[COMMITTEE PRINT]

FEDERAL RESEARCH AND DEVELOPMENT PROGRAMS

FIRST PROGRESS REPORT

OF THE

SELECT COMMITTEE ON GOVERNMENT RESEARCH

OF THE

HOUSE OF REPRESENTATIVES

EIGHTY-EIGHTH CONGRESS
SECOND SESSION

UNDER THE AUTHORITY OF

H. Res. 504

FEBRUARY 17, 1964

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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES OF THE UNITED STATES,
SELECT COMMITTEE ON GOVERNMENT RESEARCH,
Washington, D.C., February 17, 1964.

Hon. JOHN W. MCCORMACK,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: Pursuant to House Resolution 504, 88th Congress, I am submitting herewith the first progress report of the Select Committee on Government Research.

Respectfully yours,

CARL ELLIOTT, *Chairman.*

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FIRST PROGRESS REPORT OF THE SELECT COMMITTEE ON GOVERNMENT RESEARCH OF THE HOUSE OF REPRESENTATIVES

INTRODUCTION

This is the first progress report of the Select Committee on Government Research, authorized by unanimous vote of the House of Representatives by the passage of House Resolution 504 on September 11, 1963.[1]

What follows is neither a collection of predetermined judgments nor a list of hastily drawn conclusions. Rather, this is an expression of our thoughts, plans, and goals, presented at this time for all to study in order that we may continue to receive constructive comments and suggestions.

This committee is functioning in a spirit of bipartisan cooperation; its only bias is one in favor of wisely conceived and soundly administered research and development programs designed to strengthen our country and promote the general welfare of our people.

[1] A copy of the resolution will be found in the appendix.

I. An Overview of Research and Development

The history of research, as part of the story of man, goes back for more than a thousand years. The capability for productive research has been demonstrated by persons of practically every society that has ever been recorded.

However, the unparalleled wealth, the advanced state of health, and the myriad technological comforts we in the United States enjoy today have been made possible by a singular and unprecedented combination of encouragement and exploitation of research, under our system of freedom, which attests to a unique American genius.

The importance of research as an aspect of our national life is as natural as it is obvious. Our American society, now as always preoccupied with the notion of freedom, seems to know that through research people may find greater freedom. Such freedom extends from a higher level of physical well-being, through earning an income without the backbreaking toil known to generations past, to the control of our environment, which frees us to enjoy a quality of living dreamed of by all mankind.

Therefore, it is perhaps not startling that today 15 cents out of every American tax dollar is spent by the Federal Government for research and development. What is striking is the leap in levels of Government-supported research and development from the pre-World War II years to the present.

In 1940, our Government spent only $74 million for research and development. By 1953, this figure had risen to about $2 billion and, for fiscal 1965, the figure for research and development expenditures is estimated at above $15 billion.

The Federal Government's $15 billion expenditure for research and development pays both for intellectual exploration of the unknown and for the creation of countless new or improved devices, products, facilities, and weapons. Currently, for example, Federal research and development funds are financing sustained studies of outer space and oceanic depths, of clouds and cancer, of nuclear power and water pollution, of plant and poultry diseases. These and other Government research efforts, added to those of the private sector, will undoubtedly lead to new markets for coal, timber, textiles, chemicals, and other important industries and products.

These tax dollars have provided us with the most extensive, diverse, and modern defense establishment and the most bounteous agricultural production in the world. They have provided us with superior medicines, more accurate weather forecasts, and better trained teachers.

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Additional funds requested for research and development in the coming fiscal year are less than $1 billion, the lowest annual increase in recent years. Nonetheless, the 1965 Federal budget proposes an expenditure for research and development larger than that for any other single category of goods or services to be purchased. Research and development continues to be, therefore, a larger item in the aggregate than the appropriation for any single Federal department or agency except the Department of Defense.

The research and development expenditures estimated in the new budget are nearly seven times greater than those for the conduct of our foreign policy, including foreign aid. They are about triple the amount estimated for all veterans' benefits and services, or for all the agricultural programs of the Federal Government. They are about 50 percent greater than the total of all Federal financial assistance to State and local governments.

But perhaps the most significant thing that can be said about these figures is that, isolated, *they are misleading.* At best, they may be educated estimates and generalizations. To make an accurate comparison between today's level of support and that of former years, for example, one must consider not only the changes in dollar values but also the changes in the Federal agencies' definitions. These definitions now include, as research and development, many items and projects which in former times may have been found and funded in other administrative categories.

For one thing, the figures ordinarily used do not distinguish between the actual conduct of research and development and the agencies' administrative support; hence, the entire budget of NASA, nearly $5 billion in fiscal year 1964, is considered as research and development.

In general, agency research and development figures are based upon their separate estimates of support for basic research, applied research, and development, as reported annually to the National Science Foundation. These estimates break research and development activities into categories which most major agencies and departments never actually employ for any other purpose.

In addition to the National Science Foundation's "Federal Funds for Science," the President's budget for fiscal year 1965 has taken steps to try to provide a correct analysis of research and development expenditures. Its special analysis H is a further step in the right direction, but even so the research and development "budget" is merely a collection of estimates filtering through every Federal department and agency from scores of bureaus and offices.

While the House of Representatives may have considered the separate parts of our Government's research and development programs, it has made no *overall* examination of the entire effort—to be sure that it is being properly directed and coordinated, and to insure that the legislative branch of our Government, as the provider of research and development funds, does not act without comprehensive knowledge and a firm sense of direction.

It was largely because of an awareness that Congress was letting drift from its grasp the means of understanding, controlling, and perfecting the use of a vastly significant and vital segment of our Federal resources, that the House of Representatives unanimously

authorized its first comprehensive investigation and study of Federal research and development programs.[1]

The Federal Government's marriage to research and development has been marked by an amazingly long and luxurious honeymoon. This is due mainly to the exhilarating nuclear age atmosphere in which the union was finally fused and unsparingly nurtured.

Noting the recently slackening annual increase of Federal funds for research and development activities, some say the honeymoon is over.

Be that as it may, it is certain the marriage will endure. And while it is not so certain what precise course this permanent venture will take, what must be made certain is that some plans are now provided to help avoid the diversions and obstacles and problems of all sorts that inevitably lie in the road ahead. At the same time it is the task of this committee to insure that the incentives for engaging in research and development are strengthened and safeguarded rather than strangled by excessive controls and redtape.

II. Summary of Activities and Investigative Resources

The select committee began its formal operations in October 1963. The chairman and ranking minority member, after consultation and approval of the full committee, appointed the staff director, the deputy staff director and counsel, the chief clerk and a general advisory panel to aid in planning the first series of general hearings, now completed, and a general outline for the committee's work. Seventy-five witnesses, representing virtually every Federal department and agency, institutions of higher learning, professional organizations, private industry, research organizations and foundations, were either heard or invited to file formal statements for the record. A list of witnesses may be found in the appendix to this report. The witnesses, authoritative spokesmen in their respective fields, were asked to draw upon their experience and advise the committee in its task. A sample of the invitation follows:

November 5, 1963.

Dear _____:

The Select Committee on Government Research, established by the U.S. House of Representatives, has been charged to make a complete, full, and thorough investigation of the numerous research programs being conducted by sundry departments and agencies of the Federal Government. I want to invite you, as one of the leading scientists of our Nation, to appear before the committee on Wednesday, November 20, at 2 p.m. in the House Public Works Committee, room 1302, Longworth House Office Building, to give your observations and ideas about our Government's research and development programs in general and about specific programs of which you have firsthand knowledge or about which you may be familiar.

We want to know your ideas and suggestions—first, about how you think this investigation might best be accomplished; but, more importantly, we want your observations on the effectiveness, efficiency, worthwhileness, and general impact of present Government research and development efforts or programs. Further, we invite you to make suggestions about how these programs may be improved in the future, based upon your experience and observations.

[1] The Select Committee on Government Research was conceived in H. Res. 455, introduced by Representative Elliott on July 24, 1963. Similar resolutions were introduced by the following Members of Congress: Mr. Smith of Virginia, H. Res. 456; Mr. Bolling, H. Res. 457; Mr. Brown of Ohio, H. Res. 458, July 24, 1963; Mr. Karth, H. Res. 461, July 29, 1963; Mr. Teague of Texas, H. Res. 471, Aug. 1, 1963; Mr. Laird, H. Res. 473, Aug. 5, 1963; Mr. Fraser, H. Res. 476, Aug. 6, 1963; Mr. Tupper, H. Res. 478; Mr. Fogarty, H. Res. 480, Aug. 7, 1963; Mr. St Germain, H. Res. 482, Aug. 8, 1963; Mr. Gross, H. Res. 485; Mr. Shriver, H. Res. 488; Mr. Martin of Nebraska, H. Res. 489, Aug. 12, 1963; Mr. Morse, H. Res. 494, Aug. 14, 1963; Mr. Elliott, H. Res. 504, Aug. 27, 1963. The committee was authorized by the passage, on Sept. 11, 1963, of H. Res. 504, 88th Cong., 1st sess., introduced by Mr. Elliott who was, thereafter, appointed chairman.

Because of the size and scope of this inquiry the committee has found it necessary to limit the time allowed each witness to 20 minutes for an oral presentation. This statement will be followed by 10 minutes of questioning by members of the committee.

We realize that you may want to say more than can be said in 20 minutes. You may, therefore, extend your remarks in writing to whatever reasonable length you may desire, said remarks to be made a part of the record of our hearings. Under the rules of the House, your written statement should be submitted to our select committee office by November 18, 1963, in 100 copies. It is understood that no copies of your statement will be released, either by you or the committee, prior to your oral presentation.

I hope that you can advise me by return mail that you will appear before the committee on the above date.

Sincerely,

CARL ELLIOTT, *Chairman.*

Analysis of the testimony provided at the general hearings reveals 10 major, recurrent issues. These issues form the basis for the 10 staff studies described in section 3 of this report. The published proceedings of the hearings will include a summary of the analysis of the testimony.

In recent weeks, the committee has added a science director and other professional and clerical persons to its staff. In addition, the chairman has appointed a panel of science-engineering advisors to aid the committee in its deliberations. As projected studies go forward, more professional staff persons and many additional advisors will be called upon for special services as needed. The Select Committee's Science-Engineering Advisory Committee is composed of the following:

GEORGE W. BEADLE, President, University of Chicago, Chicago, Ill.
J. W. BEAMS, Professor, Department of Physics, University of Virginia, Charlottesville, Va.
LLOYD V. BERKNER, President, Graduate Research Center of the Southwest, Dallas, Tex.
ROBERT C. BERSON, Dean, South Texas Medical School, University of Texas, San Antonio, Tex.
DONALD DOUGLASS, Jr., President, Douglass Aircraft Corporation, Santa Monica, Calif.
HENRY T. HEALD, President, The Ford Foundation, New York, N.Y.
PENDLETON HERRING, President, Social Science Research Council, New York, N.Y.
AUGUSTUS B. KINZEL, Vice President for Research, Union Carbide Corp., New York, N.Y.
JOHN H. RUBEL, Vice President for Long-Range Planning, Litton Industries, Beverly Hills, Calif.
ALBERT B. SABIN, The Children's Hospital Research Foundation, College of Medicine, University of Cincinnati, Cincinnati, Ohio.
E. V. SMITH, Dean, School of Agriculture, Auburn University, Auburn, Ala.
ELVIS J. STAHR, JR., President, University of Indiana, Bloomington, Ind.
MAX TISHLER, President, Merck Sharp & Dohme Research Laboratories Division, Merck & Co., Inc., Rahway, N.J.
CHARLES H. TOWNES, Provost, Massachusetts Institute of Technology, Cambridge, Mass.

In addition to making use of technical advisors, benefiting from hearings and utilizing its professional staff, the committee will take full advantage of related studies completed or in progress by others—including Government and private groups.

Within the executive departments, agencies, and offices, for example, there is available to the committee a wealth of studies, planning proposals, and coordinating activities, the use and evaluation of which cannot properly be ignored. Such offices as the Bureau of the Budget, the National Science Foundation, the Patent Office, and the President's Office of Science and Technology, with its coordinating Federal

Council on Science and Technology, all offer considerable information concerning, and keen insight into, the problems confronting this committee.

In addition, during recent months many departments and agencies, which had not previously done so, have recognized the need for broader coordination and control of their research programs. They have, in some instances, elevated consideration of science to policymaking levels, often by appointing or designating responsible persons at the assistant secretary or assistant administrator level. Our select committee is gratified by the efforts, on the part of many agencies and offices, to tighten up their procedures for controlling and coordinating research and development activities.

The legislative branch, of course, also provides fruitful sources of information, in the form of studies and of experience within the Legislative Reference Service of the Library of Congress and the General Accounting Office. In addition, many standing committees and subcommittees of the Congress have made, or have recently begun, valuable reports on selected aspects of research and development. House Resolution 504 directs this committee to coordinate with and "make use of information currently available in the various committees of Congress," and the committee has already begun to do so to its great advantage.

Finally, the committee will make use of studies and evaluations of Government research and development activities available from nongovernmental sources or the quasi-governmental National Academy of Science. These sources include committees and study groups representing industry, educational institutions, trade associations, and professional societies. In all cases, *it is the committee's intention not to duplicate useful work already done*, but to find and reinforce, where possible, existing mechanisms for the control or coordination of research and development. For example, plans are already underway to strengthen and utilize the potential of the Science Information Exchange, presently of the Smithsonian Institution.

Finally, it should be noted that the select committee has adopted the policy of requesting from executive agencies, wherever possible, data in the form most easily made available.

III. Areas of Committee Inquiry

The committee realizes it is sailing an uncharted sea when it seeks to study a subject involving the entire U.S. Government and its vast and ever-growing aggregate of research and development programs. It has, therefore, authorized the staff to begin work on 10 separate studies which are designed to divide the complex subject into meaningful and manageable parts. As will be seen, some subjects will be treated, although from different perspectives, in more than one study. It is expected, however, that each study, when completed, will stand alone as a separate report or committee print as well as become an integral part of the overall study. Hearings will be held, when necessary, to amplify the work of the staff and to provide further assistance to the committee in framing its recommendations to the House of Representatives. The 10 studies are as follows:

1. ADMINISTRATION OF RESEARCH AND DEVELOPMENT PROJECTS

Even though the need for support of research and development is undisputed, Congress would be doing only part of its job if it were merely to provide financial support. It has a clear responsibility, in addition, to assure itself and the public that funds are being administered *wisely, efficiently,* and *in the public interest.* At the same time we must be sure that the basic incentives to engage in research and development are encouraged and not dampened. This study, and study No. 3 relating to fiscal and contractual policies will deal primarily with the efficiency of the decisionmaking process which determines the programs to be supported. We will do so by ascertaining the administrative policies and procedures employed by each Government department and agency. We will also explore the implications of some of these policies by studying the effects of the various ways in which the Congress authorizes and appropriates for research and development programs.

In this study, some of the questions to be considered include: What are the administrative steps, from the initiation of a proposal to the decision to commit funds or sign a contract, which each agency takes to insure that it is obtaining a well-conceived and well-defined service or product or a well thought out and promising scheme for basic exploration? How are intermediate decisions made and reviewed? How are advisory panels utilized?

It is anticipated that a variety of different administrative procedures will be found in the several departments and agencies. Through appropriate analysis, an effort will be made to determine the extent to which diversity of practice is desirable and the extent to which common principles might be found to simplify and reduce the administrative problems of both the Government and the private contractors and grantees. Special attention will be given to instances in which the research and development programs have not worked out well, so that the proper lessons can be drawn to improve future programs.

2. FACILITIES FOR RESEARCH AND DEVELOPMENT

A study of the Government's research and development effort requires a broad analysis of the major expenditures for physical plants and equipment. As much as 15 percent of the total Federal expenditure for research and development each year, in excess of $2 billion this year, is applied to the acquisition of land, equipment, and construction of new buildings to house laboratories, testing sites, and other scientific facilities. In the three major agencies—Department of Defense, National Aeronautics and Space Administration, and Atomic Energy Commission—as much as half or more of the research and development funds have, in some years, been allocated to acquisition, construction, equipment, and maintenance of plant facilities.

This study will inventory the facilities of the Government which are used primarily for research or development activities, ascertain the projected use of such facilities, and secure from the agencies their plans for construction of new facilities during the next 5-year period. Special attention will be given to Government support of research and development centers and other industrial and educational facilities used for federally supported research and development.

This study will reveal the patterns of current Government conduct and investment in research and development facilities. The facts developed will be helpful in identifying possible duplication and gaps in programs and facilities. In the later phases of this study, an attempt will be made to set forth general principles to guide the development and acquisition of future facilities as well as the termination or modification of the use of existing ones.

3. FISCAL AND CONTRACTUAL POLICIES AND PROCEDURES

Our committee will address itself to many unresolved problems with respect to policies and procedures for negotiating research and development contracts and grants. The importance of this subject is made obvious by the fact that 75 percent of all Federal funds for research and development is not spent within Federal agencies, but is paid to private industry and, to a lesser extent, to private, nonprofit laboratories, research organizations, colleges and universities. Some problems arising from Government payments to private groups for research and development involve patent and other proprietary rights in inventions, technical data, and published material; security classification provisions; tax incentives or inhibitions; various types of contract and grant instruments; and numerous varieties of procurement contract and negotiation practices, policies, procedures, and regulations.

Questions have been raised as to the wisdom of administering research and development under traditional procurement regulations which were originally designed to facilitate the purchase of goods and materiel. Questions should be raised as to whether there is any need for widely differing policies and regulations, among the Government agencies, which apply to essentially simlar if not identical contractual requirements. In view of the impact of these large expenditures on all segments of our Nation, attention will be given to the extent to which the various decisions should be made within our traditional concepts of due process of law. As in the case of other staff studies, a preliminary review of the available literature will be conducted in order that a judgment may be made as to which areas of study will prove most productive.

It is expected that this study will provide the House a context in which problems of research and development contracting, management, administration, and policymaking can be better evaluated. Recommendations will then be considered for the purpose of making the contract or grant a more effective legal and administrative tool in promoting, as well as protecting, public and private interests.

4. IMPACT OF GOVERNMENT RESEARCH

Prior to World War II, most Government research and development was performed in Federal installations. Today, three-quarters of the annual Federal research and development program is conducted in the private sector, nearly 80 percent of which is obligated by contracts with private, profit-seeking firms. Some 15 percent is disbursed to colleges and universities through grants or contracts, and the remaining 5 percent is paid to other nonprofit organizations.

In 1939, about $500 million was expended for research and development by industry, the universities, foundations, and the Federal Government, of which the Federal share was but some 15 percent. Now, the Federal Government performs or finances more than two-thirds of the research and development effort in the United States, insofar as this activity can be measured by expenditures. In 1953, private industry expended $4.3 billion for research and development, of which 60 percent was derived from corporate funds. Today, industry's annual outlays for research and development total $13 billion, of which 60 percent is derived from the Federal Government. While industry's research and development expenditures doubled in this period, those of the Federal Government were multiplied by 4½ times.

Although smaller in magnitude, research and development expenditures in the field of higher education may have had a greater impact than those in industry. In 1940, the Federal Government expended only about $15 million for research in colleges and universities. By fiscal 1962, institutions of higher learning received $613.1 million from the Federal Government for basic research alone, according to the report [2] of the Special Subcommittee on Education of the House Committee on Education and Labor, under the chairmanship of Representative Edith Green. Most of these funds have gone to a comparatively small number of institutions.

There is a growing feeling of concern that a more than generous share of the infinitely larger funds spent for applied research and for development is also concentrated in a handful of States. It is clear that our national security must not be impaired by regional consideration in research and development expenditures; it is equally clear that, to an extent perhaps not yet accurately measurable, these same expenditures have an extraordinarily powerful impact on the educational, industrial, and employment sectors of every region's vitality.

This study will, after reviewing the extent and quality of available knowledge, seek to measure and assess the impact of Government-sponsored research and development upon various segments of the Nation's economy. These will include industry, small business, State and geographical areas, and institutions of higher education. Policies and principles for future action will be developed.

5. STUDENT ASSISTANCE IN HIGHER EDUCATION

Through a score of departments and agencies, the Federal Government annually assists a significant number of students to obtain higher education. Most of these students are working toward the Ph. D. degree in the natural or social sciences. Such Federal support may take any of the following forms: loans; graduate fellowships awarded directly by the Federal agency; assignment of fellowships for award by the educational institution; payment of a training grant to the institution, a portion of which may be used to support graduate or undergraduate students; research contracts and grants which permit employment of graduate assistants.

In one or another of these ways, approximately 275,000 young men and women received some measure of support from the Federal

[2] "The Federal Government and Education," H. Doc. 159, 88th Cong., 1st sess., September 1963.

Government in degree-granting programs in American colleges and universities during fiscal year 1963. Although research grants and contracts supported a significant proportion of students, it is quite difficult to state with precision the number of students assisted or the amount of Federal funds which accrue to students as a result of secondary participation in professorial or institutional research grants. Research and development work occupies much of the student recipients' time, however, and thus the federally sponsored research effort derives much strength from this method of indirect student support.

Our staff has begun a study to determine the extent and direction of the Government's financial assistance programs for students in American degree-granting colleges and universities. This staff study will consist of two principal parts: The first will be the collection and analysis of data from some 20 Federal agencies presently granting some form of financial assistance to students in higher education. Concomitant to this inquiry, an exhaustive questionnaire to some 1,500 colleges and universities is contemplated which will be followed by selective personal staff contact.

This latter phase of the staff study will help to verify and expand available Government figures; it will also provide the first extensive source of information regarding the extent of indirect Government support of students through professorial and institutional grants.

Finally, data collected from the Federal agencies will be further analyzed to explore the various questions implicit in such student assistance. A breakdown of college and university student financial assistance data will pinpoint, for example, the extent and types of Government research and development being aided by this support.

6. INTERAGENCY COORDINATION OF RESEARCH AND DEVELOPMENT PROJECTS

Although research and development funds are appropriated to a variety of departments and independent agencies, approximately 90 percent of the expenditures are administered by five of these. In order of fiscal magnitude, they are, the Department of Defense, National Aeronautics and Space Administration, Atomic Energy Commission, Department of Health, Education, and Welfare, and the National Science Foundation. The entire program of the National Aeronautics and Space Administration is regarded as research and development by the Bureau of the Budget. The expenditures of NASA currently constitute one-third of all Federal funds allocated for research and development.

The committee is conducting a study to determine both the existing methods of coordinating research and development projects among Government agencies, and an examination of specific scientific and engineering fields to determine whether needless duplication or gaps exist. All Government-sponsored research and development projects will be analyzed by two major groupings: First, an analysis will be made of basic and applied research projects. The facilities of the Science Information Exchange of the Smithsonian Institution will be employed for this phase of the study. Second, development projects principally in the Defense Department, NASA, and AEC will be analyzed. These projects are not registered with SIE, but most of

the necessary data may be obtained from existing sources in the three agencies.

When data are compiled on specific scientific or development fields in which various agencies are involved, panels of expert consultants will review projects in selected areas. The report of the consultant panels will deal with the adequacy and efficacy of research and development programs in the sample areas.

This examination of existing coordinating activities may well yield general principles and mechanisms for further coordination of research and development programs.

7. STATISTICAL REVIEW OF GOVERNMENT RESEARCH AND DEVELOPMENT

House Resolution 504 directs this committee to ascertain, among other things, "the overall total amount of annual expenditures on research programs." In an area of expenditure which has mushroomed so greatly, as has research and development, the committee deems it vital that the Congress have a full and accurate accounting of all research and development expenditures by subject, by type, and by governmental unit; in other words, an across-the-board, statistical review and analysis of all federally conducted or supported research and development activities.

Considerable groundwork has already been laid for such a review. The annual report on "Federal Funds for Science," prepared by the National Science Foundation, provides an available summary. Because of serious reservations as to the completeness and accuracy of figures supplied the National Science Foundation by the Government agencies involved, the committee has been gathering considerable data of its own. These two sources will be studied and correlated, and quantitative data from other studies will be summarized as well, to achieve an overview of research and development programs supported by the Federal Government.

The committee has instructed the staff to include in this study, among other items, the following goals:

(*a*) To identify the amount of annual expenditures and the number of research and development projects supported by the Government during the 1963 fiscal year;

(*b*) To determine what departments and agencies of the Government are conducting research and development and at what cost;

(*c*) To ascertain the amounts expended and the number of research and development projects supported by the various departments and agencies through grants and contracts with colleges and private industry;

(*d*) To determine the distribution of current research and development projects and expenditures by State and geographical areas;

(*e*) To survey the subject matter of all projects undertaken or supported by departments and agencies, as well as the type of research or development undertaken.

8. DOCUMENTATION, DISSEMINATION, AND USE OF RESEARCH AND DEVELOPMENT RESULTS

The scientific communities within Government, industry, and the universities are, more and more, recognizing a need for accessible and current information on research and development efforts and results. As research and development activities continue to increase there is a corresponding need for thorough, meaningful documentation of their results. In each of these communities conscientious efforts are being exerted to strengthen existing systems. Every attempt made to improve present standards now will have even greater significance for the future.

Within the Federal executive establishment, the President's Science Advisory Committee and the Committee on Scientific Information of the Federal Council on Science and Technology have offered leadership in this rapidly expanding field.

Much credit for these advances can be taken, as well, by various congressional committees, especially the Subcommittee on Reorganization and International Organizations of the Senate Committee on Government Operations and the Subcommittee on National Data Processing and Information Retrieval Center of the House Government Operations Committee. As in the case of other studies, it will always be a goal of this select committee to strengthen, where possible, existing mechanisms in the documentation field.

The select committee, in this study, will attempt to assimilate a broad view of the documentation, dissemination, and communication processes as they pertain to the Federal research and development effort. Preliminary study of the subject has indicated the existence of a substantial number of documentation and information services throughout the Government, both in-house services and those under contract to private companies. It has also revealed an apparent difficulty on the part of the agencies to identify all the services they perform, not to mention their difficulty in coordinating these services. Thus, an inventory of documentation and information services is particularly needed and such an inventory will be an early task of this committee.

Particular attention will be given to the varying systems of documentation in existence, the publication habits of the agencies, the geographic spread of research documentation facilities throughout the United States, the standardization of indexing and abstracting forms, and specifics on the user's need for this documentation. Consideration will also be given to the question of page charges, patent and copyright policies, national security restrictions and their effect on the private enterprise system. Adequate flow and translation of foreign research and development results will be reviewed by the committee, as well as the current discussions regarding clearinghouses, central depositories, and specialized information centers.

Documentation, per se, is but a means to an end. It is necessary to look at the process to determine if the consumer and the scientific and technological communities are actually being served. It is anticipated that this study, possibly amplified by appropriate hearings, will form the basis for conclusions and recommendations by the committee.

9. MANPOWER FOR RESEARCH AND DEVELOPMENT

Some 400,000 scientists and engineers in the United States are engaged in full-time research and development work. Of this number, industry employs about 300,000, and colleges and universities 50,000. Research and development workers represent nearly 40 percent of the scientists and engineers employed by industry and about 35 percent of those employed by colleges and universities.

Although the Federal Government now performs or finances more than two-thirds of the research and development effort in the United States, insofar as these activities can be measured by expenditures, it cannot be readily determined how many scientists and engineers engaged in research and development are on the Federal payroll, directly or indirectly.

The Green committee report concludes in its chapter on "Projected Manpower Needs":[3]

> There is scarcely a field of endeavor which is not now experiencing a critical shortage of professional or highly trained manpower with little relief in sight.

The report continues:

> The existing information on professional manpower supply and demand is totally inadequate for proper planning and coordination of the national effort.

According to many of the witnesses who testified before the Select Committee on Government Research, this critical shortage of manpower is looming ever larger on the research and development horizon.

For example, it is significant that the number of individuals capable of performing research and development increases by only 7 percent annually, while the annual growth in Federal research and development expenditures has averaged 15 percent.

The purpose of this study by the select committee's staff is to determine the supply of manpower available to support the total research and development effort of the United States; to determine the extent to which sufficient manpower is being educated to meet evident national requirements in this field in the years ahead; and, to consider the possible redirection or redeployment of presently available scientists and engineers. The first step to be taken in this connection is to review manpower studies of the recent past so as to determine specific areas which should be given concentrated attention. Members of the National Academy of Science, the Engineers Joint Council, and other professional groups will assist in this effort. The second step will be to synthesize previous related studies and to investigate gaps apparent in previous efforts.

Surely an overall perspective of current utilization and projected needs for research and development manpower will help departments and agencies evaluate their current programs and plan better for the future.

10. NATIONAL GOALS AND POLICIES

Without minimizing the importance of science for its own sake, the ultimate question which Government agencies must resolve before obligating funds for research and development is: What is the relationship of the program to the national interests and the responsibilities of the Government? Conversely, the question might be put: What

[3] Op cit., p. 8.

areas of research and development is it not the proper function of the Government to support?

In an area where definitional problems run rampant, perhaps the most complex problem of all is to define national goals and policies. However, the general hearings identified for study some of the problems raised by centralization or lack of centralization of research and development responsibility, both in the executive and legislative branches, with respect to developing national research and development goals and programs. The purpose of this study, then, is first to identify the existence, or the lack thereof, of explicit departmental, agency, and national research and development missions, policies and goals and, second, to identify priorities or the techniques to do so.

This will be a continuing study, drawing from conclusions of the other staff studies as well as from analyses of the available constitutional, legislative, and academic literature. Guidelines for helping to decide the relative merits of supporting competing proposals, as well as for striking the balance between basic and applied research and between research and development, may result from this study. In any event, it is envisioned that the study on national goals and policies may prove to be the basis for the committee's final report and it is hoped that a structure may result which will serve as a basis for the evaluation of specific agency missions in the future.

IV. Preliminary Research and Development Checklist

Our committee has identified a number of questions which will be investigated as part of the 10 preceding studies. While it is not possible at this time to make specific recommendations, the committee is anxious to share with other committees of Congress a few of these questions in the hope that they will be of some value. It is also hoped that congressional committees will not hesitate at a later date to contact the Select Committee on Government Research should there be a desire to secure an up-to-date report on the progress of any of the studies.

1. *To what extent should congressional review include oversight of specific projects?* Great variation occurs in types of authorizations and appropriations made by the Congress to the various agencies and departments. These range from specific research and development project approval by the Congress, to general programwide approval by the Congress with agency personnel determining specific projects.

2. *In reviewing a program, to what extent are committees of Congress able to consider an entire program, and not merely special parts of it?* Sometimes a program comes to a congressional committee for review under statutory terms which limit the scope of that review to one item, such as "construction." At other times a program may come to a committee for review when there are other parts of that program or other related programs which are subject to review by another committee.

3. *In reviewing a program, to what extent is a committee able to identify and concentrate on the key samples of the program, relying on the agency for other phases?* With research and development projects numbering into the hundreds of thousands, it is impossible for any committee of Congress to evaluate the total effort within its jurisdiction.

4. *In reviewing a program, to what extent can and does a Government agency verify whether similar work is being done elsewhere in the Government, in the private sectors, or in other nations?* Research and development work is being carried on extensively in many sectors. Many Government agencies have programs which touch upon similar or overlapping problems. Universities and industries have research and development programs which often come close to programs in which a Government agency may be interested. There are similar programs being carried on in other countries, and sometimes these programs are also under the supervision or guidance of an international organization.

5. *When construction funds for a new or expanded program are being sought, to what extent has the agency verified that it cannot put the program in facilities of its own or of another agency that are already in existence?* One of the major demands for funds arises out of the need for new construction. Sometimes there are existing facilities within the agency which might, upon examination, be found suitable for the new program. Sometimes there may be such a facility in another Government agency.

6. *To whom do the congressional committees turn for help in evaluating technical matter?* There are many persons and organizations to whom the Congress can turn for advice in deciding the problems raised by the research and development programs it has to review. Some committees have staff members or consultants who are scientists. There are scientists in the executive agency presenting the program. There are other scientists available through the Library of Congress and through the Executive Office of Science and Technology.

7. *In planning a particular program, does the agency consider the effect of its request upon the manpower available to that program as well as to other programs?* In considering any program, the agency has to consider the human resources available for the program as well as the financial terms. Sometimes by richly endowing one program, it can attract scientists and engineers who are in short supply from some other program where they may be needed as much, if not more.

8. *To what extent do agencies contract for services in order to circumvent the limit or number of employees?* As is well known, the executive branch of the Government places a personnel ceiling upon departments and agencies in an effort to control expansion.

9. *To what extent do procedures operate to encourage sound decisions and the enhancement of the most promising projects?* Each department and agency has developed procedures for approving projects. In some instances the procedures include the use of advisory panels with agency personnel making the final judgments.

10. *In reviewing a program, to what extent is an agency able to verify that there has been adequate consideration given to all of the problems that need to be resolved before the successful completion of the project can be anticipated?* In a program, and especially a large development program, there may be any number of questions which will have to be resolved before the program can be successful. Sometimes these problems are successfully surmounted, as in the nuclear submarine program. At other times

these problems, or unforeseen ones, become obstacles which make it undesirable to spend further funds on the program, as with the aircraft nuclear propulsion program.

11. *What policies and procedures exist in each agency to terminate contracts and grants when it is discovered, while the project is being operated, that the outcomes will be of little or no value?* Research and development projects entail an element of risk in that the value of outcomes cannot be known in advance. Such is particularly true of crash programs operated on an accelerated basis.

12. *In the selection of a contractor, does the agency justify its decision by weighing the relative merits of technical resources versus geographical impact?* There is evidence that research and development activities have been concentrated in several of the larger cities. Placing further activities in areas such as these may be necessary because they contain the only human or physical resources by which a program can be completed. Yet this very placement can deprive some other locality of a program that it might be able to complete and thus help spread our technological development out over more geographic areas of our Nation.

13. *To what extent is the potential effect on industry considered as a factor in the decision to contract for research or development?* Government research and development expenditures exert a major impact on the private, industrial sector of our economy. (The extent of this impact is the subject of one of the select committee's studies.)

14. *In considering the terms of a particular program, does the agency consider the ways in which that program's results can be commercially developed for the benefit of the public?* There are many ways in which the effect of any particular research and development program can, by itself or in other applications, be of commercial value. There are many factors which have to be weighed in the proper setting for commercial development. These can range from having a single corporation, chartered under the auspices of the Federal Government, to exploit the development (as in the Communications Satellite Corp.), to having the development available for any company to use. Many factors need to be weighed in the decision as to which method will produce the greatest scientific acceleration and the most benefit to the Nation as a whole.

15. *When a program is to be funded, what is the extent of the search made to find alternative methods of financing, and how are the benefits and drawbacks of the possible alternatives weighed?* There are many ways of funding a research or development program. These include outright grants, cost-plus contracts, fixed-price contracts, subsidies for part of the costs, and governmental guarantees for costs which exceed estimates.

16. *Particularly in major programs, to what extent are contractual provisions and conditions reviewed to assure that economy and efficiency are encouraged?* Under certain circumstances, research or development can be conducted most economically in-house; often, however, facilities under contract are either the most economic or the only feasible method.

17. *When agencies contract with, or place grants in, universities, what consideration is given to the overall impact of research and development funds on higher education; on the development and training of scientific manpower?* It has become the prevailing practice of Government agencies to support considerable basic research in educational institutions.

18. *Are the documentation networks and coordinating bodies established by the Federal Government being used to fulfill real needs and purposes, or are they window dressings?* Thoughtful decisions should be made prior to establishment of new informational depositories as to who needs the information so that the method of documentation and dissemination decided on will serve specific audiences, though of the widest range possible. Also, as the research and development informational system within the Federal Government improves, plans must be made to inform potential users of the availability of the gathered information.

19. *To what extent does salesmanship, on the part of industry, educational institutions, or private research organizations insure the receipt of Government contracts or grants?* Smaller institutions, while having qualified, competent, and scientific manpower, may not have sufficiently large organizations to spend great sums of money and use full-time personnel to sell their capabilities to Government agencies.

20. *On what bases do Government departments or agencies decide to contract either with profit or nonprofit organizations?* Many times, it appears that nonprofit organizations might perform equally competent service in a research and development project as a profit-seeking firm.

21. *In the evaluation of basic scientific research programs, are all necessary steps being taken to insure that, where appropriate, applied research is undertaken?* Certain of our witnesses raised questions relating to the possible inadequacy of our support of applied research in general and the training of applied scientists in particular. We want to be certain that the results of basic science which have an application (often unforeseen by the researchers themselves) are fully developed.

APPENDIX

ALPHABETICAL LIST OF WITNESSES APPEARING BEFORE HOUSE SELECT COMMITTEE ON GOVERNMENT RESEARCH, NOVEMBER 18, 1963–JANUARY 22, 1964

Dr. O. C. Aderhold, president, University of Georgia.
John B. Babcock, senior vice president, Associated Business Publications.
Dr. Paul W. Bachman, chairman, Committee on Research, National Association of Manufacturers.
Dr. W. S. Bailey, associate dean of the graduate school and coordinator of research, Auburn University.
Dr. Lloyd V. Berkner, president, Graduate Research Center of the Southwest.
Dr. Robert C. Berson, American Association of Medical Colleges.
Dr. Harold Brown, Director of Defense Research and Engineering, Department of Defense.
Dr. Vannevar Bush, Massachusetts Institute of Technology.
Dr. John C. Calhoun, Assistant and Science Adviser to the Secretary of Interior.
Dr. Robert D. Calkins, president, the Brookings Institution.
F. R. Collbohm, president, the Rand Corp.
George C. Denney, Jr., deputy director, Bureau of Intelligence and Research, Department of State.
Dr. Lee A. DuBridge, president, California Institute of Technology.
Dr. H. Ward Ewalt, Jr., immediate past president, American Optometric Association.
Dr. Edward G. Feldmann, director, Scientific Division, and Dr. Grover C. Bowles, Jr., chairman, governing council, American Pharmaceutical Association.
Dr. John C. Flanagan, American Educational Research Association.
Hon. Eugene P. Foley, Administrator, Small Business Administration.
Hon. William C. Foster, Director, U.S. Arms Control and Disarmament Agency.
Dr. Monroe E. Freeman, Director, Science Information Exchange, Smithsonian Institution.
Bernard D. Haber, assistant to the president, North American Aviation, Inc.
Hon. Najeeb E. Halaby, Administrator, Federal Aviation Agency.
Dr. George L. Haller, vice president, General Electric Co.
Dr. William J. Harris, Jr., chairman, Government Liaison Committee, Engineers Joint Council.
Daniel J. Haughton, president, Lockheed Aircraft Corp.
Hon. Leland J. Haworth, Director, National Science Foundation.
Henry T. Heald, president, the Ford Foundation.
Hon. J. Herbert Hollomon, Assistant Secretary of Commerce for Science and Technology.
Boisfeuillet Jones, special assistant to the Secretary of Health, Education, and Welfare (for Health and Medical Affairs).
Dr. Charles F. Jones, president, Esso Research & Engineering Co.
Dr. James R. Killian, Jr., chairman of the corporation, Massachusetts Institute of Technology.
Dr. Grayson Kirk, president, Columbia University.
Dr. George B. Kistiakowsky, Harvard University.
Dr. Edwin H. Land, president, Polaroid Corp.
Dr. Louis Levin, dean of science and associate dean of faculty, Brandeis University.
Dr. F. A Long, vice president for research and advanced studies, Cornell University.
Dr. John W. McConnell, president, University of New Hampshire.
Dr. W. M. Murray, Jr., director, Southern Research Institute.
Dr. Frank A. Rose, president, University of Alabama.
Dr. Howard A. Rusk, chairman, department of physical medicine and rehabilitation, New York University Medical Center.

Dr. Clarence Scheps, chairman, Committee on Governmental Relations, National Association of College and University Business Officers.
Dr. Glenn T. Seaborg, Chairman, Atomic Energy Commission.
Dr. Frederick Seitz, President, National Academy of Sciences.
Dr. Byron T. Shaw, Administrator, Agricultural Service, Department of Agriculture.
Dr. Elmer B. Staats, Deputy Director, Bureau of the Budget.
Dr. Robert E. Stiemke, associate dean of faculties and administrator of research, Georgia Institute of Technology.
Dr. Edward Teller, University of California.
Dr. B. D. Thomas, president, Battelle Memorial Institute, Columbus, Ohio.
Dr. Wernher von Braun, Director, George C. Marshall Space Flight Center, National Aeronautics and Space Administration.
Dr. Alan T. Waterman, president, American Association for the Advancement of Science.
Hon. James E. Webb, Administrator, National Aeronautics and Space Administration.
Dr. Alvin M. Weinberg, Director, Oak Ridge National Laboratory, Atomic Energy Commission.
Dr. Edward Wenk, Jr., Executive Secretary, Federal Council for Science and Technology, Executive Office of the President.
Dr. Jerome B. Wiesner, Director, Office of Science and Technology, Executive Office of the President.
Dr. Logan Wilson, president, American Council on Education.
Hon. W. Willard Wirtz, Secretary of Labor.

WITNESSES WHO DID NOT APPEAR BEFORE THE COMMITTEE BUT FILED STATEMENTS FOR THE RECORD

Dr. William R. Baldwin, dean, College of Optometry, Pacific University.
Andrew J. Biemiller, legislative director, AFL–CIO.
Dr. F. J. L. Blasingame, executive vice president, American Medical Association.
Dr. John S. Dickey, president, Dartmouth College.
Dr. Milton S. Eisenhower, president, The Johns Hopkins University.
Dr. Novice G. Fawcett, president, Association of State Universities and Land-Grant Colleges.
Dr. James B. Fisk, president, Bell Telephone Laboratories, Inc.
Dr. Karl Folkers, president, Stanford Research Institute.
Dr. C. C. Furnas, president, State University of New York at Buffalo.
Dr. Ivan A. Getting, president, Aerospace Corp.
Dr. J. George Harrar, president, The Rockefeller Foundation.
Dr. Elmer Hutchison, director, American Institute of Physics.
Representative Robert E. Jones, Jr., chairman, Subcommittee on National Resources and Power, House Committee on Government Operations.
Dr. Clark Kerr, president, University of California at Berkeley.
Dr. Evron M. Kirkpatrick, executive director, American Political Science Association.
Donald L. Peyton, secretary, Science and Technology Committee, Chamber of Commerce of the United States.
George S. Schairer, vice president, research and development, The Boeing Co.
Dr. Austin Smith, president, Pharmaceutical Manufacturers Association.
Dr. Lindley J. Stiles, dean, School of Education, University of Wisconsin.
Harry F. Vickers, president, Sperry Rand Corp.

[H. Res. 504, 88th Cong., 1st sess.]

RESOLUTION

Resolved, That there is hereby created a select committee to be composed of nine Members of the House of Representatives to be appointed by the Speaker, one of whom he shall designate as chairman. Any vacancy occurring in the membership of the committee shall be filled in the manner in which the original appointment was made.

The said committee is directed to make a complete, full, and thorough investigation of the numerous research programs being conducted by sundry departments and agencies of the Federal Government and, without limiting the generality of the foregoing, the committee shall give special attention to the following: (1) the overall total amount of annual expenditures on research programs; (2) what departments and agencies of the Government are conducting research and at what costs; (3) the amounts being expended by the various agencies and departments in grants and contracts for research to colleges, private industry, and every form of student scholarships; (4) what facilities, if any, exist for coordinating the various and sundry research programs, including grants to colleges and universities as well as scholarship grants.

In order that this investigation of the numerous research programs may be better coordinated, without limiting the scope of the said committee's investigation, it is directed, among other investigative procedures, to make use of information currently available in the various committees of Congress which have legislative jurisdiction over Government research activities to the end that the said select committee may be able to recommend the necessary legislation to coordinate and prevent unjustifiable duplication in the numerous projects and activities of the Government relating to scientific research.

The committee shall report its findings to the House with such recommended legislation as the committee may deem appropriate to correct any deficiencies. The committee shall make such reports to the House prior to December 1, 1964, and may submit such interim reports as it deems advisable. Any reports submitted when the House is not in session may be filed with the Clerk of the House.

For the purposes of this resolution the committee, or any subcommittee thereof, is authorized to sit and act during the present Congress at such times and places within the United States, whether or not the House has recessed or adjourned, to hold such hearings, to require the attendance of such witnesses and the production of such books, papers, and documents, and to take such testimony as the committee deems necessary. Subpenas may be issued under the signature of the chairman of the committee or any properly designated chairman of a subcommittee, or any member designated by him and may be served by any person designated by such chairman or member. The chairman of the committee or any member thereof may administer oaths to witnesses.

The majority of the members of the committee shall constitute a quorum for the transaction of business, except two or more shall constitute a quorum for the purpose of taking of evidence including sworn testimony.