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MEMORANDUM FOR EXECUTIVE DIRECTORS OF COMMITTEES

SUBJECT: Annual Report of the Executive Secretary, RDB.

Attached is a copy of the Annual Report of the Executive Secretary, Research and Development Board (XX 30/2), as it was finally transmitted to the Office of the Secretary of Defense. A copy is being forwarded also to each member of the Executive Council.

Since this report is to be included as a part of the over-all report of the Secretary of Defense, the OSD has requested that it not be distributed outside the Board until such time as the report of the Secretary of Defense has been released by the President.

F. H. RICHARDSON
Deputy Executive Secretary

Attachment:
(XX 30/2)

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ANNUAL REPORT OF THE EXECUTIVE SECRETARY

RESEARCH AND DEVELOPMENT BOARD

as of

17 SEPTEMBER 1948

YX No. 30/2
(This supersedes YX 30/1,
which shall be destroyed)

Transmitted
10 November 1948

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RDB Editorial Branch

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1. SUMMARY - CONCLUSIONS AND RECOMMENDATIONS

The Over-All Situation.

The military research and development program of the United States, after a year of effort on the part of the Joint Research and Development Board and a second-year's contribution by the Research and Development Board, presents some cause for satisfaction. This is particularly true if the picture is brought into comparison with the immediate postwar situation and even with the situation as it was during World War II. But from the standpoint of over-all progress toward true unification and toward the attainment of the ultimate objectives, much remains to be accomplished. To those most intimately associated with the Research and Development Board the rate of progress is cause for dissatisfaction. This fact in itself, however, can have a salutary effect if it points up the reasons for unsatisfactory progress and suggests possible solutions.

The Credit Side of the Ledger.

On the positive side, the current research and development programs of the three Departments are vigorous and enthusiastic. There has been recognition at high levels of the important interaction of research and strategy. The public seems alive, even if apprehensively so, to the implications of scientific innovations; and Congress has approved large appropriations for active endeavor in military research. The limiting factor in the opinion of many is not money, for once, but the number of available people with adequate training and skills to do the job. In return for a dollar investment in the neighborhood of a half billion

dollars, the United States has, so far as can be determined, a fair margin of superiority in practically every technical area of weapon development. If the research and development program of any one Department is examined by itself, there can be only praise for the broad attack on the various problems and the energy with which the various investigations and developments are carried forward.

The Debit Side of the Ledger.

When current activities are scrutinized from the viewpoint of a national program as distinguished from individual programs of the three military Departments, however, it becomes obvious immediately that there remains much to be desired. The unified and integrated program of research and development, such as the RDB is required by law to formulate, has not yet been attained; and it is becoming increasingly apparent that such a program is not likely to be achieved without extensive alterations in the Board mechanism.

Recommendations for Improvement.

In order to eliminate the difficulties of the current situation, the following specific steps should be taken as rapidly as possible:

(1) The military members of the Research and Development Board staff should be further encouraged to regard themselves in relationship to the RDB organization as technically expert individuals, operating on the premise that the over-all objective takes precedence over the more limited plans and programs of the several departments.

(2) The scope of the Board's authority should be extended to give it a voice in controlling a part of the research and development budgets of the three Departments in order to make possible shifts of emphasis in the interest of national security.

(3) Old line budgetary and accounting practices within the three Departments should be critically reviewed and revised to permit interdepartmental uniformity and realistic treatment of the portions concerned with research and development funds.

(4) Greater effort should be expended upon establishment of standard nomenclature within the three Services and standardized methods of reporting so that greater understanding of mutual problems can be achieved, and progress toward a mutual objective considered in terms of a common denominator.

Conclusion.

It is recognized that within the present RDB structure there is much room for improvement in administrative practices and in operations. This observation applies equally to the committees and to the secretariat. These areas of weakness are being recognized and named and steps taken to effect reforms. They are omitted from this paper only because it is felt that a report which may go forward to the Secretary of Defense should focus his attention on only those problems which are incapable of solution within the existing framework of the RDB.

2. ORGANIZING THE RDB

General Statement.

In the decade of the second World War and its aftermath, research and development have emerged from the seclusion of campus and industrial laboratory and become an issue of national importance. This remarkable expansion of scientific effort has received its impetus largely from Government support. An analysis of fiscal year 1948 obligations shows that the Government is spending 20 times as much for research and development as it did in 1940. The decline from the all-time peak in 1946 when the Government was spending 30 times the amount of 1940 obligations is not so great as might be expected. It is significant also that the total funds being spent by the National Military Establishment and the Atomic Energy Commission in 1948 represent approximately 50 per cent of the national total for Government-sponsored and independent academic and industrial research.

The scale of Government participation in research, and particularly the emphasis on military research, very properly raises the question as to what planning is behind the funds being expended and what kinds of coordination and determination are being made to insure the maximum effectiveness of this gigantic effort.

The answer as far as the National Military Establishment is concerned is to be found in the Research and Development Board which was created by the National Security Act of 1947 to be a part of the National Military Establishment with over-all responsibility for the formulation of the military research and development program.

Background of the RDB.

The new Board, which entered on its official existence on 30 September 1947 when the Chairman, Dr. Vannevar Bush, took the oath of office, assumed its responsibilities with its organizational pattern already established. Its principal operating arms were staffed, and it had a year and a half of experience behind it, as the Joint Research and Development Board, which had functioned since 6 June 1946 under charter from the Secretaries of War and Navy. Considerable headway had been made also in the acquisition of basic information regarding the research and development programs of the Services, and some progress had been made in the coordination of those programs and in the elimination of gaps and duplication.

The duties and responsibilities of the new Board were considerably broadened under the National Security Act of 1947, however; and, in addition to the coordinating and allocating functions, the Board was charged with the responsibility of preparing a complete, integrated program of research and development for military purposes and of advising the Joint Chiefs of Staff regarding the interaction of research and development with strategy.

On 18 December 1947 the Secretary of Defense signed a directive to the Research and Development Board under the terms of the National Security Act of 1947 spelling out in detail what its duties and functions were to be and delegating broad authority to it.

Organization of the Board.

In accordance with provisions of the Act, the Board is composed of a Chairman appointed from civilian life by the President and two representatives each from the departments of the Army, Navy, and Air Force, to be designated by the secretaries of their respective departments.

General Jacob L. Devers, Chief of the Army Field Forces, and Major General Henry S. Aurand,[1] director of the Research and Development Division, were named by the Secretary of the Army. Admiral DeWitt C. Ramsey,[2] vice chief of Naval Operations, and Rear Admiral Paul F. Lee,[2] director of the Office of Naval Research, were named by the Secretary of the Navy. General Joseph T. McNarney, commanding general of the Wright-Patterson Air Force Base, and Major General L. C. Craigie, director of Research and Development in the Office of the Deputy Chief of Staff for Materiel, USAF Headquarters, were named by the Secretary of the Air Force.

The newly constituted Board held its first meeting, which was the tenth meeting in the Joint Research and Development Board sequence, 19 December 1947, at the Pentagon. The Board accepted the credentials of the Chairman and members and named Dr. L. R. Hafstad, Executive Secretary. As provided for in the terms of its directive, the Board formulated its own rules of organization and procedure which were adopted at the initial meeting.

The Board performs a dual function in that (1) it serves as an advisory body to the Secretary of Defense and the Joint Chiefs of Staff on research and development matters as they affect the national defense, and (2) it surveys and analyzes the research and development programs of the three Services and makes recommendations looking toward a completely integrated and balanced program, free of gaps and undesirable duplication.

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[1]Succeeded by Major General Anthony C. McAuliffe, deputy director for research and development, Logistics Division, General Staff.

[2]Succeeded by Vice Admiral Earl Watkins Mills, chief of the Bureau of Ships and Vice Admiral John Dale Price, deputy chief of Naval Operations (Air)

The Committees and Panels.

The Board operates principally through its committees. As of 30 September 1947, the following committees had been established and were in operation: Aeronautics, Atomic Energy, Electronics, Geographical Exploration, Geophysical Sciences, Guided Missiles, Human Resources and the Panel on Petroleum. During the fiscal year 1948 the following committees were added to the Board structure: the Committee on Basic Physical Sciences, the Committee on Ordnance, the Committee on Medical Sciences, the Committee on Navigation, the Special Committee on Technical Information, the Ad Hoc Committee on Scientific and Synthetic Analysis, and the Committee on Plans for Mobilizing Science. Because of the overlap between the functions of the Military Liaison Committee and the Committee on Atomic Energy of the Research and Development Board, it was decided to constitute the Military Liaison Committee, augumented with civilian members, as a committee of the RDB.

The committees are composed of top-ranking civilian scientists and Army, Navy, and Air Force officers, usually of general and flag rank. The committee chairmen and members serve on a part-time basis, maintaining their regular affiliations while serving the Board.

For convenience, many of the committees have organized panels covering various aspects of the fields of interest, and these in turn have formed subpanels and working groups. Membership of committees, panels, and working groups is drawn from industrial and academic scientific institutions, from the three Services, and from other government agencies. These

people bring into the Board extensive and valuable information regarding progress and developments in their respective fields. Much coordination is achieved at the working level through detailed presentation and discussion of plans, projects, and programs which enable representatives of the Services to become aware of what is going on in laboratories other than their own. In many instances, the awareness so created obviates the necessity for deciding at a higher level within the Board where a particular project should be allocated.

The Secretariat.

The Secretariat comprises the full-time permanent staff of the RDB. It is made up of the Board Secretariat, which executes and implements the actions of the Board and furnishes administrative and housekeeping services, and the committee secretariats, which prepare agenda and minutes for committee meetings, assist in the preparation of reports and special studies, and otherwise provide supporting administrative and clerical services for committee activities.

The Board Secretariat is headed by the Executive Secretary and his deputy; Army, Navy, and Air Force Secretaries (of flag or general rank); and the directors of the Planning and Programs Divisions. There is a small supporting staff of administrative and clerical personnel. The committee secretariats consist of an executive director, Army, Navy, and Air Force secretaries, technical aides in accordance with the volume of the work, and administrative and clerical personnel as needed.

3. PROGRESS IN SOLVING MAJOR PROBLEMS

The major tasks assigned to the Research and Development Board by Section 214 of the National Security Act of 1947 are: (1) to prepare a complete and integrated plan of research and development for military purposes; (2) to advise with regard to trends in scientific research relating to national security and the measures necessary to assure continued and increasing progress; (3) to recommend measures of coordination of research and development among the Military Departments and allocation among them of responsibilities for specific programs of joint interest; (4) to formulate policy for the National Military Establishment in connection with research and development matters involving agencies outside the National Military Establishment: (5) to consider the interaction of research and development and strategy and to advise the Joint Chiefs of Staff in connection therewith; and (6) to perform such other duties as the Secretary of Defense may direct.

The Secretary of Defense amplified this basic mission in the Directive which he issued to the Board on 18 December 1947 and directed that the RDB act for the Office of the Secretary of Defense on all research and development matters except those involving major policy.

The most important continuing responsibility of the RDB is the preparation of a complete and integrated program of research and development for the National Military Establishment. This program is stated in terms of military objectives to be attained, general technical characteristics of equipments for future weapon systems that can meet those objectives, time scales, and necessary priorities for equipments for

future weapons systems. In other words, it is an over-all plan in the light of which the numerous individual programs and projects of the Armed Services can be evaluated. This plan is reviewed continuously and revised periodically--at least once a year--in order that it will be realistic in terms of changes in strategic plans and advances in research and development knowledge and techniques.

Tied in with the integrated plan is the review of military research and development programs to determine whether (1) they fit into the over-all plan; (2) all parts of the over-all plan are being covered by adequate programs or projects; and (3) there is undesirable duplication of programs and projects. In addition, this review entails a determination of the balance of effort to be placed on a particular field relative to other fields of military research and development.

Information Required for Carrying out Mission.

In order that it may have an adequate background against which to prepare over-all plans and to review the programs, facility and project proposals of the Military Departments, the RDB has found it necessary to accumulate a large amount of data which had never before been centralized.

Projects: The first requirement was comprehensive information on each project of the three Services. In order that uniform information could be acquired, the RDB devised a form, and, after coordination with the Military Departments, it was adopted for use by the Services in reporting project information. During the year, approximately 18,000 of these project cards were received and reviewed by the RDB and forwarded for purposes of coordination to committees having primary and secondary interests. In addition, the standard RDB project technical progress reports received from the Military Departments were reviewed and routed

to the cognizant committees. Of the total number of projects on which information was received, approximately 5,000 have been completed, cancelled, or superseded, leaving approximately 13,000 active and inactive projects which must be coordinated by the RDB.

One of the most useful tools developed is the subject classification system by which information on all projects in a given class may be secured promptly. In the early days of the JRDB a classification system was set up to assist in searching and organizing project information by subject. This system, which was based in part on the Universal Decimal System and in part on other systems used for classification of scientific information, proved unsatisfactory. Therefore, during the past year, the entire problem was reviewed, and as a result a new system was established for the subject coding of project cards so that they may be filed by class and subclass, and a revisable index was also prepared.

Facilities: A second type of data needed is information regarding the research and development facilities owned or operated by the Services. A survey of existing facilities of the Military Departments was made, and data on these have been catalogued according to name of the facility, geographical location, the cognizant Service, and capabilities in the several fields of research and development.

Intelligence: Adequate intelligence on foreign research and development, including significant trends, is also exceedingly important in order that the RDB may measure the adequacy of our program against what foreign powers are doing and so that ample provision may be made for countering potential enemy weapons. Information of this type has been received only in random areas, and complete coverage is yet to be obtained.

Technical Information: The vast body of scientific data constantly being published on all subjects in all parts of the world poses a problem of such complexity that it has become, in itself, a project requiring much study and research for its ultimate solution. In recognition of the pertinence of the problems of receiving and assimilating all scientific data of actual or potential usefulness to the military, representatives of the various agencies of the National Military Establishment met at the Library of Congress in November 1947 to consider ways and means of dealing with this problem, and, after thorough discussion, recommended that the RDB assume cognizance of the problem for the Military Establishment. The Board approved the establishment of the Special Committee on Technical Information to coordinate for the National Military Establishment such matters as scientific nomenclature, document publication and distribution, abstracting and abstract journals, classification and indexing, and other documentation problems relating to scientific research information.

At the first meeting of the Committee on 1 September 1948, it was decided that the first necessity was a realistic inventory of the technical information activities already operating within the various bureaus and commands of the Military Establishment. The members from the Military Departments have agreed to conduct a survey and report in detail on these activities. Working groups were established to develop improved interchange of research results between the NME and the Atomic Energy Commission to devise new methods of disseminating technical information among scientists associated with military research and development projects.

Policies for Review and Allocation of Programs, Projects and Facilities.

To guide the committees and secretariat of the Board, as well as the Military Departments, the Board established policies for review of programs, projects, and facilities, and for the allocation of programs of joint interest.

The first policy requires that all proposals for programs, projects, or facilities, when presented by the Military Departments to the Board for action, be accompanied by evidence of (1) need for action, (2) coordination, and (3) evaluation. The criteria established as justification of the need for action are (1) military necessity or (2) the need to establish or maintain a margin of superiority in a specific field related to the national security. Military necessity implies the necessity, or desirability, of being able to perform, by a foreseeable date, a specified type of operation beyond the capabilities of existing weapons. The maintenance of a safe margin in the general skill, knowledge, and practice in those fields of technology which contribute in a major way to the quality of weapons and techniques of warfare is a necessary element of national security. Coordination among the three Services should be accomplished before the proposal is sent to the RDB; however, the committees are responsible for assuring that such coordination has been accomplished, that unwarranted duplication and program gaps are eliminated, and that a unitary program is produced. In addition, the committees are required to evaluate programs and projects to determine their relation to the integrated plan. This means that they must report the degree to which the activity in question is necessary in attaining the objectives of the field and whether it is sound in nature, extent, and cost. On the basis

of these facts, the Board will determine the balance of emphasis to be placed on the particular field relative to other fields of military research and development. The Board also participates in the determination of the relationship of research and development to other phases of the military effort.

The second policy, which supplements the foregoing policy, defines the terms research and development establishment, research and development facility, and supporting utility and provides that the Board will review and finally pass on the necessity for additional Service research and development facilities exceeding a certain minimum cost, the Services to report to the Board, for information purposes, proposed expenditures for all other facilities of consequence.

The expectation is that this policy will result in the maximum utilization by the three Services of needed facilities--such as the White Sands Proving Ground, Squier Signal Laboratory, Naval Air Missile Test Center--with a minimum of expenditure of government funds. This is important, since laboratory and test facilities with their attendant administrative, logistic, maintenance, land supporting utilities, and community activities are one of the largest expenditures arising out of research needs.

Where a program is of common concern to more than one Department, if allocation of responsibility to a single Department is undesirable or premature, the Board will, upon advice of the appropriate committees, subdivide the program into parts, assign responsibility for each part to a Department, which in turn is responsible for adequate interchange of technical information, and maximum joint utilization of facilities as may be indicated. In the case of programs which are the concern of more than

one Department, but in which one of the Departments has a predominant interest, the Board will allocate primary responsibility to that Department.

Accomplishments in Specific Areas.

In addition to the collection and organization of information and the establishment of policies to implement its operation, the Board has carried out its mission in specific areas. Those of which mention can be made at the present time include:

Interim Plan and Program Review: During its first year of operation it was not possible to prepare a complete, integrated plan for military research and development. However, an interim plan was prepared which has served as a guide pending completion of an over-all plan. The committees prepared program reports placing in proper perspective the accomplishments of the fiscal year 1948, the programs for 1949, and the proposals for fiscal year 1950.

Exchange of Information: Considerable exchange of information among the Military Departments with respect to programs and specific projects takes place among representatives of the three Services, who are members of RDB agencies and offices, through regular meetings and informal discussion. Also, several committees, notably the Committee on Electronics and the Committee on Human Resources, have arranged series of symposiums and special conferences for the discussion of work being carried out in particular areas. The requirement that each Service forward copies of project information to the other two Services concurrently with its transmission to the RDB is the one formal device the Board has established to discharge its responsibility for effecting exchange of information among the Departments.

Examples of Coordination and Allocation:

Unitary Plan and AEDC: Among the major programs and facilities which the RDB has coordinated this year are the Unitary Plan for Transsonic and Supersonic Wind Tunnels, as proposed jointly by the NACA and the Armed Services, and the Air Engineering Development Center, as proposed by the Air Force. The wind tunnel facilities of the AEDC are included in the Unitary Plan. Based upon studies made by the Committee on Aeronautics, the Board approved the expenditure of fiscal year 1949 funds for design and initial construction of certain facilities for the AEDC and recommended submission to the Bureau of the Budget by the Air Force of a request for funds to establish the AEDC and to provide the service facilities and housing necessary to support the test facilities. The immediate construction for 8 working tunnels and 13 tunnels for research training to be located at educational institutions was recommended by the Board as the initial action on coordination of the Unitary Plan.

Quartermaster Corps Laboratory: With regard to a proposal of the Quartermaster Corps for a research and development laboratory directed toward providing adequate clothing, supplies, and equipment to the personnel of the Armed Forces, the Board found that the proposed facility did not duplicate existing facilities, either Government-owned or industrial, and recommended that enabling legislation for this laboratory be obtained and that the laboratory be considered a laboratory of the Armed Services.

Geophysical Sciences: As a result of studies and recommendations of the Committee on Geophysical Sciences, the RDB allocated a joint program for geophysical research in the Aleutians to the United States Geological Survey, to be supported by funds specifically appropriated for this purpose to the Departments of the Army, Navy, Air Force, and

United States Geological Survey. Formerly, this project was carried out by the USGS in cooperation with the Army. On the basis of recommendations by this Committee, the RDB also requested the Army and the Air Force to undertake at the earliest practical date a program of research on wave propagation over arctic paths and called the attention of these Departments to the importance of developing electronic methods for geodetic control.

Electronics: In line with the policy of standardizing equipment for use by the several Services, in so far as practicable, and of eliminating duplication of research and development effort, the responsibility for the development of ground-based electronic countermeasures equipment for the Army and the Air Force has been allocated to the Signal Corps on the basis of agreements effected by the Committee on Electronics. The Committee also has coordinated developments in ultra-high frequency communications equipment that may be used either by the Air Force or the Navy.

Guided Missiles: The Earth Satellite Vehicle Program, which was being carried out independently by each Military Service, was assigned to the Committee on Guided Missiles for coordination. To provide an integrated program with resultant elimination of duplication, the Committee recommended that current effort in this field be limited to studies and component designs; well-defined areas of such research have been allocated to each of the three Military Departments.

With a view to the preparation of recommendations on the future direction of an over-all national guided-missiles program, the Technical Evaluation Group of the Committee on Guided Missiles has undertaken to survey and report on the activity at each of the approximately 25 major

missile contractors. This Group has presented its first set of recommendations regarding the national program, which, if adopted, will result in the cancellation of some projects in this field and a change in the relative emphasis of others.

As a result of a study of guided-missile test ranges, which was made by the Committee, (1) an integrated test-range program now exists which provides for the work load to be concentrated at four existing ranges; (2) the capabilities of the various test ranges have been established; and (3) the principle has been accepted that all ranges are available to all Departments.

Human Resources: The Committee on Human Resources has recommended that an inter-Departmental coordinating agency be established for planning programs of joint interest and for monitoring such distinctly inter-Service projects as: population standards on psychological and physical traits; techniques of rapid assessment of psychological and physical characteristics in the event of rapid mobilization; research on scientific and technical personnel; strategic planning and intelligence; basic research on problems of common interest. The Committee has collaborated with the Munitions Board's Steering Committee on Manpower Requirements Methods on the problem of securing uniform descriptions of jobs and their human requirements on the part of all three Services and, also, of describing the relationship of military to civilian jobs. Such information is essential to the resolution of conflicts between the three Services over their manpower requirements.

Geographical Exploration: Scientific programs for two expeditions north of Alaska were planned for the Strategic Air Command, and six

other proposed expeditions advanced by non-Service sponsors were appraised by the Committee on Geographical Exploration. As a result of these latter expeditions, the Services expect to gain useful information regarding such little-known areas as the Yukon, Ungava, northern and central Alaska, central Africa, and southern Arabia.

Policy Involving Outside Agencies: One of the most important RDB recommendations to be effectuated during the year was the establishment of the Air Navigation Development Board by joint agreement between the Secretary of Defense and the Secretary of Commerce. This recommendation was part of an over-all report[3] made by an Ad Hoc Committee on Navigation.

Other matters affecting outside agencies, in addition to the Unitary Plan for Transsonic and Supersonic Wind Tunnels which has been discussed in the foregoing section, were the request to the Weather Bureau, based on findings by the Committee on Geophysical Sciences, that the Northern Hemisphere Charts be brought up-to-date and kept current and that ways and means of establishing five aerological stations in given areas be recommended. In addition, the Committees and the RDB Secretariat studied pending legislation and made recommendations to the Secretary of Defense in connection with formulation of Military Establishment policies and views with respect to such legislation.

Advice to Joint Chiefs of Staff: In carrying out its directive to advise the Joint Chiefs of Staff regarding the interaction of research and development and strategy, the RDB prepared and submitted technical estimates on weapons and countermeasures.

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[3] Navigation and National Security, 5 March 1948.

Upon the request of the Joint Map and Photo Committee, Joint Intelligence Committee, for selection of analogous geographic areas to be used in testing the utility of photo interpretation keys as a method of gaining terrain information on regions that are presently inaccessible, a full report was prepared by the Panel on Geographic Environment and transmitted to the JMPC. In addition, there was forwarded to the JMPC a paper outlining map information requirements of the Committee on Geographical Exploration, in which the Committee recommended that strong support be given to the continued development of radar-scope photography and suggested that in establishing mapping priorities, consideration be given to areas which are of potential military importance to the United States.

On the basis of a report prepared by the Panel on Radar of the Committee on Electronics, the Chairman of the Board recommended that a study be established in cooperation with the Joint Communications Board, JCS, to consider the over-all problems of air defense requirements.

Recommendations to Secretary of Defense: In view of the high cost of research and development, the Board has given serious consideration to the need for evaluating weapons and weapons systems at an earlier stage than is now the case, and recommendations have been made to the Secretary of Defense in regard to the establishment within the National Military Establishment of a Weapons Systems Evaluation Group.

The Chairman of the Board, jointly with the Chairman of the Munitions Board and the Director of the Joint Staff, recommended to the Secretary of Defense that a review be made of the committee structure of the entire National Military Establishment to determine which of the present boards, committees, and panels are unnecessary and should be abolished; what

agencies are needed; and what authority, functions, and position in the NME each should have. A resultant simplification of committee structure would conserve the time of key NME personnel who, because of their positions, serve on a number of NME committees.

The Research and Development Board held a special meeting to discuss the request of the Secretary of Defense for a recommendation regarding the scope and distribution of the research and development program for the NME for the fiscal year 1950. The Chairman and the Army and Navy members agreed that approximately the current rate of effort on military research and development should be maintained, but the Air Force members recommended that the rate should be increased. The Board was divided, also, on the amount of funds that would be adequate to maintain the current rate.

With respect to the distribution of funds for the 1950 program, the Board found that available information was insufficient to enable it to recommend any substantial change in the distribution of effort between the Departments, now approximately, in dollars, 20 per cent Army, 40 per cent Navy, 40 per cent Air Force.

4. STATUS OF RESEARCH AND DEVELOPMENT IN THE MILITARY DEPARTMENTS

Fiscal Aspects.

For the past several years, the research and development effort has been in excess of 500 million dollars. From the peak of approximately 570 million dollars obligated for the fiscal year 1946, there was a marked drop for the two succeeding years. Estimated allocations for the fiscal year 1949, however, approximate the fiscal year 1946 obligations. This increase over 1948 obligations does not represent an anticipated increase in the magnitude of the current research and development effort but is required to continue the current rate of effort in view of the lower purchasing power of the dollar.

The distribution of funds among the Services for the fiscal year 1949 will be roughly 20 per cent, Army; 40 per cent, Navy; 40 per cent, Air Force. On a monetary basis, approximately one-third of the program will be carried out in Service installations, and the remaining two-thirds will be carried out by industrial and academic contractors. This is in line with the general policy that the Services will not duplicate research and development facilities that are provided adequately by non-Governmental agencies.

Current Programs.

When the research and development program of any one Department is examined alone it seems evident that a broad attack is being made on the various problems and that the various investigations and developments are being carried forward energetically, but when the programs of the three Departments are examined in parallel it is apparent that appreciable improvements or desirable modifications should be made.

As far as can be determined, the United States has a fair margin of superiority in practically every technical area of weapon development. The fact that few instances of undesirable duplication have been uncovered, is owing, in some measure, to the informal coordination which has been effected by military representatives on the committee and panels of the Board. A truly integrated program of military research and development, however, would require that some current projects be cut back severly, that new programs be initiated, and that emphasis be shifted in certain areas.

Operations Analysis.

A salutary trend in military research and development is the extension and strengthening of operations analysis research which was begun in isolated fields during World War II. The success of the Antisubmarine Warfare Operations Research Group established in 1942 by the aid of the National Defense Research Committee led to the organization of operations analysis and evaluation groups within the three Services. The objective of these groups is to provide analyses from an operational point of view of weapons and weapon requirements which will indicate the probable critical limitations of instruments of war as yet undeveloped and if training problems which may be expected when new items of equipment are placed in operation by the Services. Examples of investigations made by these groups are the comparative over-all costs of various methods of waging warfare; the relative value of short-range guided missiles, free rockets, and artillery; the application of the principles of biomechanics to equipment design.

Basic Research.

Because of the nature of military research and development, the major effort is directed to applied research. Strides in applied research, however, depend upon knowledge derived from basic research. In other words, applied research and development soon encounter diminishing returns and grow sterile unless new facts are provided through basic research. Since the reservoir of basic research which had been developed prior to World War II has been drained, and non-Government agencies are unable to carry the load of refilling it without financial assistance, the military are giving some support to this activity. This support takes the form of contracts with universities and non-profit institutions and industrial laboratories and of transfers of funds to other Government laboratories.

The Office of Naval Research bears the largest share of this program with an annual expenditure rate of approximately $25,000,000. The ONR sponsors about 1000 projects devoted, for the most part, to basic research by contracts with about 220 laboratories. The Air Force depends on the National Advisory Committee for Aeronautics for basic research in aerodynamics and thermodynamics. In areas which are not covered by regular programs of other government agencies the Air Force and the Army, also, must assume responsibility for basic research. The number of contracts of these Services that involve some measure of basic research are: for the Air Force, approximately 280 contracts with 69 laboratories; for the Army, approximately 390 contracts with 73 laboratories.

In considering these figures, it should be remembered that one outstanding discovery in basic research may alone justify the entire program many times over.

Conclusion.

On the whole, the research and development program of each individual Service is well conceived and carried out; although a completely integrated program of military research and development has not yet been developed. The achievement of this goal is dependent, to a large extent, upon the solution of several basic problems which are discussed in the following section of this report.

5. PROBLEMS FOR THE IMMEDIATE FUTURE

Much of the work of the Board on the preparation of the integrated plan and the program review is of a recurring nature, and procedure for these operations and for the coordination of proposals for projects and facilities have been established.

There are some individual programs and proposals for large facilities on which initial RDB coordination will not be completed for some time. Among these are the Unitary Plan for Transsonic and Supersonic Wind Tunnels, which was discussed previously, and unitary plans for rocket and ram-jet test facilities. Various aspects of the arctic rubber problem have heretofore been the concern of a number of agencies, but no integrated program in this field has been developed. An ad hoc group has been appointed within the Committee on Basic Physical Sciences to recommend an integrated arctic rubber program and to determine the method by which the program may be coordinated.

Many problems which face the RDB are of such nature that they can be solved only in cooperation or agreement with other departments or agencies or by the passage of new legislation. A discussion of these problems follows.

Dual Responsibilities of Top Management.

The difficulties of the Research and Development Board in carrying out its mission are owing, in part, to the shortcomings of unification as a whole: the misconception that a Secretary of Defense can carry out his function of integrating the entire Military Establishment with staff agencies that are wholly inadequate to implement the over-all unifying

point of view. The staff agencies established to assist the Secretary of Defense (Joint Chiefs of Staff, Munitions Board, and RDB) have the responsibility for formulating and establishing unified, integrated top policy for the guidance of the Departments. Yet these agencies are staffed at the policy-making level by representatives of those same three Departments who spend a fraction of their time, effort, and thought on viewing the problems as a whole and a major portion of their time conducting the affairs of their own Departments.

JCS-RDB Relationship.

Authoritative action regarding the distribution of research moneys between the military programs under the purview of the different committees is dependent upon the receipt of strategic guidance from the Joint Chiefs of Staff. This involves information regarding time scales, indicating when certain equipments and weapons will be required; priorities for programs and projects; zones of operation of certain equipments and weapons; and probable phases of warfare.

Up to this point adequate strategic guidance has not been received by the Board because the two-way flow of information between the JCS and the Board, as provided for in the RDB Directive, has not been perfected. Nevertheless, during this first year of unification the Board has furnished to the Joint Chiefs of Staff some technical information regarding weapons and the JCS has furnished to the Board some strategic guidance. Progress in this area is slow, but as mutual problems are worked out this exchange will become more effective. The fact remains until adequate strategic guidance can be provided the Board cannot make authoritative decisions regarding the priorities of projects and the distribution of research moneys between the military programs.

Fiscal Problems.

Standardization of Accounting Procedures: One problem, on which the RDB is cooperating with the Office of the Secretary of Defense and the Military Departments in working out a solution, is the need for standard methods of accounting among the three Services. Among the questions which must be answered are (1) what elements of cost constitute direct and indirect costs of research and development, and (2) what cost elements are to be included in budget and fiscal reports.

The present lack of standardization makes comparisons difficult. In some instances, figures can be adjusted in light of known facts; however, in many instances, large elements which are unknown to the RDB are included in or omitted from the fiscal data submitted. As a result, much of the information on which an adequate integrated plan can be based is lacking. In other words, the list of objectives and relative priorities of programs and projects can be determined, but up to this time, it has been impossible for intelligent recommendations to be made regarding the distribution of moneys between programs and Departments.

Unliquidated Obligations: Although unliquidated obligations for military research and development have been somewhat reduced in 1948 from the fiscal year 1947, there is still an accumulation of unliquidated obligations. These are a source of concern to the Bureau of the Budget, which considers them as accrued liabilities. However, in research and development work, substantial carry-overs are necessary in order to insure long-range planning and continuity of the work. In recent years,

certain obligations have been carried for more than the two additional years now normally permitted by law, by asking Congress to reappropriate the funds. The situation is neither healthy nor necessary. Proposed legislation would extend from three to five years the period of time within which research and development programs of the National Military Establishment must be planned and executed.

Contract Authority: One important aspect left unprovided for by the proposed legislation is the need for contract authority in an amount equal to one year's average expenditures. This will enable the various agencies of the Military Departments to extend by two years the average duration of their contracts. Unless thus financially implemented, the proposed legislation will remain ineffective. It is to be noted that contract authority, if used for the purpose of extending the average length of research and development contracts, will not result in higher expenditures in any one fiscal year and will therefor cost the taxpayer nothing.

Appropriation Structure: A great handicap to the Board in performing the duties assigned to it by the National Security Act and the directive of the Secretary of Defense is the fact that most of the research and development funds are appropriated administratively rather than functionally and are, therefore, difficult to analyze. A functional appropriation structure would obviate many of the difficulties attendant to the present system. Pending improvement of the appropriation structure, established appropriation accounting processes must be duplicated by special research and development accounting procedures. Even with such duplicate reporting, there is no firm relationship between research and development budget formulation and the subsequent use of appropriated funds.

Functional appropriations would also facilitate desirable transfers between Departments and agencies of the NME of research and development funds, a very cumbersome and limited procedure under the present system. Upon such transfers depends to a large extent the effectiveness of the Board's recommendations with regard to relative emphasis, allocation and reallocation of responsibility, and initiation of projects and programs, which must be carried out if an integrated program of military research and development is to be achieved.

Shortage of Scientific Personnel.

The shortage of scientific manpower seriously affects the military research and development programs. The limiting factor in expanding present research and development programs is the availability of scientific manpower. In view of the long training periods involved, only a few qualified research workers are added from year-to-year to the reservoir of active workers.

Some scientifically-trained persons are added to the pool each year as a result of the education and training provisions of the G. I. Bill of Rights and through the fellowship programs established by the National Research Council, with funds furnished by the Atomic Energy Commission and private grants, and by the United States Public Health Service. In addition, advanced scientific training is provided to a number of persons employed on research projects in academic institutions which have contracts with the Office of Naval Research and the Army and the Air Force. The shortage of scientific manpower is so acute, however, that there should be additional grants-in-aid for scientific education and training such

as those provided in the National Science Foundation bills introduced in the 80th Congress.

To provide for maximum utilization of available personnel, a study of the scientific personnel resources of the National Military Establishment has been proposed.