84th Congress, 1st Session - - - - - House Document No. 174

RESEARCH AND DEVELOPMENT IN THE GOVERNMENT

LETTER

FROM

CHAIRMAN, COMMISSION ON ORGANIZATION OF THE EXECUTIVE BRANCH OF THE GOVERNMENT

TRANSMITTING

A REPORT ON RESEARCH AND DEVELOPMENT IN THE GOVERNMENT, PURSUANT TO PUBLIC LAW 108, 83D CONGRESS

MAY 31, 1955.—Referred to the Committee on Government Operations and ordered to be printed

UNITED STATES
GOVERNMENT PRINTING OFFICE
63195 WASHINGTON : 1955

Commission on Organization of the Executive Branch of the Government

HERBERT HOOVER, *Chairman*

HERBERT BROWNELL, JR.	ROBERT G. STOREY
JAMES A. FARLEY	CLARENCE J. BROWN
ARTHUR S. FLEMMING	CHET HOLIFIELD
STYLES BRIDGES	JOSEPH P. KENNEDY
JOHN L. MCCLELLAN	SIDNEY A. MITCHELL

SOLOMON C. HOLLISTER

Letter of Transmittal

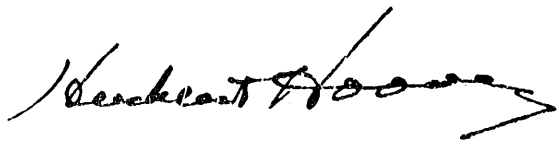
May 31, 1955.

DEAR SIRS: In accordance with Public Law 108, Eighty-third Congress, approved July 10, 1953, the Commission on Organization of the Executive Branch of the Government submits herewith its report on Research and Development in the Government.

The Commission has had the services of an able task force, consisting of a subcommittee of the Committee on Business Organization of the Department of Defense, presided over by Dr. Mervin J. Kelly, President of the Bell Telephone Laboratories. Their exhaustive investigation is embodied in the subcommittee report on this subject, which will be filed with Congress in the near future.

The recommendations of the Commission do not necessarily coincide with all of those of the subcommittee, but include the results of independent investigation by the Commission's staff and the experience of the members of the Commission.

Respectfully,



Chairman.

The Honorable
The President of the Senate
The Honorable
The Speaker of the House of Representatives

Contents

Acknowledgments

This investigation and report upon the Research and Development activities of the Federal Government comprise two parts:

Part I. Research and Development in the Department of Defense

Part II. Research and Development in the Civilian Agencies

The investigation into the defense agencies was performed by a Task Force Subcommittee of the Commission's Committee on the Business Organization of the Department of Defense under the chairmanship of Charles R. Hook. The investigation into the civilian agencies was performed by the Commission's staff under the direction of Harold W. Metz.

The members of the Task Force Subcommittee on Research and Development in the Department of Defense were:

Mervin J. Kelly, *Chairman.* Missouri School of Mines and Metallurgy, University of Kentucky, and University of Chicago. Formerly physicist with Western Electric Co. Member of several technical societies and institutes; served on various governmental committees. Fomerly physicist, now President, Bell Telephone Laboratories, Inc.

Frederick L. Hovde. University of Minnesota; Rhodes Scholar from North Dakota, Oxford University. President of Purdue University. Member of Research Advisory Board of National Research Council.

Robert M. Kimball. Massachusetts Institute of Technology. Various administrative positions at M. I. T. since 1933. Administrative Associate Director, Los Alamos Scientific Laboratory, New Mexico, 1948–50.

C. Guy Suits. Research Physicist. University of Wisconsin. Presently Vice President and Director of Research of the General Electric Co.

Clyde E. Williams. University of Utah. President of Battelle Institute since 1929 and a Director since 1934. Member of Advisory Committee, Atomic Energy Commission.

Staff Director

G. Terrell Selby. Baltimore City College and University of Pittsburgh. Since 1922 with Bell Telephone Laboratories, Inc. Served with Field Artillery in World War I.

The Commission wishes to express its appreciation for the service and devotion of the Task Force Subcommittee members and of our staff and wishes to record its appreciation for the information and assistance provided by officials of the Federal agencies in this field.

Preface

The Federal Government through 29 different agencies conducts programs of research and development. On the basis of the budget proposals for appropriations for the fiscal year 1956, the total expenditures of the Government for that year will be about $2,400,000,000, of which about $2,050,000,000 is in the Department of Defense and $350,000,000 by the civilian agencies. A total of at least about 124,000 persons in the military and civilian departments participated in these programs. If we include the research and development carried on by our industries and nonprofit institutions, the aggregate sum probably exceeds $4,500,000,000 annually.

This organization of Research and Development in the Government is the largest integrated scientific and technical endeavor that any nation has ever attempted. The programs in the departments reach through the realm of abstract science, the evolution of scientific discovery into inventions and improvements. In the military departments the development of inventions and improvements in weapons extends into the test of these improvements; the standardization of design; the development of production programs; the placement and coordination of production; and, finally, production must be accompanied by continuous further research and constant evaluation of results.

The organization of all Government research and development has been a slow growth and a constant realignment to meet every discovery in basic science and the inventions which flow from these discoveries.

Indeed the foundation of the greatest sector of human advancement in modern times is basic research into nature's laws and materials. It is from these sources that come the raw materials of applied science. We owe to basic research the fabulous improvement in the health of the Nation; the greatest industrial productivity known to man; the weapons of defense which have protected our independence; and our knowledge of the laws which govern the Universe.

There is no tribute great enough to express the Nation's obligations to its scientists, engineers, and military personnel, for their contributions to our constantly-increasing productivity and the strengthening of our national defense. And there can be no relaxation in this effort.

This investigation and report on Federal research and development activities are directed to improvement in organization from the constant lessons of experience. Comments on secondary weaknesses in organization are not intended to disparage this enormous accomplishment but to constructively improve its management, whose major conduct has the approbation of this Commission.

Part I

RESEARCH AND DEVELOPMENT IN THE DEPARTMENT OF DEFENSE

I. Research and Development in the Department of Defense

The sureness of our defense depends upon the improvement of our weapons as well as upon their production and the abilities of our military personnel.

Our strategy and tactics can be superior to those of potential aggressors only to the extent that research and development provide superior design of weapons. These designs must grow out of scientific research and engineering development. And to attain these ends, there must be a close coupling of military research and development with advancing frontiers of science and technology.

The budget proposals for expenditure on Research and Development in the defense services for the fiscal year 1956 are estimated at $1,648,335,000, with an additional $214,600,000 for improved facilities, or a total of about $1,862,935,000. To this must be added roughly $190,000,000 for personnel budgeted to other agencies, or a grand total of about $2,050,000,000.

Under the pressures of the world situation these expenditures have progressed rapidly from about $29,000,000 in fiscal year 1940 to the prospective sum of about $2,050,000,000 for fiscal year 1956. The effective organization of this great research and development requires the constant inte-

gration of military with civilian skills and effective coordination.

The gains cannot be measured in dollars. They must be measured in terms of our defense.

These operations are performed in the installations of the military, industrial, academic, and nonprofit organizations. In 1954, more than 120 installations of the military were involved, and at these installations approximately 39,000 military and 63,000 civilian personnel participated in the programs. A few thousand installations of the civilian economy were active in the programs. More than 8,000 separate projects were active. Some 40 percent of the appropriated funds that year were expended in the installations of the military departments, 50 percent in installations of industry, and 10 percent in those of academic and nonprofit institutions.

The Research and Development programs for military strength extend across the entire forefront of basic research in the physical sciences and the technologies of their application.

Concurrently all areas of the physical sciences—chemistry, biology, mathematics, and physics—are represented in the Basic and Applied Research programs. The aeronautical, chemical, electrical, electronic, mechanical, and metallurgical technologies are all contributors to the development programs, and one or more of them is a component of every weapons development project. The scope of Research and Development leading to new weapons designs has a subject

matter content whose scope is comparable to that underlying the design of facilities for the entire civilian economy. The Task Force Subcommittee has limited its examination to management, organizational, personnel, and major programmatic areas.

While the high quality of the weapons systems resulting from these programs gives constant evidence of successful accomplishment, the report of the Task Force Subcommittee has revealed areas where significant improvement can be made and economy realized.

In presenting this report, we have condensed the reasoning and the findings of the Task Force Subcommittee Report, but we give in full their recommendations.

II. Research and Development at the Secretary of Defense Level

The organization and coordination of these activities have passed through many phases, which are given in detail in the Task Force Subcommittee Report. Each of the Military Departments has always operated its own Research and Development program. With the formation of the Department of Defense in 1947, the coordination and integration of the programs of the three Departments were attempted through the activities of the Research and Development Board in the Office of the Secretary of Defense. This Board was inadequate for the task, and reorganization in the Office of the Secretary of Defense was initiated by the President under Presidential Reorganization Plan No. 6 of 1953.

Under this reorganization, the Research and Development Board was discontinued and there were created two Assistant Secretaries of Defense—an Assistant Secretary of Defense (Research and Development) and an Assistant Secretary of Defense (Applications Engineering)—and an Assistant for Atomic Energy. By the Directives of the Secretary of Defense issued in 1953, the functions of the two Assistant Secretaries were defined. Coordination of the Atomic Weapons program between the Atomic Energy Commission and the Department of Defense was established in the Atomic Energy Act of 1946, creating a Military Liaison Committee.

This arrangement was modified by Reorganization Plan No. 6 of 1953.

The Task Force Subcommittee states:

(*a*) In detail the functions, organization, and operations of the Assistant Secretaries of Defense (Research and Development and Applications Engineering).

(*b*) That while these organizations have been in operation only a little over a year, real improvements in effectiveness and in economy of the military Research and Development program are evident.

(*c*) That it commends the present organization pattern and states that the Assistant Secretaries are well staffed for their responsibilities of evaluation, coordination, and integration programs of the three Military Departments and of the Atomic Energy Commission.

(*d*) That by their very nature, Research and Development and Applications Engineering in the military departments are intertwined and inseparable, in contrast with those for the civilian economy. The Secretary of Defense directive in October 1954 established further integration of the staffs of the two Assistant Secretaries which has improved operations. The two Assistant Secretaries have shown great objectivity and an admirable sense of duty in their attempts to establish an effective working arrangement.

(*e*) That it considers the separation of the functions of Research and Development and Applications Engineering at the Assistant Secretary level unsound organization. They believe that the two areas must be administered by one Assistant Secretary.

Task Force Subcommittee Recommendation No. 1

That the Department of Defense review and assess the effectiveness of the recently established plan of combined operation of the Offices of the Assistant Secretary (Research and Development) and the Assistant Secretary (Applications Engineering) with a view to their integration into the Office of one Assistant Secretary.

Improvements and Economies at the Secretary of Defense Level

The Task Force Subcommittee states:

(*a*) That the discontinuance of the Research and Development Board and the establishment of the Assistant Secretaries resulted in significant economies and efficiency. From the situation in September 1952 to December 1954, the staff at the Secretary of Defense level was reduced from 2556 persons, of whom 300 devoted full time, to a total of 508, military and civilians, of whom 165 devoted full time.

(*b*) That the Assistant Secretary of Defense (Research and Development) established a Research and Development Policy Council comprised of himself, the Assistant Secretary of Defense (Applications Engineering), and the senior civilian and military officer in Research and Development of the three Military Departments. This Council with its weekly meetings is developing into an effective instrument for coordination and integration of the programs of the three Departments. The Task Force Subcommittee commends this Policy Council and recommends its use as a major instrument for unification and coordination.

(*c*) That while there has been pressure from various sources that some of the operations of Research and Development be integrated into one service, the present framework, in which substantially all the operational work is done by the three Military Departments, with these measures of coordination is preferable, and the Task Force Subcommittee recommends that this pattern be continued. A healthy evolution toward leadership, coordination, and integration of the programs of the three Departments is in progress. The Task Force Subcommittee commends this trend and ascribes it to the present organizational pattern; the professional qualities of the personnel; and the generally good atmosphere of cooperation between the Secretary of Defense level and the three Departments.

Matters Involving the Secretary of Defense Level and the Level of the Three Military Departments

Duplication and Overlap.—The Task Force Subcommittee states:

(*a*) There has been much concern about waste and excess expenditure through duplication in the Research and Development programs of the Army, Navy, and Air Force. The Subcommittee finds some basis for this concern.

(*b*) That the deficiencies primarily reside in the "self-sufficiency complex" of each of the services. There are areas of "warranted duplication" as well as those that are "unwarranted." In many of the forefront areas of weaponry, multiple approach through parallel developments are essen-

tial and should be continued. The "warranted" can be planned for and controlled, and the "unwarranted" prevented by the present patterns of organization and relationships between the Secretary of Defense level and the level of the three Services.

(*c*) Where parallel development is in course, the present organization and procedures for standardization and for production can select the preferred one of the parallel developments. The Task Force Subcommittee finds that progress is being made, although much remains to be done, in the elimination of unwarranted duplication in development, standardization, and production.

Task Force Subcommittee Recommendation No. 2

That the authority of the Secretary of Defense to withhold appropriated funds from any research and development project be wisely and fearlessly used to promote integration of the programs of the three Departments, to prevent unwarranted duplication, and to promote effectiveness and efficiency in the use of research and development funds.

Task Force Subcommittee Recommendation No. 3

That the Office of the Assistant Secretary (Research and Development) give emphasis in its consideration of research and development programs in preventing unwarranted duplication, and that the Assistant Secretary (Research and Development) and Assistant Secretary (Applications Engineering), through standardization for production procedures, prevent unwarranted duplication in weapons.

Approaches to Radically New Weapons Systems

The Task Force Subcommittee states:

(*a*) Criticisms have been expressed in various quarters that the Armed Services are not sufficiently daring and imaginative in their approach to radically new weapons and weapons systems. It shares this view. The present organization, with its procedures, is inadequate for the initiation of such projects. It states that the three Military Services have not distinguished themselves in the initiation of radically new approaches to weapons systems.

(*b*) That the Research and Development Board made most of these contributions during World War II. Since then, such approaches have been largely inspired through informal proddings by civilian scientists and technologists. While such proddings have been productive, so vitally important an area should not be left to chance. It is desirable that the Department of Defense encompass this responsibility. Its present organization does not provide an adequate framework for such initiation.

Task Force Subcommittee Recommendation No. 4

That the Assistant Secretary of Defense (Research and Development) appoint a standing committee, reporting directly to him, of outstanding basic and applied scientists. This committee will canvass periodically the needs and opportunities presented by new scientific knowledge for radically new weapons systems. The Assistant Secretary of Defense (Research and Development) will appropriately implement this committee's recommendations where action is indicated.

Weapons Systems Evaluation

The Task Force Subcommittee states:

(*a*) In 1949, the Joint Chiefs of Staff established an organization of scientists to apply techniques of "Operation Research" to the evaluation of the relative military worth of different weapons systems. The studies made were of such value that constant effort has been made to increase the size and the field of the group. There has been increasing difficulty in recruiting adequate staff. The three Services each embrace such a group. These groups are maintained by contract with nonprofit institutions. They have expanded and improved in quality and effectiveness with time.

(*b*) That the Weapons Systems Evaluation Group is of such importance to the Joint Chiefs of Staff that it should be expanded and strengthened at that level. To accomplish this, it is necessary to provide an environment suited to such endeavor and to establish adequate compensation.

Task Force Subcommittee Recommendation No. 5

That the Weapons Systems Evaluation Group be shifted to contract operation with university or nonprofit organizations. It then be expanded to a size adequate for performing the studies required by the Joint Chiefs of Staff and Assistant Secretary of Defense (Research and Development).

The Assistant Secretary of Defense (Research and Development) be responsible for the action essential to bringing Weapons Systems Evaluation Group to an adequate level of size and effectiveness.

Use of Advisory Boards and Consultants

The Task Force Subcommittee states:

(*a*) That both at the level of the Secretary and at the level of the three Military Department continuous cooperation with the scientific and technical communities of the Nation is essential for the most effective weapons research and development programs.

(*b*) That through the contracted programs of the military with the acedemic institutions and industry, an effective operating relationship is maintained. This is supplemented by a multitude of committees and panels selected from the Nation's scientific and technical communities. These committees are established by the Department of Defense and each of the Military Departments. Their effectiveness varies from great to small. There is need for administrative review and cleanup in this area.

(*c*) That the National Research Council and the National Academy of Sciences are providing splendid service in establishing such committees and providing staff for them. The use of this agency could profitably be increased.

Task Force Subcommittee Recommendation No. 6

That an administrative review and assessment of the operations and contributions of all committees and consultants be made by the Department of Defense and each of the Military Departments.

III. Research and Development at the Level of the Army, Navy, and Air Force

Civilian Administration in the Three Services

The Task Force Subcommittee states:

(*a*) The attention given to research and development in the top-level civilian organizations at the level of the Army, Navy, and Air Force has been inadequate in numbers and the personnel involved have largely not been trained in science and technology or experienced in research and development operation and administration. It believes this to be the area of greatest organizational and personnel inadequacy in the work of research and development and one that promises greatest reward through correction. It points to more emphasis upon the organizational structure and the use of personnel of high professional capacity in the areas of finance, logistics, and personnel.

(*b*) That it urges a prompt recognition of the deficiency in the research and development area and recommends:

Task Force Subcommittee Recommendation No. 7

That an Office of Assistant Secretary for Research and Development be established in each of the three Military Departments. This Office be restricted in its functions

to the research and development organization and operations of the Department.

That the Assistant Secretary be trained in science and technology and experienced in the operations and administration of research and development.

That this Office have a small staff trained in science and technology and experienced in the operation and administration of research and development.

The Task Force Subcommittee notes that, since its studies were made, the position for an Assistant Secretary for Research and Development has been established by the Air Force with an appointee that meets the professional requirements the Task Force Subcommittee recommends. They urge that he be promptly provided with an adequate staff, meeting the professional requirements of their recommendations.

The Task Force Subcommittee also notes a partial step in the direction of its recommendation by the Navy. They commend it as an improvement over the previous situation but believe it to be still inadequate, and hopes that its recommendation will be implemented "in full."

The Operation of the Research and Development Program

The Task Force Subcommittee states:

(*a*) That each of the Military Departments initiates and operates its own program after authorization by the Secretary of Defense. The authority of the Secretary of Defense to

withhold appropriated funds from any proposed program can make effective coordination and integration of the programs of the three Departments and the elimination of unwarranted duplication.

(*b*) That the scientific and technical knowledge that is basic to our progress in new weapons systems is obtained through basic and applied research, which are the first two functional areas of the research and development operations. The fiscal 1954 basic research programs of the three Departments are at an annual rate of $20,000,000. It considers the present level of basic research inadequate.

(*c*) That the applied research is not cleanly separated from development activities, so that its level can only be estimated. Since the tempo of progress in weaponry technology is limited by availability of new basic and applied scientific knowledge, it is most important that basic and applied research be carried out in adequate volume.

Task Force Subcommittee Recommendation No. 8

That the level of basic research in the Department of Defense be significantly increased above its present $20,000,000 level of annual expenditure.

Greater Use of Civilian Institutions

The Task Force Subcommittee states:

(*a*) The operations of the research and development program are performed by the three Military Departments in their installations and in the civilian economy by industry, and academic and nonprofit organizations. It has critically

examined the placement of the operations in these different areas. It is their view that the work should be placed, when choice is possible, where it can be performed with greatest effectiveness. It found that of the $1,400,000,000 appropriated funds for fiscal 1954, 40 percent (some $560,000,000), was expended in the installations of the Military Departments, 50 percent (some $700,000,000) in industry, and 10 percent (some $140,000,000) with academic and nonprofit institutions.

(*b*) Research and development and design operations are, in general, best performed by civilian agencies. Since the close of World War II, the Military Departments have greatly expanded their facilities and personnel for the operations of research and development. The operations performed there are generally at a lower level of effectiveness than could be realized if suitably placed in the civilian economy. The Task Force Subcommittee estimates that in 1954 there was a $125,000,000 volume of such work that was susceptible to shift into the civilian economy.

Task Force Subcommittee Recommendation No. 9

That where choice is possible, operations of research and development should be performed at that place in the Nation where they can be done most effectively and with the greatest efficiency.

The Task Force Subcommittee states:

(*a*) There would be delay and inefficiency in abruptly shifting programs. Good management dictates an evolutionary shift through placement of the new programs with

the civilian economy and, of course, concurrently taking appropriate "shrinkage of staff" action at the military installations.

(*b*) Major portions of the establishment, placement, and monitoring of the programs, test for evaluation, development aid to production, and current development activities must be performed by the Military Departments and in the installations of the military. Even where operations must be done in military installations, frequently increased effectiveness and efficiency will be realized through operations by civilian economy organizations. The Task Force Subcommittee commends the trend in this direction by the Department of the Air Force.

Organization for Research and Development

The Task Force Subcommittee states:

(*a*) The increasing application of science and technology in the instrumentation of warfare has brought about a major change in the character of weapons. An integration of the operating elements into a "weapons system" is the growing pattern of weaponry. A single element of the system cannot be developed independent of the others. The "system's" requirements and those of each of its elements must be jointly established and a continuing "give and take" between the elements, their character and requirements must be made throughout the course of the development.

The traditional organizations for Research and Development of the Army and Navy are not well suited to the needs

of modern weaponry development. A weapons system is frequently made up of elements developed by two or more Corps or Bureaus. This compartmentalization of weaponry development between a number of independent Technical Corps (in the Army) and Technical Bureaus (in the Navy) makes effectiveness and efficiency in the operations of today most difficult.

However, these Corps and Bureau structures are so firmly built into the organization of the two services that their elimination would present grave problems and, without doubt, would cause a serious hiatus in progress. This cannot be afforded in these critical times.

Both services are aware of the deficiencies, and, based on the Army Davis Committee and Navy Gates Committee studies, have recently taken organizational steps to minimize the undesirable effects of the compartmentalization and to increase effectiveness and efficiency.

(*b*) *The Army.*—The Army has seven independent Technical Corps that are responsible for research, development, production, storage, and distribution of the facilities of their respective areas. The Research and Development organization of each Corps reports to its Chief Officer. Until recently, the staff functions for coordination of the development programs of the Corps and of development relations with the field forces were distributed among several staff organizations. It was most ineffective organization.

In December of 1954, all Research and Development staff functions were placed in the organization of the Deputy

Chief of Staff for Plans and Research under a Chief of Research and Development. He is the program director of the Army Research and Development Primary Program. The research and development programs of all the technical services will be subject in their planning, coordination, supervision, and direction to this office. In a "program" sense, the research and development of the technical services will report to him; in a "management" sense, the research and development organization will continue to report to the Chief of the Service, who, since the recent reorganization, reports to a Deputy Chief of Staff for Logistics.

This plan is a major improvement in the organization of the Army for establishing, planning, coordinating, and supervising its research and development.

Task Force Subcommittee Recommendation No. 10

That the Secretary of the Army and his Chief of Staff give strong support to the research and development staff reorganization of December 23, 1954. The staff be adequate in size and of highest possible professional competence in research and development. The staff be given positive and effective administrative support in its operations in meeting its responsibility for control, integration, and coordination of the Army's research and development programs.

(*c*) *The Navy.*—The Navy has seven independent Technical Bureaus that are responsible for research, development, and production in their respective areas. (The Office of

Naval Research is coordinate with these Bureaus.) The Research and Development organization of each Bureau reports to its Chief Officer. Until recently, there was no formal staff organization for coordination and integration of the development programs of the Bureaus. The technical staffs of the Chief of Naval Operations work with each Bureau. The Gates Committee recognized the need for staff coordination of development and recommended that this responsibility be given to the Office of Naval Research. This recommendation has been adopted and the Office of Naval Research is now assembling a staff for the task. This Office has rendered a distinguished service in the area of research.

It is important that this limited step toward coordination be given strong support by Navy administration. However, since the Office of Naval Research is coordinate with the Bureaus and since the directives assigning it this function have not given it authority to direct these activities, the Task Force Subcommittee views this as an inadequate organizational step toward effective coordination, but believes there is value in the basic plan, even though it is still inadequate.

Task Force Subcommittee Recommendation No. 11

That the Secretary of the Navy and responsible senior Navy officers give strong administrative support to the new functions of the Office of Naval Research in coordinating and integrating the development program of the Navy. A staff adequate in size and of highest research and development competence be provided, and the pro-

grammatic recommendations of the Office of Naval Research be implemented.

(*d*) *The Air Force.*—In contrast with the compartmentalization by the Army and Navy of their research and development within several organizations, the Air Force has a well integrated organizational structure for research and development. Based on the Ridenour Report of the Air Force Science Advisory Board, the Research and Development Command was established in 1950. All operations of research and development are the responsibility of this Command. The only other organizational element for research and development is within the Air Staff of the Chief of Staff, where a Deputy Chief for Research and Development maintains a small staff for plans, programs, and direction. The Research and Development Command is composed of a headquarters organization and eleven centers distributed across the Nation.

This organization, of recent origin, is in a framework well suited to the needs of modern weaponry research and development. The Task Force Subcommittee commends it.

The headquarters of the Research and Development Command was placed in temporary quarters in Baltimore. It has outgrown the available facilities and is operating under considerable handicap in rented office space in the business center of Baltimore. The Task Force Subcommittee urges that an adequate permanent headquarters building with appropriate facilities be promptly provided.

Personnel in Research and Development

The Task Force Subcommittee states:

(*a*) ***Military Personnel.***—As stated above, approximately 39,000 military and 63,000 civilian personnel within the organization of the Department of Defense now participate in the military research and development programs. The charges to the research and development appropriations for their operations in fiscal 1954 amounted to some $560,000,000, 40 percent of the total appropriated funds. These expenditures are supplemented by more than $100,000,000 of funds from other appropriations.

(*b*) The impact of the total military research and development program on the operations of the Government is much greater than indicated by the proportion of the budget that it absorbs. The management and control of the program must establish, place, monitor and programs, and conduct the tests for revaluation as they progress. As pointed out earlier, a portion of the operations of research, development, and design now performed by Department of Defense personnel might well in the interest of effectiveness and efficiency be largely shifted to the civilian economy. Even with such shifts, however, some 30 percent of the appropriated research and development funds would and must be expended within Government in areas vital to the overall success of the programs.

(*c*) It is, therefore, most important that the personnel have the highest professional competence.

The military personnel, at the officer level, are generally men of high personal qualities and with professional equipment for their jobs because of the excellently organized professional training programs. An increasing number of officers are receiving training to the doctorate levels in science and technology.

(*d*) With the growing technical complexity of warfare and the increasing dependence of our military strength on the qualities of our weaponry, there are not a sufficient number of the younger officers in the training programs to provide for the increasing demands for technical officers.

Task Force Subcommittee Recommendation No. 12

That each of the Military Departments make a realistic examination of their growing needs for technical officers. If need be, as the Task Force Subcommittee expects, expand their programs to provide generously for an expanding number of officers trained in research and development.

Continuity of Service

The Task Force Subcommittee states:

(*a*) Due to the rotational assignment policies of the services and the inadequate appreciation of the necessity for career officers in research and development, the military are not making the best use of their officers trained in research and development. The constant rotation of officers between research and development and operating command positions ignores the urgent need for increased specialization. Officers

adequately expert in research and development for current and future needs cannot be developed under this philosophy. A large fraction of the officers in the research and development program must have careers in this area and be excluded from the present cycle rotations from research and development to field assignments.

Even in areas where officers are rotated only through technical assignments they are left on a particular assignment for too short a period. The officer's professional development is retarded and the jobs to which he is assigned suffer from this "rapid rotation." The development of a sufficiently competent corps of specialists in research and development will not be realized unless the length of the assignment to a particular post is materially increased.

Task Force Subcommittee Recommendation No. 13

That the three Military Departments review policies and their implementation on career officers in research and development. Move toward limiting the areas of rotation of research and development officers to technical assignments, and increase the time period of assignment in a position.

(*b*) *Civilian Personnel.*—The quality of the civil service employee contribution to research and development suffers through inability to acquire and retain in the program enough men of adequate professional training and competence. The professional training program for civilians of each of the three Departments is good. Its improvement, while desirable, will not alone meet the situation. Generally

higher pay levels and a larger number of high level civil service positions are essential for the improvement of the situation and probably essential to prevent deterioration.

Task Force Subcommittee Recommendation No. 14

That higher levels of compensation for civil service professional employees be established, more nearly competitive with industry, and the number of higher level civil service positions be materially increased.

IV. Research and Development in Defense Related Agencies

National Advisory Committee for Aeronautics

The Task Force Subcommittee states:

This organization, now some 40 years old, has a splendid record in its leadership of the Nation's aeronautics research. It justifies continued confidence and support. Its organization and ties to the aeronautic needs of the Nation through its 28 technical subcommittees are admirable.

This agency has splendidly equipped laboratories, more than $300,000,000 having been invested in them. Continued large investment can be anticipated, as the instrumentation of its research programs is costly. Such investment should be made as required, for our progress in aeronautic science and technology should not be retarded by inadequate research facilities.

Military Applications of Atomic Energy

The Task Force Subcommittee states:

(*a*) That it especially commends the Atomic Energy Commission policy of staff control and coordination by contractors from the civilian economy. The rate of scientific and technical progress in military applications of atomic energy and the uniquely high level of atomic warfare strength are evidence of the effectiveness of the program.

(*b*) The coordination of the programs by the Department of Defense through the Assistant for Atomic Energy, the Assistant Secretary (Research and Development), the Military Liaison Committee, and the Armed Forces Special Weapons Group, while a ponderous organization, is highly effective.

This organizational mechanism has been evolving since 1947, while the Department of Defense effective participation in the coordination and integration of nonatomic research and development programs of the three Military Departments is not yet two years old. Much progress has been made in this short time.

Tennessee Valley Authority

The Tennessee Valley Authority has carried on various research activities on behalf of the Department of Defense especially in relation to certain gases.

The Cognizance Method

The Task Force Subcommittee views with concern some recent trends associated with the Department of Defense's assignment of "cognizance" for certain specific weapons to a military service. The integration of the development program and the unification of relations with the Atomic Energy Commission may well be endangered by the "specific cognizance" step. The Task Force Subcommittee Report gives a complete analysis of the "specific cognizance" situation and recommends:

Task Force Subcommittee Recommendation No. 15

That the Department of Defense make a close examination of the operations under "cognizance" and take appropriate action to insure the preservation of the present highly effective integration of the development program through the Military Liaison Committee and the Armed Forces Special Weapons Project organization.

The Task Force Subcommittee states:

(*a*) The building of a highly effective organization of applied science and technology is a process of evolution with a time scale measured in years, even within the confines of an industrial company. This task for the Nation's military research and development is larger and more difficult because of its greater magnitude. There must be tireless effort, continued vigilance, and patience to realize the improvements that are possible.

(*b*) Adoption and implementation of the recommendations of their Report will greatly accelerate present progress in improvement of effectiveness and efficiency, and permit the attainment of much higher levels.

(*c*) An increase in effectiveness and efficiency after five years of diligent effort, along the lines of these "evaluations and recommendations," may well amount to some 25 percent. There is sound basis for concern that such an increase in effectiveness and efficiency may be too slow to provide the added research and development output that will be required to maintain our leadership in weaponry. The military research and development appropriations have been at about

the same level for the three years 1953, 1954 and 1955 (about $1,400,000,000). While the maintenance of a substantially constant level has been of great value in improvement programs, expanding research and development opportunities and needs may well not be met unless it receives stronger support.

(*d*) Serious consideration needs to be given to the adequacy of the present research and development level. Pioneering in intercontinental ballistic missiles, the maturing technology of shorter range missiles, the needs for greater effectiveness in continental defense, the opportunities for major improvements in all military electronics through application of the rapidly evolving solid state electronics technology, for example, combine in presenting the Department of Defense with an increasing volume of research and development opportunities and demands. It would be false and dangerous economy to hold the research and development appropriations at a level too low to permit a volume of effort essential to effective programs in areas of opportunity for new and improved weaponry.

V. Commission Recommendations as to Defense Agencies

All but 2 of the 15 Recommendations of the Task Force Subcommittee can be effected by administrative action in the Department of Defense.

Commission Recommendation No. 1

We earnestly commend the administrative recommendations of the Task Force Subcommittee to the Department officials concerned.

The two recommendations requiring legislative action (Recommendation No. 12 and Recommendation No. 13) are concerned with the rotation of military personnel and the stature of civilians employed in the Defense agencies.

Other reports of this Commission have called attention to the same inadequacy of short-term assignments of military officers in Defense, Subsistence, Transportation, Surplus Property and other functions.

Commission Recommendation No. 2

(*a*) That military officers assigned to Research and Development should serve for longer periods in order that they may become professionally adept;

(*b*) That in order to make such longer service possible such officers should be given the same preferment

and promotion as if they were rotated in short-term service.

In order to strengthen the quality of the civilian services in Research and Development we make:

Commission Recommendation No. 3

That the Senior Civil Service as recommended in our report on Personnel and Civil Service is urgently required in Research and Development if competency in administration is to be provided.

The Task Force Subcommittee also raises the question of the necessity for continuity of positions and technical background of presidentially appointed Assistant Secretaries concerned with Research and Development, and those responsible for Research and Development in the three military services. They point out the successful action of the Air Force in this direction.

Commission Recommendation No. 4

That the Presidential appointments of Assistant Secretaries of Defense and those in the three services, who are concerned with Research and Development, in the future be made from men of professional training oustanding in the Research and Development field.

Part II

RESEARCH AND DEVELOPMENT IN THE CIVILIAN AGENCIES

VI. Research and Development in the Civilian Agencies

In order to present the full Research and Development activities of the Federal Government, it is desirable to briefly review the civilian agencies. These services have proved so important to our national life that their support has grown from about $68,000,000 in 1946, to $90,000,000 in 1950, to $291,000,000 in 1954, and to about $350,000,000 in the budget recommendations for 1956. The major Research and Development in the departments are carried on in the—

Department of Agriculture
Department of the Interior
Department of Commerce
Department of Health, Education, and Welfare

In 1954, these four Departments employed 22,335 persons in Research and Development.

Aside from the Departmental agencies, there are a number of importance independent Government agencies and affiliated nongovernmental agencies which participate in the Research and Development work of the Government. They are:

The National Science Foundation
The Science Advisory Committee of the Office of Defense Mobilization

The Smithsonian Institution
The National Academy of Sciences
The National Research Council
The Carnegie Institution of Washington

The Department of Agriculture

The Department of Agriculture engages in research and development activities of the utmost importance. This work is carried on by the Agricultural Research Service, created on November 2, 1953, to take the place of the Bureaus of Agricultural and Industrial Chemistry, Animal Industry, Dairy Industry, Entomology and Plant Quarantine, Human Nutrition and Home Economics, Plant Industry, Soils and Agricultural Engineering. The research work of this Service is divided into the following major divisions:

1. *Crop Research.*—Under this heading investigations are conducted to develop improved varieties of food, feed, fiber, and other plants; to improve crop production; to control harmful insects; and to develop and test new chemical formulas for the control of crop pests.

2. *Farm and Land Management Research.*—Investigations are conducted to improve fertilizers; to determine the relation of soils to plant, animal and human nutrition; and to apply engineering principles to agriculture. These investigations include basic research in pathology and physiology of plants.

3. *Livestock Research.*—Under this heading are included research into the cause of animal diseases, parasites, and the breeding of animals.

4. Human Nutrition Research.—These studies are designed to gather useful information on the nutritive value of various foods; the effects of foods and their preparation; as well as on the use of fibers.

5. Utilization Research.—This includes investigations in the fields of chemistry and biological sciences to develop new and improved foods, feeds, drugs and fabrics from agricultural commodities; to develop better processing of foods; and to increase the use of by-products.

The budget estimate of the total funds allocated for these research activities of the Agricultural Research Service for 1956 is $37,684,000.

The Department of the Interior

The Department of the Interior carries on research and development work through the Geological Survey, the Fish and Wildlife Service, and the Bureau of Mines.

The Geological Survey.—This agency carries on certain routine duties in land classification, in gauging streams, in the study of water supply, and mapping. Its major duty is the scientific study of and reports on the geology of the Nation in its many aspects. These research activities reach into geophysics, geochemistry, petrology and paleontology.

The Fish and Wildlife Service major functions are in the field of conservation. However, it carries on a certain amount of biological research into aquatic and animal life.

The Bureau of Mines conducts research and development into protection in coal mining. It has made notable contributions to improvements of metallurgical and other processes. Its basic research has resulted in the development of new metals.

The Department of Commerce

The major scientific and research and development work of the Department of Commerce is conducted by the National Bureau of Standards and the Weather Bureau.

The National Bureau of Standards is the largest physics laboratory in the Nation. Most of its duties are routine, such as the standardization of weights and measures, development of specifications, testing materials, and development of aids and instruments for scientific research. It conducts research for private institutions into industrial production problems on a reimbursement basis and into ordnance development for the military services. It gives aid and advisory service and staff to other Government agencies on scientific and technical matters.

The Bureau conducts basic research in many directions, including fundamental physical phenomena and the determination of the characteristics of materials. The scope of work in this field by the Bureau is indicated by the titles of the separate Divisions devoted to Applied Mathematics,

Atomic and Radio Physics, Chemistry, Electronics, Metallurgy, Mineral Products, Optics, and Metrology.

The Weather Bureau, in addition to its great routine work, carries on research in the field of meteorology.

The Department of Health, Education, and Welfare

The Department of Health, Education, and Welfare conducts widespread research into health, medicine, the character and effects of drugs. The principal agencies under the Surgeon General are as follows:

The Bureau of Medical Services conducts a number of hospitals where medical research is carried on, especially in mental disease.

The National Institutes of Health comprise eight specialized institutes as follows:

National Microbiological Institute.
National Institute of Arthritis and Metabolic Diseases.
National Heart Institute.
National Cancer Institute.
National Institute of Dental Research.
National Institute of Neurological Diseases and Blindness.
National Institute of Mental Health.

These institutes conduct much basic research into the causes of disease, diagnosis, and remedy and also make grants to other institutions.

There is before Congress an appropriation of about $80,000,000 for the maintenance and expansion of this research work.

The Food and Drug Administration carries on many routine activities in the testing and control of drugs. In addition, it conducts scientific research in the fields of vitamins, bacteriology, antibiotics, toxicity and potency of drugs.

VII. The Independent and Collaborating Civil Research and Development Agencies

The Smithsonian Institution

The Smithsonian Institution was founded in 1846 and is supported partly by private endowment and partly by Federal appropriated Funds. Its "establishment" and Board of Regents include the leading officials of the Government and representatives of the Congress.

The Institution not only conducts a great national museum but also conducts scientific research in anthropology, zoology, botany, and geology. It conducts also the Astrophysical Observatory.

The expenditures of the Institution for 1955 fiscal year included $356,000 for research.

The Atomic Energy Commission

The Atomic Energy Commission, in addition to its research and development work in the defense field, carries on widespread scientific studies in the medical fields and basic research into the fundamentals of atomic structure and the natural laws which govern them.

The National Science Foundation

The First Commission on Organization of the Executive Branch of the Government in March 1949 [1] recommended to the Congress the creation of a National Science Foundation. In 1950 the Congress established this institution with the following duties:

1. To develop and encourage a national policy for basic research and education in the sciences;
2. To support basic scientific research in the natural sciences through grants;
3. To initiate and support research activities in connection with national defense matters as requested by the Secretary of Defense;
4. To grant scholarships and fellowships; and
5. To evaluate scientific research programs undertaken by agencies of the Federal Government, and to correlate the Foundation's scientific research programs with those undertaken by individuals and by public and private research groups.

The Foundation is headed by a director and a Board of 21 members appointed by the President. In 1954 it spent $7,953,529 and in 1955 it will spend about $12,657,722. The greater part of its expenditures ($8,100,000 in 1955) is for grants in support of basic research. For research fellowships it will spend $2,245,000 in this year.

An Executive order of March 1954 (No. 10521) further

[1] *Report on Federal Research*, March 1949, p. 50.

emphasized the purposes of the Foundation. Section 4 of this order provided in part:

> * * * the Foundation shall be increasingly responsible for providing support by the Federal Government for general-purpose basic research through contracts and grants. The conduct and support by other 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 material needs, and shall continue.

Other sections of the order direct agencies of the Government engaged in scientific research to advise and consult with the Foundation. The Foundation has been conducting surveys of the Government's organization, expenditures, personnel and facilities for research. It is making other surveys covering the research efforts of industry, universities, private foundations, trade associations and other organizations. These are not yet completed.

Science Advisory Committee of the Office of Defense Mobilization

In April 1951 by presidential action there was created a Science Advisory Committee in the Office of Defense Mobilization. This group is composed of twelve scientists with a full time executive director.

The functions of this group are:

1. To bring to the attention of the President, and the National Security Council, new developments of science or technology having significance relating to national security;

2. To advise on the preparation of plans for the mobilization of scientific resources of the nation in case of emergency;

3. To assist the Office of Defense Mobilization and the Executive Office of the President to identify elements in their work which would benefit from scientific advice and appraisal.

The Committee made studies of the organization of science for defense presented to the Office of Defense Mobilization recommendations on scientific personnel; assisted the Central Intelligence Agency on problems of science; reviewed the criteria for dispersal of critical industries to reduce the effect of an atomic attack; studied the technical aspects of programs for continental defense; and prepared a study on the relationship of scientific developments and military preparedness.

National Academy of Sciences

The National Academy of Sciences was established by Act of Congress in 1863 on the recommendation of President Lincoln. This law provides that the Academy

> • • • shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States.

New members of the Academy are elected by its members from distinguished scientists, engineers and technicians

of every branch of science and technology. Each branch of these professions is represented by groups who nominate persons for membership. The Academy has supported scientific work and publication for over 90 years. Government agencies have from time to time called upon the Academy for advice and assistance. It has made notable surveys which have led to legislative action such as a study of the operations of the Coast and Geodetic Survey in 1884, and again in 1897 by a report on forest policy.

The National Research Council

The National Research Council was created in 1916 by the National Academy of Sciences to more effectively operate its research activities. The Council served in many ways in World War I, and at the close of the War President Wilson asked that the Council be constituted on a permanent basis to formulate and to stimulate research in the sciences.

The Council on request recommends scientists and assembles panels and recommends institutions for special research activities for the Government agencies.

The Academy and the Council are supported by an endowment of $5,000,000 contributed by the Carnegie Corporation. They receive no direct appropriation from the Congress, but when the Council undertakes studies for Federal agencies, the costs are paid by the agencies concerned. In 1954, the two organizations spent about $5,500,000, about two-thirds of which came from the Federal Government and the rest from private sources. The Council is at present

engaged in a study of atomic bomb casualties which involves an expenditure of $1,000,000 for staff.

The Carnegie Institution of Washington

The Carnegie Institution was established in Washington in 1902. It has given research assistance and advice and staff to the Government in World War I and World War II. The Institute has endowment funds of about $50,000,000 from Andrew Carnegie and the Carnegie Corporation of New York.

The Institution is devoted to basic research not normally covered by other institutions. Its fields have largely been astronomy, terrestrial science, biology and archaeology. It gives grants to other institutions for research in these and other fields.

Over the years the Institution has expended over $70,000,000 in research and publication of its reports.

VIII. Commission Recommendation as to Basic Research and Medical Research

Basic Research

Among the Federal Agencies devoted to research and development there is but a minor amount of basic research into the laws of nature and the nature of materials. Yet the safety, the increase of productivity and the advancement of health in our Nation must come from constantly increasing knowledge through fundamental research. From these explorations come knowledge, discoveries, inventions and progress. Out of about $2,400,000,000 Federal expenditures proposed by the Budget for fiscal year 1956 on research and development work, probably less than $130,000,000 is to be devoted to Basic Research. Of this, the Defense agencies probably expend about $77,000,000.

Medical and Health Research

Of all the special research and development activities inside and outside the Federal Government, the most beneficent to mankind has been in medical and health research. Basic research in these fields covers such subjects as anatomy, physiology, biochemistry bacteria, viruses, their contagions and their control.

We are concerned over the fact that many private foundations devoted to research and education have in the recent past tended to deemphasize their medical programs. The Congress, of course, has not, nor should it have, the right to tell our great foundations, who probably have an aggregate income of over $500,000,000 annually, how their programs should be conducted. However, as these private funds are diverted from medical research and medical education, appropriate increases in Federal appropriations may well be inevitable.

We are greatly concerned over the inadequate public and State support of our medical schools where our research technicians are trained and an important part of basic medical research is carried forward. No greater instance of university research need be cited than the dramatic accomplishment at the University of Pittsburgh by Dr. Jonas Salk in basic research which produced the polio vaccine. The universities have contributed much to understanding and alleviation of mental diseases, cancer, and many other fields. The National Fund for Medical Education, which raises about $2,000,000 annually to support the medical schools, has repeatedly stated that these institutions in the United States are carrying an aggregate annual deficit of $15,000,000, which in the instances of university medical schools must be made up by diversions from other branches of education. One consequence is that the medical schools are compelled to restrict the amount of their research, and the number of their students. The Nation is today short of both technicians and doctors. And there are today a large number of youths who

have completed their premedical education and cannot find admission to medical schools.

We cannot afford stagnation of our medical research in our medical schools or the training of our technicians. In the Federal Government research is supported as an incident to other duties by the Defense services, the Atomic Energy Commission, and the Department of Agriculture. It is one of the major functions of the Department of Health, Education, and Welfare.

The actual Federal expenditure applicable to basic research in the medical field is only about $18,000,000, or less than 1 percent of the total Government Research and Development expenditures.

The Report of this Commission on Federal Medical Services, together with our task force report, have outlined constructive steps toward better organization and support in this field.

It should be noted that, although the Congress has treated appropriations requests for medical research and development generously, there are still many approved projects which have not been undertaken because of the lack of funds. These projects, primarily in the field of basic research, have been approved by several important research agencies.

An instance is the so-called "backlog" of 723 projects totaling about $7,400,000 which the National Institutes of Health predict will not be undertaken by them in fiscal year 1956 because funds have not been requested by the Department of Health, Education, and Welfare or the Bureau of the Budget. Of this amount, about $1,900,000 is for basic medi-

cal research.* We are concerned over the apparent failure of the executive branch to indicate these "backlog" projects to the Congress. That such amounts have not been recommended to the Congress or supported by the Congress may indicate a tendency to deemphasize basic and medical research. Possibly, this results from the belief that the Congress will be more receptive to requests for funds devoted to projects likely to produce startling and dramatic results. But it should be noted that there are also the dramatic accomplishments of basic and medical research.

Nor do we think that any congressional authorization or appropriation should be open-ended; if a reasonable ceiling can be established, those responsible for administering the funds will of necessity adopt some form of priority and will allocate the available funds to those projects deemed most important.

We must make sure of general support to this field which daily demonstrates such potential benefits for mankind.

We urge also that this is a problem for the Nation as a while.

Commission Recommendation No. 5

That greater Federal support be given to basic and medical research.

---

*Commissioner Brownell objects to this language, because he is informed the figures submitted are merely projections for fiscal year 1956 and nearly three times the actual current figures. He is also advised that information on this subject is conveyed to Members of the Congress in the course of budgetary presentations.