questioning, objective examination of military technology which P.S.A.C. achieved, so that the President has a real opportunity to appraise what's coming up to him. I do not mean to condemn the military in any way; I simply propose that the monolithic, massive quality of what they must do requires this kind of service to the President.

Dr. Kistiakowsky: I agree with you. And I believe that to a significant extent we in P.S.A.C. essentially dismantled ourselves because we encouraged very strongly in the early years the creation of a Director of Defense Research and Engineering and his office. In the beginning this office worked very harmoniously with P.S.A.C.; I remember two occasions during the last year of the Eisenhower administration when the Secretary of Defense and his Director of Research and Engineering asked us to undertake very sensitive studies for the Defense Department. But as time went on the character of the people who filled those offices changed very much, and instead of being skeptics and challengers of military plans they simply formed another enthusiastic component of the force in the Pentagon. We now have the extraordinary situation in which, as far as I can see, the only question that is raised is, Do we have the money to do this? The question of whether the big project is really important for the country is not really considered. And so we are now spending billions of dollars for things like submarines which will cost approximately $2 billion each. (15)

Dr. DuBridge: I agree, but I think the point can be over-emphasized. Even through Ed David's time, P.S.A.C. continued to bring to the attention of the military and the President those military projects which seemed not essential or were too extravagant or were inadequately founded in technology. As the proportion of the national research and development effort given over to military work dropped and the amount of civilian research and development rose, the attention of P.S.A.C. and the science adviser shifted correspondingly. It is not a question of either defense or civilian; it is a question of the necessary balance of the two. In P.S.A.C.'s very early days we had all come through the war experience, and we were all civilian experts, so to speak, on military problems. It took a while for us to develop expertness in civilian problems, because—as has been said—these are tangled up with many things—they are not just a matter of science and engineering. I think that P.S.A.C. did a heroic job in recent years in beginning to separate out the chaff from the Wheat in many of these very difficult civilian areas. (16)

(17) **Dr. Hornig:** There are some more subtle factors involved in the changing role of P.S.A.C. with respect to the military, too. There is nothing sadder than an adviser whose advice isn't wanted. During World War II and at the time of Sputnik, there was a clear identity of interest between the scientific community and the President. The President knew he needed advice, and the country knew he needed advice; and under Killian a heroic role was played. As time went on, quite aside from the building up of scientific expertise in the Department of Defense, attentions turned to other things; the most urgent political items were no longer quite so closely allied with the things P.S.A.C. was interested in. And in fighting its own personal battles, P.S.A.C. came to be regarded, rightly or wrongly, as having its own political positions. In the beginning there was an identity of interest between the President and P.S.A.C.; the President knew that even if P.S.A.C. disagreed with him, even if it disagreed with some of his other principal advisers, basically P.S.A.C. members identified with

him as his scientific advisory committee. Later I believe that this feeling was eroded.

Dr. Wiesner: I remember when I had to go to President Johnson and explain that P.S.A.C. disagreed with his views on the Vietnam war.

Dr. Hornig: Yes, there is no question that P.S.A.C. came to be regarded as not having an identity of interest with the President. And it seems to me that in many respects this parting of the ways was related to our own inability to be critics and nevertheless be part of the team at the same time.

(18) When we talk about giving him scientific advice, it seems to me we must remember that the President of the United States is two different kinds of people—a political leader and a chief executive. And really we talk about two different kinds of problems, and the solutions will undoubtedly be two different kinds of solutions. There is the kind of advice that Killian talked about—that the political leader needs in orienting himself. And then there's the more detailed kind of advice that the Chief Executive needs in running this country. Some of us forget that a large part of the relationship of the President and the science advisers—or any other groups—depends upon the personal interests and characteristics of the President and his method of operation—particularly with the staff people who are around him.

Dr. Wiesner: What about the civilian issues? As we pointed out earlier, P.S.A.C. did look at many of these issues and see that they were problems. I remember very well the Cambel energy group, which predicted almost all of the problems we are facing today; if you look at their report you will see the curves which are now being reproduced by the dozens in popular journals, showing the rate at which energy consumption was and is growing. But it wasn't possible to mobilize the government. The reason that we were able to do something about space and defense was the government arrived at a point where there was a crisis. Since there was a crisis, there was something one could do about it; and it was also easy to do something about space and defense because the government was also the customer. Now it's not clear to me that even with a crisis we can do anything about some of the civilian problems; clearly P.S.A.C. was not very successful in stimulating effective government action on these government problems. Can we have any optimism that, with or without the influence of a P.S.A.C. in the future, we can in fact know how to manage our society appropriately?

Dr. DuBridge: It's true that P.S.A.C. didn't solve any big civilian problems and wasn't even able to propose solutions which were adequately comprehensive, because the problems were so vastly difficult. Nobody today could sit down and say that here is the way to solve the energy problem. There has been some fine studies and some fine articles—nearly 100 reports, I would guess, and yet it would be hard to find more than four people in the country to agree on which report gave a proper solution, if there is one.

The forecasts of energy shortages which were made years ago and which proposed that something ought to be done to anticipate them were correct. But there are lots of people in this country who opposed increasing our energy resources, who prevented the development of new power plants, who stopped the installation of transmission lines, who protested the building of more oil and gas wells and refineries, who stalled a great many of the actions which we have been trying to take. So our energy production has not grown as fast as we would like to have seen it. We must remember that the American government moves not only in response to a singular point of view, such as that of a P.S.A.C., but also in response to the feelings of many, many thousands of groups and individuals around the country, many of whom are in violent disagreement.

Dr. David: I don't think I have answers to the profound question Jerry Wiesner asked. However, if you look at what P.S.A.C. and O.S.T. did in response to the energy area as an example, I believe you have a much better story than Jerry suggested. After the Cambel report, an energy policy office was set up within O.S.T. That office worked very hard for several years on an energy program, and the three Presidential messages which came out concerning energy between 1971 and July, 1973, were all essentially products of that office. They provided the background of that effort.

During the time that this energy policy office was working, funding for research and development rose by a factor of three to approximately $800 million per year, and now the federal government has agreed to spend over the next five years $10 billion, which just happens to be exactly the spending rate on the Apollo program during the 1960s. Simply spending money like that is not necessarily going to solve this problem. There are some very tough issues here. (19) But I think the country is moving. I think energy requires a more diverse, less centralized approach than military and space problems, that industry must play a part, that private funding must play a substantial part. And I would not expect to see this program as easily understood or the solutions as clean and neat as you would find in the military and space program. But I think that in the long run—by that I mean within the decade—substantial progress will be made in the energy crisis on conservation.

(20) and (21) I must say that I think that the scientific or engineering mind with its discipline of careful, structured thought is a very important element in unscrambling the problems of society that we see today. The present mechanism doesn't preclude that kind of input, provided it receives the support of the President and of the people to whom it reports.

But I'd like to suggest that we may now be in a period when science advice alone, except in limited circumstances, is inadequate to serve our purposes. We have to find new institutional arrangements, new kinds of task forces and committees to deal with the multidisciplinary considerations in problems like energy. You may be able to deal with disarmament without a whole constellation of different kinds of people thinking about it. But the energy problem is more complex, and we've got to face it in that way. To try to find these means is one of the most challenging issues that faces us at this time.

Dr. DuBridge: We should recall that the science advisory mechanism has not died, that it has simply been transferred to different auspices where its attention will be devoted entirely to civilian scientific and technical problems.

In one sense, Dr. Stever has an impossible job because he's running a $600 million a year agency supporting research and development of all sorts, and now he has to take on what was for us a full-time job of advising the President. On the other hand, the fact that he has $600 million to spend means that he has a tremendous amount of power behind him in terms of staff and transferrability of budget, so he can focus on problems in the civilian area in ways which may be extremely fruitful in the coming years. (22)

Where we do lack, of course, is in the defense area. Whatever you say about militarism, we live in a real world in which military force is still an essential feature. So we must have an effective military technology always. And this is where much of our thinking ought to go.

I do not see a bright future for careful, independent examination of our military technology.

(23) **Dr. Agrain:** You have suggested that the demise of P.S.A.C. was in part due to the fact that it could not act effectively on civilian questions. We have in France something very similar to P.S.A.C. with an Office of Science and Technology—which is called the G.R.S.T. It is only concerned with civilian science. (For military science there is another organization—D.N.R.E.—which falls under the Department of Defense for supervision but really has some independence.) From our experience in France I feel that you need a system like the O.S.T. with a science adviser and a scientific committee for civilian and for military questions. You need a common team, a permanent office probably even more structured than O.S.T. ever was, more powerful with more permanent people. You need a good deal of authority delegated from the Office of Management and Budget, which very fortunately we have in France. Within the total amounts of money available we could write out our own budget; and if we had not had that authority I doubt if we could have gone through the very serious budget reductions we have known in 1969 and in the 1970s; at least we could make fairly good use of our funds, which an office of management and budget would not have been able to do. The final thing you need is, I think, a fair amount of seed money. Your present organization does contain seed money through the National Science Foundation, but certainly it does not have authority delegated from the Office of Management and Budget, delegated authority which I feel is essential. So I wonder how you can really handle civilian questions without establishing something a good deal stronger than your present structure.

Dr. David: Frankly, we would all agree.

(24) **Dr. Stever:** I am an optimist. We're going to give it the old college try, working on the civil science jobs to which we've been assigned. I think we have gone through some rough times. I don't expect the funding channel to suddenly open up, but I think we'll have plenty of opportunity to influence things. I also think that confrontations—such as between energy and environment—will continue for the rest of our lives. We'll be working on these problems for decades.

Question from the audience: Some of the panel commented that the problem of the "energy crisis" was well predicted in 1966 and 1967, and yet there has been very little response in that time. How can we improve the response time of the government?

Dr. Wiesner: I think there is no single answer to that question, and in this kind of society there probably should not be one. A number of things need to be done and to be developed. First of all, we need better capabilities, as Dr. Killian indicated, for interrelating technical, economic, and social knowledge so our projections are more comprehensive and, therefore, I think much more correct and convincing.

Secondly, I believe that we have moved from a period in which the government and the people paid very little attention to the effects of changing technology into a time when we have all become very sensitive to those effects. As a result, we will see from now on a much more detailed monitoring of what is going on in technology, and we may see legislation to control it. In fact, there may be the danger that we will over-control technology. Many of you have heard my simile for what's going on here—our society being a learning machine, trying to improve our detection of the feedback or error signals so that we can correct our mistakes while their consequences are still very small.

Yet I've puzzled about this a lot, because I was responsible for that first energy study, and I thought it was a good study. Yet it produced no results. There is a serious problem here. The country cannot afford to respond to every issue that somebody raises: we don't have enough resources. You have not only to make a prediction but to be sure that matters are turning out as you predicted, and then you can begin to apply corrections slowly. This calls for a sensitivity and a process which I don't understand and which I think we lack.

Dr. Killian: If we are to look to the future in a time when many trends seem to us unfavorable and many questions seem so complex as to be beyond understanding, let me ask: Is there not a man, is there not an institution that can put together for us another charter for science in this country that would have the qualities of the great manifesto that was published by Vannevar Bush in "Science—the Endless Frontier," as he was completing his service with President Roosevelt? It seems to me that this was a landmark in looking at the future of science. How do we do that now?

Dr. David: Lest I seem tonight to have been insensitive to the potentialities of new opportunities generated by science, let me stress my conviction, shared with Dr. Killian, that the influence of science and technology on society is fundamental and lasting. That influence is inexorable; it is a force which provides the frontier for us and for the nation's future. This must be widely and well understood among the country's people and especially at the highest levels of its leadership.

NOTES ON DIALOG NOT INCLUDED IN *TECHNOLOGY REVIEW* ARTICLE "SCIENCE ADVICE FOR THE WHITE HOUSE" JAN. 1974:8–19

(1) Eisenhower asked whether there was in fact a missile gap?

(2) Omitted at this point are Killian's remarks concerning the PSAC panel work with the BOB on the space bill. The impression he gave is that the legislation was entirely an Executive Branch responsibility; the role of Congress is not mentioned.

(3) Killian noted that "it must be said that some of my predecessors did not have that good fortune."

(4) Killian noted that PSAC was sometimes criticized as being too conservative and unimaginative. He said it was constantly opposing "blue sky" proposals. One of the "blue sky" proposals was that by the Air Force for exploitation of space for military purposes; said it showed an ignorance of Newtonian principles of mechanics. PSAC also opposed nuclear aircraft and some of the command and control systems of DOD.

(5) To the sentence, "they sought never to embarrass the President by differing with him publicly" Killian had originally added, "although they might have done so privately."

(6) Killian refers to Eisenhower's Farewell address in which he noted that the concept of science in the terms previously noted reflected the things that Eisenhower said at that time and that the scientific community could agree with so much.

(7) Dr. David, in introductory remarks, queried why Dr. Wiesner should have invited him—"the last of the Mohicans"—and then he said he realized the answer, "He wanted to see if I could commit suicide after being assassinated."

(8) Said the cancer program was the result of lobbying by a relatively few people, mostly not scientifically trained.

(9) Said it was difficult to document with figures that problem-orientation is definitely on the upswing compared to opportunity-orientation, "but I believe it is."

(10) In speaking about the problems of interagency coordination, he referred to the competition as the "inevitable territorial imperative—the competition for turf so prized on the Washington scene."

(11) Said the Coleman report was sponsored by the National Institute for Education after OST went out of existence.

(12) After noting that the answer for the organization going out of existence was straightforward, David explained that R & D in new military and space programs was the driving force; new technologies could animate new needs and requirements from the military. Science and technology were controlling factors in military and space programs.

(13) (Unidentified) Remark concerning the NSB report that we should be thinking not about where we are but where we're going—what the trends are regarding other parts of the world. These are unfavorable at present.

(14) $21 billion includes procurement.

(15) Kistiakowsky remarked that the only advantage he could see of Trident submarines were that they were "big enough so an admiral can have comfortable quarters" to which Wiesner replied, "big enough to require an admiral."

(16) DuBridge said that he talked "the other day" with a man who has been a high official in AEC, DOD and CIA, who is now trying to advocate a restoration of the PSAC mechanism because "especially in the defense area, in his point of view, this kind of independent advice and evaluation was still required." It is not a question of either/or. It is a question of balance between military and civilian R & D which will change as time goes on.

(17) There was general agreement to Kistiakowsky's statement. "I submit that PSAC and the science advisor had far greater influence in military technology area relative to the other advisory sources the President received."

(18) I believe this was David who interjected that many of the PSAC panels have been reconstituted under the National Security Council. But whether they will be effective remains to be seen. We must remember that the objective of military programs today is not the creation of military capability but more a demonstration of resolve. The further you get from war, the more that becomes true.

(19) David, in illustrating "tough issues" said ". . . such as if the U.S. is going to depend on the strategy of coal as enunciated, where will coal come from: How will we mine it with acceptable environmental impact?"

(20) At this point Wiesner expressed the general view that science and technology are very unpopular in the nation. He asked the group: "Do you feel that?

DuBridge's response: The NSB report, Science Indicators, is a great bible of information on questions we've been talking about tonight. Certain people distrust science but the vast majority feel that S & T do have a role to play. I do not agree that there has been a downgrading of science in the public mind. The fact that appropriations have leveled off may mean that in Administration and Congress there has been a downgrading, but I think this is due to other things—necessity to fight inflation by restricting the budget, the tapering off of the space program after Apollo. R & D has gone down in all the developed countries except USSR.

The leveling off has been painful in some areas—physics, astronomy—but total downgrading not as radical or catastrophic as some people maintain. In the last year there has been a slow upward climb, and I think it will continue.

(21) Wiesner's next question concerned the changing view in the USSR concerning the civil rights of scientists. He asked Kistiakowsky for his opinion on how to interpret this. Is there less concern for Communism now?

Kistiakowsky's reply was that there is no doubt that the persecution cases are hurting seriously the dialog between the two scientific communities (US–USSR). On the other hand, American scientists are extraordinarily naive in thinking that because they have established person to person contact with Soviet scientists that will change Soviet policy. The USSR has never been an open society. We should continue our contacts. It may contribute to the slow evolution in the direction of a more free society. He compared progress to an old dance—the Lambeth Walk—2 steps forward, 1 step back; maybe the other way around. The cases of persecution do not justify a dramatic change in American attitude. We must convey a sense of disturbance without lecturing. Few of us have perfect records. It is easy to get in a glass house and toss stones.

None of the group believed U.S. should show concern by changing our foreign policy or by bans on trade agreements. Wiesner noted that there could be a difference between the official government position and personal opinions.

(22) DuBridge's final sentence concerning Stever's job was "We should stand behind him, recognizing his difficulty and try to help him in any way we can as he focuses on civilian problems."

THE FLOOR WAS OPENED FOR AUDIENCE PARTICIPATION

(23)* Hornig made some further comments regarding the matter of science advice. Said we forget that the President is two different people—the political leader and chief executive—and the advice for each may differ.

DuBridge continued this point by noting that the way the President does his job depends on the staff people around him. He said it was not accidental that the problems of recent months have come at the same time the science apparatus was degraded.

DuBridge then said, "There is another thing—that is the whole problem of Congressional science advice, which we haven't touched upon at all. Congress has a desperate need for better institutions and mechanisms at the present time. I see evidence of a growing effort on the part of

Congressional committees to build up institutional arrangements which will give them the kind of advice the Executive Branch has been having in the past."

DuBridge continued, "I had great hopes when the Miller Committee established the Science Advisory Panel, but they treated the Panel as a bunch of witnesses in a hearing rather than as a group who got around a table and batted issues back and forth. While it was educational for members of the Miller Committee, I don't think it had a large impact on their policy, except in a few specific circumstances. I think it was very useful to Daddario in some of his interests and activities. But it never really got to the heart of the matter of giving Congress as a whole frank, continuous help on the technical aspects of subjects."

(24)** Agrain's comments ended with a question to David and Stever, which in effect asked them to justify the present arrangements since he was so firmly convinced of the need for the previous mechanisms.

David said we just have to wait and see what the current mechanism will produce. He said we had tried something similar to the present arrangements earlier and it didn't work at all, but that was in a different time. He expressed the belief that the scientific and engineering mind with its carefully structured thought could be an important element in unscrambling the problems of society. Present mechanism does not preclude that kind of inquiry provided it receives the support of the President and the people it is supposed to assist.

Stever prefaced the remarks set down in the article by the following: "I'm tempted to say that I've seen the Phoenix burn and I'm supposed to rise from the ashes. (laughter). I'm also tempted to say that I'm tempted to agree with you and if I didn't have an important speech to give at MIT tomorrow, I'd put it all in effect tomorrow."

Stever went on to express agreement with many of the things which have been said but he disagreed with one thing David had said—the present mechanism wasn't tried before. It was written down into a law and no one tried to put it into effect intentionally—it was the declared policy. Then he said, "I am an optimist. . . ." Concluding, he declared, "The Phoenix is going to try to rise."

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[Correspondence *Re* OMB Testimony]

Committee on Science and Astronautics,
House of Representatives,
Washington, D.C., February 14, 1974.

Mr. Frank G. Zarb,
Associate Director for Natural Resources, Energy and Science, Office of Management and Budget, Executive Office Building, Washington, D.C.

Dear Mr. Zarb: As you may know, this Committee is in a process of reviewing in detail Federal Policy, Plans, and Organization for Science and Technology. We expect the entire process will cover some 12 to 18 months.

The first phase of our inquiry was held last July, at which time we sought to hear witnesses from the Executive branch and obtained their explanations and plans for Federal science policy. Among the Administration representatives giving testimony was your predecessor, Mr. Sawhill. I am enclosing a copy of the hearings and would appreciate it very much if you could review Mr. Sawhill's testimony and let us know if you differ with him in any substantial degree. His testimony begins on page 104 and runs through page 132.

While we do not anticipate very material differences, we would like to give you the opportunity to express to us any which you may have. We are now making plans for the second phase of the inquiry which will be devoted to the views of non-Administration witnesses, probably to begin early in the spring. May we hear from you at your earliest convenience.

Sincerely,

Olin E. Teague, *Chairman.*

Enclosure.

EXECUTIVE OFFICE OF THE PRESIDENT

March 1, 1974.

Hon. Olin E. Teague,
Chairman, Committee on Science and Astronautics, House of Representatives, Washington, D.C.

Dear Mr. Chairman: Thank you for your letter of February 14 providing me an opportunity to comment on Reorganization Plan Number 1 of 1973 and the testimony of July 1973 by Mr. John Sawhill. In reviewing Mr. Sawhill's testimony, I find that I am in agreement with the points of view he expressed. I have no significant differences with that statement on the now established arrangements wherein Dr. Guy Stever serves as Science Adviser.

I would like to express to you my belief that the mechanisms provided for by Reorganization Plan Number 1 of 1973 are working effectively. Dr. Stever and his staffs in the NSF Office of Energy Policy and NSF Science and Technology Policy Office are actively assisting and advising on numerous matters of current or recent concern. These include the preparation of the research and development elements of the FY 1975 budget, the accelerated energy research and development program, several matters of concern to the Domestic Council, and some specific interagency questions where his analysis and advice can help reveal the best solutions. An example is the examination of the compatibility of system components in military and civilian weather satellites and launch vehicles and the feasibility of developing some additional commonality of programs with a view of making savings for the American taxpayer.

Dr. Stever has effectively established communication with many sectors of the academic and industrial scientific community and plans to extend these contacts in the weeks ahead by holding a series of regional meetings with leaders of the scientific community. He has invited me and members of my staff to join him for these sessions and we expect to do so in order that we can become informed of the views of scientists and engineers throughout the United States. In summary, I have considerable confidence in the arrangements that have been established, and Dr. Stever's discharge of his new responsibilities. Thank you for providing me an opportunity to comment on this matter.

Sincerely,

FRANK G. ZARB, *Associate Director,*
Office of Management and Budget.

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SELECTED REFERENCES *Re* FEDERAL SCIENCE POLICY AND ORGANIZATION

(January 1973–May 1974)

INTRODUCTION

During 1973, by reorganization plan and other actions, President Richard M. Nixon made the following changes in the top-level executive branch organization for scientific and technical advice and interagency coordination:

Abolished the Office of Science and Technology and the Director and Deputy Director positions;

Transferred the civilian functions of the Office of Science and Technology to the Director of the National Science Foundation;

Accepted the resignations of members of his President's Science Advisory Committee and did not appoint new members;

Designated the Director of the National Science Foundation as his Science Adviser;

Designated the Director of the National Science Foundation as Chairman of the Federal Council for Science and Technology.

These actions generated considerable commentary in the current literature as evidenced by the selected references listed below. The listing also includes executive and legislative documents. Where necessary references have been annotated.

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Discussions of OST, NSF, and role of science generally appear at pages 4, 7–12, 20–28, 37, 57–63, 63–75, 107–116. References to the National Aeronautics and Space Council appear at pages 5, 22–23, 87–90.

Nixon shapes new look for R&D. Industrial research, March 1973: 26–27.

The main focus of the article is on the depressive effect on the scientific establishment of the actions to remove science from the Executive Office of the President.

White House science advice rerouted through new channels. Physics today, v. 26, March 1973: 97, 99

Senate shows little interest in abolition of science office. Science and government report, v. 3, March 1, 1973: 7

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If the boss calls, be sure to get his name. Science and government report, v. 3, June 15, 1973: 6.

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U.S. National Science Foundation. Responsibility for international scientific and technical activities performed by OST. Staff memorandum, June 30, 1973. O/D 73–22. 1 p.

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A report on an interview with STPO Director Dr. Russell C. Drew.

Hudock, Robert P. Science policy office gears up. Astronautics and aeronautics, v. 11, Oct. 1973: 6–8.

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Cowen, Robert C. Does U.S. need science advice? Christian science monitor, Oct. 20, 1973: 11.

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Of supplemental funds requested for NSF, $4 million was requested to assist the Director in carrying out the responsibilities transferred from OST. Dr. Stever answered many questions concerning the new office. He also provided good summary information on the involvement of the Office of Science and Technology in energy problems over the past decade.

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Of $8.6 million supplemental funds for FY 74 requested by NSF, $4 million was to support Dr. Stever in his added responsibilities as science adviser.

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Condensed transcription of remarks by Paul O'Neill, Associate Director for Human and Community Affairs, OMB, and Robert Marston, former Director, NIH, at debate at NAS annual meeting on topic: "Resolved, That the definition of priorities for biomedical research is primarily the responsibility of society as a whole, rather than that of the scientific community."

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National Science Foundation seen weak in influence; lack of Nixon science adviser draws increasing criticism. Christian science monitor, Jan. 17, 1974.

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Mentions FEO with Simon and Weinberg, OEP and STPO under Stever, and Ray at AEC; also OMB.

Military spending still dominates R&D budget. Science and government report, Feb. 15, 1974: 4.

The NSF Science adviser was not consulted about the military R&D budget.

Baker, W. O. Why science can't save us. Forbes, Feb. 15, 1974: 68–70.

Dr. Baker maintains that our reduced R&D spending is jeopardizing our scientific and technical capability.

Sarnoff, Robert W. Commemoration day address of February 22, 1974, commemorating the 98th anniversary of the founding of the Johns Hopkins University. In remarks by the Honorable Charles Mathias, Congressional record (daily ed.), v. 120, February 25, 1974: S2143–44.

Stever, H. Guyford. Is it a science world again? Proposed remarks, AAAS 140th annual meeting, San Francisco, California, February 27, 1974. 22 p. Processed.

Beckler, David. The changing environment for national science and technology policy. Symposium on science and public policy, AAAS 140th annual meeting, San Francisco, California, February 28, 1974. 18 p. Processed.

Quigley, Stephen T. Chemistry—the transition from science to engineering. Paper presented at AAAS 140th annual meeting, San Francisco, California, February 28, 1974. 19 p. Processed.

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David, Edward E., Jr. Prospectus for science advising. Editorial. Science, v. 183, March 1, 1974: 801.

Dr. David discusses some functions of a modernized White House science apparatus.

Government: biggest barrier to innovation: Industry week, v. 180, Mar. 4, 1974: 30.

Among findings of an Arthur D. Little study to identify barriers to innovation is the need for national science policy and a focal point for S&T in the government.

U.S. National Science Foundation. Statement of Dr. H. Guyford Stever, Director, National Science Foundation, before the joint meeting of the Committees on Aeronautical and Space Sciences, and Commerce, United States Senate, March 11, 1974. 10 p. Processed.

Dr. Stever presented the views of the National Science Foundation on S.2495, the "Technology Resources Survey and Applications Act."

Friedman, Bernard S. Statement on behalf of the American Chemical Society to the Committee on Aeronautical and Space Sciences and the Committee on Commerce, United States Senate, on the Technology Resources Survey and Applications Act, S.2495, March 11, 1974. 14 p. Processed.

Handler, Philip. Statement before the joint hearing of the Committees on Aeronautical and Space Sciencies and Commerce, March 11, 1974. 14 p. Processed.

Dr. Handler, President, National Academy of Sciences, commented on S.2495, the "Science and Technology Resources Survey and Applications Act of 1974."

U.S. National Science Foundation. Statement of Russell C. Drew, Director of the Science and Technology Policy Office before the Subcommittee on Science, Research and Development, March 14, 1974. 11 p.

Statement presented at NSF authorization hearings on the FY 1975 budget.

Rowen, Hobart. Nixon expected to nominate Simon Treasury secretary. Washington post, March 24, 1974: A2.

David cool toward government in R&D. C&EN, v. 52, Mar. 25, 1974: 7.

David cited 3 major influences which will shape S&T in the 1970's. These were the same three that he said in the July 1973 hearing, the NSF would have to cope with.

Congress again focuses on science policy; ACS, NSF, NSPE give their evaluations of proposed National Science and Technology Resources Council at hearings. C&EN, v. 52, Mar. 25, 1974: 19–20.

Holden, Constance. House Science Committee: staking out a broader claim. Science, v. 183, Mar. 29, 1974: 1277–78.

Sarnoff urges science and technology commission. Sea technology, April 1974: 9.

A summary of Robert W. Sarnoff's proposal for a Science and Technology Commission as presented in a speech at Johns Hopkins University, February 22, 1974.

An R&D shakeup? Washington is looking hard. Science and government report, v. 4, April 1, 1974: 1–2.

On-going technology policy in U.S. government urged. Journal of commerce, April 1, 1974: 12.

Rowen, Hobart, Simon is reported succeeding Shultz. Washington post, April 4, 1974: A2.

Kistiakowsky, G.B. Presidential science advising. Science, v. 184, April 5, 1974: 38–42.

Shapley, Deborah. Science advising: new setup has more resources, less visibility. Science, v. 184, April 12, 1974: 145–146.

Science advice—a problem. Editorial by Brewster C. Denny. Science, v. 184, May 10, 1974: 617.

Alvarez, Luis *in* Talk of the town. New Yorker, v. 50, May 20, 1974: 27

Dr. Alvarez, a member of PSAC until all members of the committee were "fired" in January 1973, comments on the lack of Presidential relationships with scientists in the last year and a half.

Rosenthal, Albert H. Public science policy and administration. Albuquerque, University of New Mexico Press, 1973, 322 p. Q127 U6R62

Energy R & D: Weinberg moves to the White House. [R.G.] Science, v. 183, Jan. 25, 1974: 288

Old, Bruce S. R & D: investing in the future. Technology review, v. 76, March/April 1974: 75, 77.

A book review of *Public science policy and administration* by Albert H. Rosenthal, and commentary by the reviewer.

Pizer, Vernon. Who unplugged America's science machine? Washingtonian, v. 9, February 1974: 100–107

This article reports on the views of Glenn Seaborg, H. Guyford Stever, Philip Handler, Roy Ash, William D. Carey, John C. Sawhill, Philip Abelson and others concerning the effects of removing the science advisory machinery from the White House.

Sarnoff, Robert W. Commemoration day address of February 22, 1974, commemorating the 98th anniversary of the founding of the Johns Hopkins University. In remarks by the Honorable Charles Mathias, Congressional record (daily ed.), v. 120, February 25, 1974: S2143–S2144

Mr. Sarnoff proposes the establishment of a Science and Technology Commission to plan and coordinate Federal research and development and technical education.

Letters. A fourth branch needed. By Winton Brown. Chemical and engineering news, v. 52, March 11, 1974: 5

Top-level science policy need stressed. Aviation week and space technology, v. 100, March 18, 1974: 56–57

A summary of views concerning the transfer of science out of the White House in 1973 by speakers at the 1974 annual meeting of the AAAS.

Letters. Science establishment [reply to Winton Brown proposal. C&EN, March 11, 1974] By Alan Nixon. Chemical and engineering news, v. 52, April 8, 1974: 3

Pizer, Vernon. Who unplugged America's science machine? Bioscience, v. 24, May 1974: 291–295

An abridged version of this article which appeared first in the February 1974 issue of The Washingtonian magazine.

Powell, Craig. Energy R&D . . . Utopian talk, but no national policy. Government executive, v. 6, May 1974: 14, 16–18

A report on an interview with Congressman Mike McCormack in which he suggests the creation of a cabinet-level Department of Science, Energy and Technology to manage the energy program.

Science policy vacuums—who will fill them? Research management, v. 17, May 1974: 4

Among new institutional arrangements to deal with research and technology policy discussed in this article are proposals of Edward E. David, Jr., for a new White House science office, Alton Frye and others for an Institute for Congress, Robert Sarnoff for an independent science and technology agency, and John Connor for a national planning corporation.

Handler, Philip. Excerpts from annual report of the President, National Academy of Sciences before NAS annual meeting, April 23, 1974. Public Science, v. 5, May 1974: 5–8

Dr. Handler enumerates problems raised by removal of the science advisory machinery from the White House. He believes a replacement is seriously required.

Also discussed were aspects of the NAS-legislative increasing relationships.

Handler candidly assesses federal science. Chemical and engineering news, v. 52, May 13, 1974: 13–14

A story based on the NAS annual report.

NSF moves to organize energy R&D efforts. Chemical and engineering news, v. 52, May 20, 1974: 14–15

Boffey, Philip M. U.S. research in biomedicine faces review. Chronicle of higher education, v. 8, May 28, 1974: 1, 4

Concerning pending proposals for establishment of a commission to study the Federal role in biomedical research.

Martin Perl, Joel Primack and Frank von Hippel. Public-interest science—an overview; individual scientists and their professional societies are becoming increasingly involved in public debates over the impacts and regulation of technologies. Physics today, v. 27, June 1974: 23–31

16

SURVEY OF THE HOUSE COMMITTEE ON SCIENCE AND ASTRONAUTICS OF THE MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES AND THE NATIONAL ACADEMY OF ENGINEERING

The following survey has been sent to all members of the National Academy of Sciences and the National Academy of Engineering. The committee concluded that, in addition to testimony being given by various witnesses, the opinions of the individual members of the two Academies would be valuable. Results of the survey will be incorporated in a subsequent report.

[COMMITTEE PRINT]

SURVEY

BY THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

U.S. HOUSE OF REPRESENTATIVES

NINETY-THIRD CONGRESS

SECOND SESSION

[Serial N]

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SURVEY

BY THE COMMITTEE ON SCIENCE AND ASTRONAUTICS, U.S. HOUSE OF REPRESENTATIVES, WASHINGTON, D.C.

May 28, 1974.

DEAR ACADEMY MEMBER: On July 17, 19, 23, and 24, 1973, the Committee on Science and Astronautics, U.S. House of Representatives, held hearings on the subject of "Federal Policy, Plans, and Organization for Science and Technology." These hearings were the first in a planned series dealing with this subject.

It is planned that the next set of hearings will be held during the summer of 1974. In preparing for these planned hearings, three organizations were requested to review the July 1973 hearing record and prepare comments for the Committee:

1. American Association for the Advancement of Science, Committee on Science and Public Policy
2. Industrial Research Institute, Committee on Federal Science and Technology
3. Congressional Research Service, Science Policy Research Division, Library of Congress.

Additionally, the Committee has concluded that opinions of individual members of the National Academy of Sciences and the National Academy of Engineering would be valuable. This questionnaire has been designed for obtaining your views on a number of topics which will be most helpful to the Committee as it continues its inquiry into "Federal Policy, Plans, and Organization for Science and Technology."

A stamped, addressed envelope is enclosed. It would be appreciated if the questionnaire could be returned by July 8, 1974. Placing your name on the questionnaire is *entirely optional.*

OLIN E. TEAGUE, *Chairman.*

QUESTIONS

C 1. a. ___ NAS member
b. ___ NAE member

C 2. If Academy member, your length of membership in years is:
a. ___ 0–5
b. ___ 6–10
c. ___ 11–15
d. ___ 16–20
e. ___ 21–25
f. ___ 26 or more

C 3. Your age in years is:
a. ___ 25 or less
b. ___ 26–30
c. ___ 31–35
d. ___ 36–40
e. ___ 41–45
f. ___ 46–50
g. ___ 51–55
h. ___ 56–60
i. ___ 61–65
j. ___ 66–70
k. ___ 71–75
l. ___ 75 or more

C 4. What is your major field? _____

C 5. Are you now primarily affiliated with:
a. ___ Government
b. ___ Industry (profit-type)
c. ___ Industry (non-profit type)
d. ___ University
e. ___ Other (please identify type _____)

C 6. Did you ever serve on the PSAC?
a. ___ Yes
b. ___ No

C 7. Did you ever serve on a PSAC panel?
a. ___ Yes
b. ___ No

C 8. Did you ever serve:
a. ___ On an Executive Department Advisory Committee?
b. ___ On a Presidential Commission?
c. ___ On a Congressional Commission?
d. ___ As a consultant to the Federal Government?
e. ___ As a member of the Federal Government?
f. ___ None of these.

C 9. Did you ever serve on:
a. ___ COPEP?
b. ___ COSPUP?

For the following questions which ask for an expression of your opinion, please *circle or check* the appropriate entry.

C 10. How would you evaluate your degree of familiarity with the Executive Department Reorganization Plan No. 1 of 1973, which, among other things:
(1) Abolished the Office of Science and Technology in the Executive Office of the President
(2) Transferred some of OST's functions to the Director of the National Science Foundation
(3) Led to a subsequent letter from the President to the Director of the National Science Foundation designating him as "Science Adviser to the President."

a. *Very Unfamiliar*
b. Unfamiliar
c. Familiar
d. Very Familiar

Administration View

C 11. A major justification of the Reorganization Plan advanced by the Administration was as follows: A major objective of the Office of Science and Technology (OST) had been to bring levels of scientific and technological capabilities to maturity in the various departments and agencies. This objective has been achieved, therefore the need for OST had greatly diminished.

"Others" View

On the other hand, several former Science Advisers to Presidents and other well qualified observers suggest that the need for the influence of science and technology at the level of the Executive Office of the President has, for a number of reasons, increased rather than diminished. These reasons include first the expanding need for coordination of strong departmental capabilities in science and technology, and

second, the increasing scientific and technological content of national problems.

Which view do you tend to support?

a. ——— *Administration view.*
b. ——— *"Others" view.*
c. ——— *No opinion.*

C 12. The abolishment of PSAC and its panels has been described as making way for a new informal/ad hoc structure of acquiring "grass roots" advice and counsel. Dr. William O. Baker, President, Bell Telephone Laboratories, testified before the Committee on July 19, 1973 as follows:

> And so we believe that the Reorganization Plan No. 1 of 1973 can involve not a few dozens or few hundreds but literally, through our national engineering and science organizations, tens of thousands of members of our scientific and engineering community in decision-making, as well as in planning and analysis, as well as, of course, in the actual execution.
>
> Now those engineering societies have reorganized themselves. And they have, in Washington, offices representing 145,000 people from the IEEE, and several hundred thousand from the groups of engineering societies. The American Chemical Society has structured itself, through its committee on chemistry and public affairs. President Allen Nixon of the Chemical Society is working directly with the staff director, Dr. Quigley, to devise ways that the 120,000 members of that scientific community can become available in a perfectly orderly structured form to help in early stages of analyzing and executing for the superb opportunities in research and development and applications which lie ahead.
>
> We do not mean by this some proliferation of a vast advisory group. Quite the reverse, we mean an early and extensive alerting of these national bodies, of these independent groups which are now organized to respond to such alerting, alerting by the Government through the agencies of the Reorganization Plan No. 1, so that these institutions can begin to analyze this exceedingly difficult set of choices and options which we face nowadays.

Concerning Dr. Baker's proposal for using a "grass roots" approach, do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 13. Implicit in Reorganization Plan No. 1 and Dr. Baker's testimony was that it was necessary to abolish the PSAC and its panels in order to employ the "grass roots" approach described above.

Do you believe it was necessary to do so in order to employ the "grass roots" approach?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 14. In some cases, PSAC members or PSAC panel members "went public" with personal views on an issue examined by PSAC. How do you feel about this?

a. *Very Inappropriate*
b. *Inappropriate*
c. *Uncertain*
d. *Appropriate*
e. *Very Appropriate*

Harvey Brooks, Dean, Division of Engineering and Applied Physics, Harvard University, was quoted in the National Journal (March 24, 1973) as saying, "The American system, with its emphasis on pluralism, decentralization and competition among sectors for R. & D. funds, performed pretty well until the mid-1960's. However, we've moved into an era where resources for R. & D. are limited, thus necessitating more careful planning and coordinating at or near the highest government decisionmaking level . . . In addition, a new and more difficult task of interweaving science policy with national social, economic and political policies would seem to call for a unified, coherent strategy."

The next three questions address points made by Dr. Brooks.

C 15. The American system worked pretty well from the mid-1940's until the mid-1960's. Do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

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C 16. Dr. Brooks suggested that limited resources require more careful planning and coordinating at or near the highest government decisionmaking level. Do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 17. Dr. Brooks said that a new and more difficult task of interweaving science policy with national social, economic and political policies would seem to call for a unified, coherent strategy. Do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 18. William D. Cary, Vice President, Arthur D. Little, Inc. (and former Assistant Director of the Bureau of the Budget) testified before the Committee on July 24, 1973 that: "... in my opinion there must also be a strategy center to see to it that science and technology are brought fully and effectively to bear on national priorities."

On Mr. Cary's strategy center concept, do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 19. Concerning the new organizational arrangement in which the Director of the NSF has been given the role of Science Adviser and has established a Science and Technology Policy Office, how do you feel about its capability for performing the role of a "strategy center" called for by Dr. Brooks and Mr. Carey?

a. *Very Pessimistic*
b. *Pessimistic*
c. *Uncertain*
d. *Optimistic*
e. *Very Optimistic*

C 20. How do you feel about the new organizational arrangement's capability for interweaving science policy with national social, economics and political policies as called for by Dr. Brooks and others?

a. *Very Pessimistic*
b. *Pessimistic*
c. *Uncertain*
d. *Optimistic*
e. *Very Optimistic*

C 21. Some have suggested that the new organizational arrangement will adversely affect the NSF's basic responsibilities in supporting science and science education. Do you?

a. *Strongly disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly agree*

C 22. What is your opinion about the change of NSF's status in the government heirarchy during the past eighteen months since Reorganization Plan No. 1 went into effect?

a. *Status has risen*
b. *No change in status*
c. *Status has fallen*

C 23. How important is the status of the NSF to the success of the new organizational arrangement?

a. *Very unimportant*
b. *Unimportant*
c. *Uncertain*
d. *Important*
e. *Very important*

Mr. Carey also testified before the Committee on July 24, 1973 as follows:

"What troubles me is a sense that in public policy terms we have no across-the-board approach to leveraging science and technology, that we are still going at it in a disassembled way, in a reactive rather than strategic manner. I think we are going to pay for this by sliding towards technological mediocrity. Some of the indicators of technological slacks are beginning to be seen: Long lead times in introducing new products and processes; the appearance of new barriers to innovation; industrial emphasis upon defensive R. & D.; slow responses to foreign invasion of the domestic market; postponement of technological risk taking

because of regulatory uncertainties; and an excess of technological manpower relative to demand."

The next two questions address points made by Mr. Carey.

C 24. Concerning Mr. Carey's view about "reactive rather than strategic manner", do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 25. Concerning Mr. Carey's judgment that "we are going to pay for this by sliding towards technological mediocrity", do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

On July 24, 1973, Dr. Edward E. David, Jr., Executive Vice President, Gould, Inc. and former Science Adviser to President Nixon, testified before the Committee:

> . . . today it is increasingly clear that the anatomy of the world situation requires not only the unity of engineering and science, but also the extension of this unity to include other elements, namely economics, social factors, legal considerations, and political issues. It is this coalition that is required for coping with the challenges of the 1970's and 1980's. This broader view is not yet of age, but it will become the theme of the 1970's and 1980's, just as the unity of science and technology was the theme of the 1950's and 1960's. I hope that this committee will play its traditional leading role in bringing this developing theme to the Federal policy level and to the scientific and engineering communities.
>
> It is this idea of a broader unity that I will develop in my testimony today because it sets the dimensions of NSF's task in its new role as the Government's highest level policy and advisory body with technical competence.

C 26. Concerning Dr. David's "broader unity theme", do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

Dr. David testified further that he saw fine appointments being made to the National Science Board and to the new Science and Technology Policy Office of NSF. He went on to say:

> . . . However, trying to be as realistic as possible, I see the arrangement in NSF as unstable. The tasks it must undertake are formidable and demanding, as I will indicate. NSF's history is deeply rooted in the academic style which rightly demands single-minded concentration on scientific excellence to the exclusion of other factors. This characteristic is difficult to leaven with other, less science-based realities.
>
> There seems to me to be two possible resolutions of this instability. First, NSF may follow its cultural past and thereby revert to the narrower concerns of science and academic research. Attention to these matters is, of course, of high priority, but they are only part of a much larger role. In this role, NSF would be no more than it already is.
>
> Second, NSF may succeed in transcending its past, and actually achieve the national statute necessary to perform the functions I will outline. This role would involve influencing many of the agencies and departments of government concerning technical programs that cut across their operating boundaries. It also means that NSF would serve as the technological beacon for other agencies. It must act as a surrogate for the President to exert these influences.

The next two questions address points made by Dr. David in his testimony.

C 27. Concerning Dr. David's view of the new arrangement as being "unstable", do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 28. Concerning the NSF transcending its past, do you feel?

a. *Very Pessimistic*
b. *Pessimistic*
c. *Uncertain*
d. *Optimistic*
e. *Very Optimistic.*

Dr. David also testified, ". . . Let me answer a question that has been asked me often since leaving the White House. Has science been downgraded? My answer is "no"! In a very fundamental sense, science and tech-

nology . . . cannot be downgraded. Both are advancing inexorably here at home and at many places in the world. Reorganizations in the Federal Government cannot change that. Science and technology will continue to be the warf and woof which shape our society."

Dr. David went on to say, "While science has not been downgraded the direct influence of scientists on social affairs has. It is too early to tell if this situation will persist. Again, NSF's standing in the executive hierarchy and its influence on other Federal agencies and departments is key."

C 29. Concerning Dr. David's view that science and technology cannot be downgraded, do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree.*

C 30. Concerning Dr. David's view that while science and technology has not been downgraded, the direct influence of scientists and engineers on societal affairs has, do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

Looking to the future, Dr. David testified, "I can outline my thoughts about the major concerns that any science and technology apparatus of national stature will face in coming decades. There are three." The next three questions deal with these concerns.

C 31. Dr. David said, "The first addresses national programs of R. & D. aimed at current problems and opportunities. Some of these programs exist, others are evolving, and a few are on the horizon. At OST we listed them as follows. The dollar figures are the approximate fiscal year 1973 budgets.

[Dollars in millions]

R. & D. program	Agencies	Approximate fiscal year 1973 budget
Energy	AEC, Interior, EPA, NSF, NASA	$625
Health	HEW, NSF, VA, DOT	1,900
Transportation	DOT, NASA, NSF, Commerce	750
Natural resources	Interior, Commerce, Agriculture, NSF, DOT, AEC	650
Education	HEW, NSF, OEO, DOD	200
Social systems	HUD, Justice, OEO, Labor, Commerce, NSF, HEW	360
S. & T. base	NSF, DOD, HEW, AEC, Commerce, Smithsonian, NASA	1,300

Sizing, shaping, scheduling, and monitoring of such programs in the national interest will require the broader unity that I have spoken about."

On Dr. David's first concern, do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 32. Dr. David also said, "A second major scientifically related concern for the years ahead is the rulemaking, standard setting, and regulatory activities of the Federal Government. There can be no doubt of the national impact of these activities, and they are increasing in scope with, for example, the advent of the consumer movement, OSHA, and environmental legislation. The costs of such Federal activities to the public are little short of monumental. Some estimates are as high as $500 billion over the next decade. Just as important will be the effects on the life styles of the citizenry. It is widely agreed, too, that much future research and development is in store if these Federal activities are to be soundly based. Seeing that such R. & D. is done with excellence, with balance, and without waste will be a major challenge.

For example, in toxicological research, "mega-mouse" experiments are being contemplated to study the low dosage, long exposure effects of chemicals and drugs. Needless to say, such experiments consume massive resources. The promise of basic research in this situation lies in uncovering the actual physiologic mechanisms involved in the toxic effects. With adequate understanding, much more incisive experiments coupled with predictive models could make sledgehammer, mega-mouse experiments unnecessary.

Administering programs to reach this goal while filling the needs of the moment with existing techniques will require a deft touch.

There are many similar situations in this arena of Federal standard setting, rulemaking, and regulation. These situations revolve around testing; how is it done, on what scale, and involving which cohort of subjects? Statistical design to yield definitive results is a must here. Scientific techniques based upon statistics and data analysis are an emerging necessity—one that has been recognized even earlier in the effort to control the quality of products and services produced by industry for Government and the public."

On Dr. David's second concern, do you?

a. *Strongly disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 33. Dr. David concluded by saying, "The final coming concern of the 1970's and 1980's is also clearly on the horizon. It is the impact of civilian technology on foreign affairs. We have long known of the importance of military technology in determining our Nation's place in the world. Along with space, perhaps we have become hypnotized by the influence of high-performance weapons. But now we see civilian technologies—automobile production, agricultural techniques, development of natural resources on land and the continental shelves, health care delivery technologies, and educational hardware and software becoming a principal currency of foreign relations."

On Dr. David's third concern, do you?

a. *Strongly disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 34. What other major concerns do you think that a national science and technology apparatus will face in the next several decades?

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

C 35. Dr. David stated in this testimony before the Committee that "It may be worthwhile to require that the policy apparatus produce a report on the state of science and technology in this country every year." Do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 36. Dr. David testified that ". . . my feeling is that unless there is someone at the top level close to the President who has participated in the innovation process himself, many of the essential features of that process will be overlooked and disregarded." Do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 37. Raymond J. Waldman, a White House aide on the Domestic Council staff, was quoted in the *National Observer* (March 24, 1973) as saying: "The fact is that the position of science adviser was an anomaly in the White House. Why should science have a special representative there, when there is no one for welfare or education or public works?"

Concerning the Waldman concept—that the Science Adviser to the President was really a *representative for science* in the White House, do you?

a. *Strongly Disagree*
b. *Disagree*
c. *Uncertain*
d. *Agree*
e. *Strongly Agree*

C 38. There have been extensive discussions about whether or not it is important for the Science Adviser to the President to have reasonably regular personal access to the President.

Do you think such access is?

a. *Very unimportant*
b. *Unimportant*
c. *Uncertain*
d. *Important*
e. *Very important*

---

(3)

(4)

C 46. Please list below the features you consider important to an apparatus for dealing with and using science and technology in national decisionmaking.

(1)

(2)

(3)

(4)

(5)

17

GLOSSARY OF ACRONYMS

AAAS	—American Association for the Advancement of Science
AEC	—Atomic Energy Commission
CEA	—Council of Economic Advisers
COSMAT	—Committee on the Survey of Materials Science and Engineering
COSATI	—Committee on Scientific and Technical Information
COST	—Council on Science and Technology
CRS	—Congressional Research Service
DOD	—Department of Defense
EXOP	—Executive Office of the President
FCST	—Federal Council for Science and Technology
FEO	—Federal Energy Office
FPC	—Federal Power Commission
IRI	—Industrial Research Institute
NAE	—National Academy of Engineering
NAS	—National Academy of Sciences
NASA	—National Aeronautics and Space Administration
NIH	—National Institutes of Health
NIRAS	—National Institutes of Research and Advanced Studies
NSF	—National Science Foundation
OECD	—Organization for Economic Cooperation and Development
OEP	—Office of Emergency Preparedness
OMB	—Office of Management and Budget
OSRD	—Office of Scientific Research and Development
OST	—Office of Science and Technology
OTA	—Office of Technology Assessment
PSAC	—President's Science Advisory Committee
RANN	—Research Applied to National Needs
R&D	—Research and Development
STPO	—Science and Technology Policy Office

○

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515

May 1, 1975

The Honorable Nelson A. Rockefeller
The Vice President
The White House
Washington, D.C.

Dear Mr. Vice President:

Knowing of the keen interest which you have long exhibited with regard to the potentials and uses of science and technology, I am taking the liberty of asking you to assist this Committee as it seeks to take further action in determining the most appropriate and efficient role for the Federal government in the science arena.

In addition to the years of inquiry and investigation by this Committee concerning the matter, we have become acutely conscious of the growing significance of science and technology as stated by President Ford in his State of the Union message on January 15 of this year. We all recall vividly his statements, both explicit and implied, which outlined the reliance which the nation must place on science and technology in seeking to alleviate the problems which the President designated as crucial: the economy, production of new energy, and the successful conduct of international commerce.

We are further mindful of the thoughtful and thorough observations and recommendations which you, as Governor of New York, set forth in your White Paper on Science and Technology in 1968 -- as well as similar activity subsequently undertaken by the Committee on Critical Choices which you formed.

I think it is fair to say at this point that the stake which the nation has in science and technology is now recognized by the Congress as well as the Executive. This fact should permit and encourage a healthy liaison with and between the Executive branch, the Congress, State and local administrations and the private sector. I believe, as I am sure you do, that such liaison and dialogue will be necessary to effect the kinds of mechanisms which are needed in order to utilize our technology in an optimum fashion.

In view of the foregoing, I should like to extend an invitation to you to take part in the opening proceedings of the full Committee's hearings on science policy and organization now scheduled to begin on June 10. We would welcome your participation either as a keynoter in inaugurating this final phase of our work in the area or as a witness. It is my understanding that precedent does exist on at least three different occasions for a Vice President to appear before a committee. In either mode, we would not ask you to endorse or comment on any specific piece of legislation which might be pending before the Committee, but simply to express your views and philosophy on the role which you see for science and technology in the difficult years ahead, as well as any observations which you might care to make concerning methods for its implementation.

If you could be with us as here requested, I have no doubt that your participation would prove to be an extremely strong catalyst in helping this nation and this Administration achieve the national goals and objectives which all of us seek.

Sincerely,

OLIN E. TEAGUE
Chairman

T/cfr

cc: James M. Cannon
Asst. to the President
for Domestic Affairs

Congress of the United States
House of Representatives
COMMITTEE ON
SCIENCE AND TECHNOLOGY
WASHINGTON, D.C. 20515

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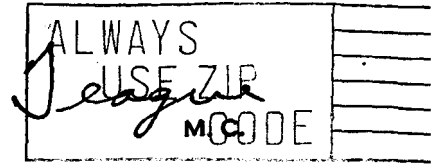


Mr. James M. Cannon
Assistant to the President
for Domestic Affairs
The White House
Washington, D.C. 20500

THE WHITE HOUSE
WASHINGTON

3/24/75

Nancy -

ElouiseFra yer asked me to return this to you.

MR

Mary Rawlins

P. made notation - "[redacted] V.P." [redacted]

Janet Cannon

March 19, 1975

Dear Mr. Chairman:

Thank you for your March 18 letter to the President requesting an opportunity to discuss Federal science policy with his designated spokesmen within the White House.

Please be assured your letter will be called to the President's attention at the earliest opportunity. You will hear further as soon as possible.

With kindest regards,

Sincerely,

Vernon C. Loen
Deputy Assistant
to the President

The Honorable Olin E. Teague
Chairman
Committee on Science and Technology
House of Representatives
Washington, D.C. 20515

bcc: w/incoming to Warren Rustand for further action.
bcc: w/incoming to Max Friedersdorf - for your information.

MXF VCL:EF:VO:vo

3-19

re Staff interview

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515

March 18, 1975

The President
The White House
Washington, D.C.

Dear Mr. President:

On March 6, 1975, Representative Mosher and I co-sponsored a comprehensive bill (H.R. 4461) dealing with Federal science policy, advice and organization. While we believe the proposals in the bill are basically sound and that a statutory base is necessary to a consistent and utilitarian approach to science and technology, we would very much like to have the benefit of your views before we begin consideration of the bill.

As you may know, we and our staff have for some weeks been developing a liaison with officials in the Executive Office concerning ways and means of arriving at a logical Federal role for handling scientific and technological issues. All parties have voiced a desire to discuss their respective ideas, beliefs and needs prior to any final action.

The purpose of this letter, therefore, is to request that we be informed as soon as possible of the nature of your thoughts on the matter and of the appropriate channels through which to discuss them. I know you will understand the indispensable need for me to inform members of our Committee on the views of the Office of the President before we take up any legislation. Since it is my intent to lay plans for hearings

promptly, I hope we will be able to meet with your designated representatives in the very near future.

I am taking the liberty of providing copies of this letter to the Vice President, Mr. Rumsfeld and Mr. Cannon.

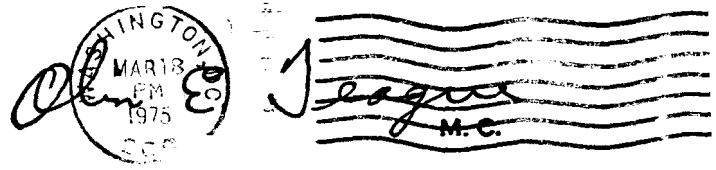
With all good wishes,

Sincerely yours,

OLIN E. TEAGUE
Chairman

Congress of the United States
House of Representatives
COMMITTEE ON
SCIENCE AND TECHNOLOGY
WASHINGTON, D.C. 20515

OFFICIAL BUSINESS



The President
The White House