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HISTORY OF THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

A summary of the activities of the entire organization in the development of improved weapons of warfare has been published as *Scientists Against Time* by James Phinney Baxter, 3rd. Details about the different parts of the organization are presented in a series of volumes with the common title, *Science in World War II*, which has been prepared under authority from:

- Vannevar Bush, President, Carnegie Institution of Washington
  Director, Office of Scientific Research and Development
- James B. Conant, President, Harvard University
  Chairman, National Defense Research Committee
- Alfred N. Richards, Vice-President in charge of Medical Affairs, University of Pennsylvania
  Chairman, Committee on Medical Research
- Karl T. Compton, President, Massachusetts Institute of Technology
  Chief, Office of Field Service

*Science in World War II*

**NEW WEAPONS FOR AIR WARFARE**
DIVISIONS 4, 5, AND 7 OF NDRC; SECTION T, OSRD

**COMBAT SCIENTISTS**
OFFICE OF FIELD SERVICE; NALOC; DOLOC

**ADVANCES IN MILITARY MEDICINE**
COMMITTEE ON MEDICAL RESEARCH

**ROCKETS, GUNS, AND TARGETS**
DIVISIONS 1, 2, AND 3 OF NDRC

**CHEMISTRY**
DIVISIONS 8, 9, 10, 11, 19 AND TDAC OF NDRC

**APPLIED PHYSICS: ELECTRONICS; OPTICS; METALLURGY**
DIVISIONS 13, 15, 16, 17, 18 AND COMMITTEE ON PROPAGATION OF NDRC

**ORGANIZING SCIENTIFIC RESEARCH FOR WAR**
ADMINISTRATIVE FRAMEWORK OF OSRD
ORGANIZING SCIENTIFIC RESEARCH FOR WAR
PUBLISHER'S NOTE

Under the terms of the contract for the publication of Organizing Scientific Research for War and of the other volumes in the long history of the activities of the Office of Scientific Research and Development, entitled Science in World War II, the publisher has agreed to waive its right under the copyright of each separate volume after ten years from the date of publication of such volume. Thereafter the volume in question will be in the public domain and dedicated to the public.

This volume of the history of OSRD is a description of the administrative framework of the organization that developed, improved, and brought into use certain new weapons. It is not intended to be a complete documentary record of the making of the inventions that happen to be mentioned in it.

The author of this volume receives no royalty from its sale.
This splendid agency but a few months hence will go out of existence. The contribution that it has made to the winning of the war is inestimable. Without such contribution, it is safe to say that victory still would await achievement. However, the office has been essentially a war agency, and it is now engaged in liquidation. To its distinguished and internationally known head, Dr. Vannevar Bush, and the staff of great scientists he gathered around him to aid in the development of new weapons, the Nation owes much.

—Excerpt from Report No. 1125 of the Committee on Appropriations of the House of Representatives, October 17, 1945
FOREWORD

WORLD WAR II was the first war in human history to be affected decisively by weapons unknown at the outbreak of hostilities. This is probably the most significant military fact of our decade: that upon the current evolution of the instrumentalities of war, the strategy and tactics of warfare must now be conditioned. In World War II this new situation demanded a closer linkage among military men, scientists, and industrialists than had ever before been required, primarily because the new weapons whose evolution determines the course of war are dominantly the products of science, as is natural in an essentially scientific and technological age.

The Office of Scientific Research and Development, one crucial aspect of whose history is ably told in this volume, was the medium through which, in the main, scientists were joined in effective partnership with military men. Such a partnership was really a new thing in the world and was a partnership between groups which one might at first thought consider inherently incompatible. The military group, both because of the extreme demands and extreme responsibilities of the profession of arms and because of long and honorable tradition, is formally organized to a very high degree. The scientific group, both because of the individualistic approach essential to research and because of the sufficiency of the loosest of organization for all practical purposes in normal times, is much more a gathering of individuals than a group in the professional or structural sense.

For two such entities to develop a pattern of highly effective collaboration — and that such a pattern was developed is clear in the record — demanded much in the beginning from each. New lessons in understanding and evaluation had to be learned both by the military and by the scientific. Old preconceptions had to be overcome and old prepossessions foregone by both. In the earlier part of the period it was inevitable that there should be much expenditure of time and energy in these vital developments, inevitable also that there should be disagreement and even outright friction. Honest and strongly held opposing convictions often had to be reconciled. Obduracy and narrow interests occasionally had to be rooted out. Both parties generally, however, were imbued with the same patriotism and actuated by the same sense of urgent responsibility, which speeded the establishment of sound interdependent effort.
It was at the administrative center where all the widely ramified activities and contacts of the scientific effort could be seen from a somewhat detached point of view that the process of adjustment and comprehension was most sharply sensed. Hence it is that Dr. Stewart's account of the administrative history of the OSRD is of the greatest value for the future and of the greatest interest to those concerned with organization and the patterns of government. It offers the data on which may be based sound appraisal of how sincere and hard-working men of professions ordinarily widely separate can set about and accomplish the development of unity.

It was the function of the administrative office of OSRD to channelize and focus an amazing array of variegated activities, to co-ordinate them both with the military necessities which they were designed to help to meet and with the requirements of the powerful industrial structure on which their effective application relied. In the contracting system which it developed, in the methods for safeguarding the public interest through sound patent policy which it created, in the means for effective and cordial liaison with co-operating agencies which it effected, and in a dozen other ways, the office brought to being a pattern of administration which aptly met a new and unique need and which stands as a richly suggestive guide for other undertakings.

Washington, D.C.
November 4, 1946
PREFACE

The present volume is one of a series devoted to the history of the Office of Scientific Research and Development. It is confined to the administrative operations of that office. Other volumes will report upon its scientific achievements. Four volumes will be devoted to the work of the National Defense Research Committee, one volume to the Office of Field Service, and two volumes to the Committee on Medical Research. These eight volumes will cover in much greater detail the operations of OSRD as already reported in a single volume by James Phinney Baxter, 3rd, entitled Scientists Against Time.

In the preparation of the present volume the author has received the assistance of many people. Approximately half of it is based upon manuscripts prepared initially by others while the remainder was prepared without the benefit of such manuscripts. The files of the office were available without restriction and only occasionally has it been necessary to tread lightly in order to avoid using material bearing a security classification.

In addition to the assistance which he received from many other persons, the author wishes particularly to acknowledge his indebtedness to W. F. Davidson, Charles H. Schauer, Mrs. Virginia B. Shapley, Arthur M. Walker, Lincoln R. Thiesmeyer, George W. Corner, Chester C. Stock, W. S. Bowen, Eugene W. Scott, Cleveland Norcross, Miss Lee Anna Embrey, Mrs. Alice Day, John J. Charuhas, Carey G. Cruikshank, Robert A. Lavender, Roy C. Bowker, Marvin L. Faris, W. A. Osborne, George W. Bailey, E. Tefft Barker, Mrs. Jean B. May, John E. Burchard, and the Division and Panel Chiefs of NDRC and CMR. The writer is also indebted to James Phinney Baxter, 3rd, for making available some of the material he had collected for his volume; to Miss Emily B. Mitchell for her work in collecting and checking material, and to Miss Mary Kathryn Horn for her assistance in preparing the manuscript.

The manuscript has benefited greatly by numerous suggestions from Vannevar Bush and Fred Fassett.

The manuscript was complete when the author left Washington in June, 1946. He wishes to express his appreciation to Dr. John S. Burlew for suggesting changes which make it current as to the date of publication.
The preparation of a volume like the present requires selection from a great mass of material and the choice among various modes of presentation. For the decisions on these points and on all others, the author assumes full responsibility.
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ORGANIZING SCIENTIFIC RESEARCH FOR WAR
Part One: Harnessing Science

CHAPTER I

THE BEGINNINGS

That phase of the European war which many Americans were complacently dubbing the "phony war" ended suddenly on May 10, 1940, when the Germans struck at France through Belgium and the Netherlands. The speed of the German advance came as a great surprise to many who had placed their faith in the Maginot Line and its northward extension. The dramatic character of unfolding events lent sharp point to the concern of a group of American scientists who realized the extent to which the United States was unprepared to fight a modern war.

Historians may differ as to the reasons why with all of its remarkable scientific advances the United States lagged so dangerously in the development of weapons, but none will deny the fact. During the two decades between the end of World War I and the beginning of World War II, the people of the United States had pinned their faith on the impossibility of another world war, although their government had not been willing to bear any share of the responsibility for the success of the one international organization which had the slightest chance of making aggression unlikely. Appropriations for military purposes were relatively small as the American people nurtured the fond hope that by its action the United States could set an example of small armaments which would be followed by the rest of the world.

Yet small appropriations are by no means the key to America's scientific unpreparedness for war; for during at least the last decade of that period, Congress appropriated every cent requested for military research and development. Perhaps the armed services were so blind to the possibilities that they did not ask for adequate funds for research and development, or perhaps the Bureau of the Budget cut the requests for funds for this purpose; in any event, the initial responsibility for low appropriations for research and development resides in the executive branch and not in the legislative.

Whether the armed services would have made any better preparation for modern war had they had more money is another subject for fruitless speculation. They certainly had showed limited imagination in opening
new fields with the funds at their disposal, although this does not foreclose the possibility that they might have exercised greater imagination had they had more money. More significant is the fact that when large amounts of money were available, there was no corresponding increase in vision as to how it might be used for the development of new and more effective weapons.

In any event, it was apparent to a few key scientists in the spring of 1940 that the United States was in imminent danger of being forced into a war for which the country was pathetically unprepared from the standpoint of new weapons. While others may have had the same feeling, four in particular discussed the matter among themselves and took steps to enlist the support of President Roosevelt to improve the situation. They were Vannevar Bush, President of the Carnegie Institution of Washington; Karl T. Compton, President of the Massachusetts Institute of Technology; James B. Conant, President of Harvard University, and Frank B. Jewett, President of the National Academy of Sciences and of the Bell Telephone Laboratories. Of this group, Bush was the one who carried the major part of the responsibility of impressing the need for action upon President Roosevelt and his advisers and of persuading the heads of the military forces of the need for a more effective mobilization of science for a program of improvement of weapons of warfare.

A great source of the fundamental strength of the United States has been in the very high proportion of its scientific and engineering talent devoted to the ordinary economy of peacetime. The contributions of the scientists and the engineers underlie the tremendous economic development which constitutes the basis for the support of a modern mechanized army and navy. The great need was to bring this scientific and engineering strength quickly and effectively to bear upon the preparation for defense in modern warfare. The situation was not unique, for the same need had been felt in other major conflicts in which the country had engaged.

Thus, the National Academy of Sciences was created by an act of Congress approved on March 3, 1863, in order better to focus scientific talent in the Civil War. The Academy was composed of distinguished American scientists and engineers from the fields of mathematics, astronomy, physics, engineering, chemistry, geology, and paleontology; botany, zoology, anatomy, physiology, biochemistry, pathology, and bacteriology; anthropology and psychology. Election to membership in the Academy was based on established eminence in some field of science; the number of members was originally limited to 50, but the limitation was later removed and in 1940 the number of members was approximately 300.

The act creating the Academy provided that it should “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 was to be borne from appropriations which might be made for the purpose, but the Academy was to receive no compensation for itself for any services to the Government. Between the time of its creation and World War I, the Academy undertook many noteworthy investigations in fields of science for the Government. At the time of World War I, the fields of science and the problems in them vital to national defense had grown to such proportions that President Wilson requested the Academy to expand its facilities for service by creating a National Research Council as its agent for the better handling of its governmental and other obligations.

A more definite status was given the Council by Executive Order No. 2859 of May 11, 1918, which empowered the Academy to establish the Council as a permanent body. That order also provided that on nomination of the Academy the President would designate representatives of the Government to be members of the Council and further provided that the heads of Government departments would co-operate with the work of the Council in every way that it required. For the most part, the Council operated through divisions in the following fields: foreign relations, educational relations, physical sciences, engineering and industrial research, chemistry and chemical technology, geology and geography, medical sciences, biology and agriculture, anthropology and psychology.

In general, the membership of the divisions was made up of official representatives of all the principal national societies or organizations in the fields covered by the divisions, of representatives of Government, and of distinguished members at large. The active work of the divisions was carried on by committees, either permanent or special, composed of men specially qualified for the specific undertakings. Many of the committees were joint committees with the Academy. In the spring of 1940, more than 1100 men were actively engaged on National Research Council work as members of the Council, its divisions or committees, and the Council was handling a large number of research problems and studies for the Army, Navy and other departments of Government.

Useful though the Academy had been in the Civil War and the Research Council in World War I, the situation in the spring of 1940 appeared to demand a new approach. The number of men in the armed services capable of knowing what was needed was small. They, with all other officers, would obviously be swamped with the gigantic task of building an army and navy of the size which would be needed if the United States were to be adequately prepared. The Academy and the Research Council were instruments of undoubted usefulness, but the basic statute incorporating the Academy was predicated upon the theory that the Academy would act when called upon by the Services. Moreover, it was primarily an advisory rather than an operating body. The Academy was fortunate in having a man like Jewett as its President during the war years, for his industrial background
coupled with his great native ability peculiarly fitted him to appreciate the requirements which modern war would make upon scientific and industrial establishments. However, what was needed was an organization which could make its own assessment of what the armed services needed and which could then, preferably with the assistance of the Services but over their opposition if necessary, go about the business of getting the necessary weapons developed.

Previous efforts to bring civilian science into the program of weapon development were based on the theory that the Services would know what they needed and would ask the scientists to aid in its development. Modern science has progressed to the point where the military chieftains were not sufficiently acquainted with its possibilities to know for what they might ask with a reasonable expectation that it could be developed. The times called for a reversal of the situation, namely letting men who knew the latest advances in science become more familiar with the needs of the military in order that they might tell the military what was possible in science so that together they might assess what should be done. It was this conception which Bush and his colleagues sold to President Roosevelt and to which General Marshall and Admiral Stark gave their blessing prior to the issuance of the order of the Council of National Defense, which on June 27, 1940, established the National Defense Research Committee of the Council of National Defense.
CHAPTER II

NATIONAL DEFENSE RESEARCH COMMITTEE

JUNE 27, 1940, TO JUNE 28, 1941

THE Council of National Defense had been created in 1916 "for the co-ordination of industries and resources for the national security and welfare"; it consisted of the Secretaries of War, Navy, Interior, Agriculture, Commerce and Labor. (U. S. Code, Title 50, section 1.) The Council was authorized to organize subordinate bodies for its assistance in special investigations, including the creation of committees of specially qualified persons.

The order of the Council which created the National Defense Research Committee (NDRC) was issued with the approval of the President on June 27, 1940. Of the eight members of the Committee, two were designated by virtue of their positions as President of the National Academy of Sciences and Commissioner of Patents respectively, four were appointed without reference to other offices, and two were selected by the Secretary of War and the Secretary of the Navy respectively. Members of the Committee served as such without compensation. The original members of the Committee were: Vannevar Bush, President of the Carnegie Institution of Washington, electrical engineer, Chairman; Rear Admiral Harold G. Bowen; Conway Peyton Coe, Commissioner of Patents, attorney; Karl Taylor Compton, President of the Massachusetts Institute of Technology, physicist; James Bryant Conant, President of Harvard University, chemist; Frank Baldwin Jewett, President of the National Academy of Sciences and President of the Bell Telephone Laboratories, electrical engineer; Brigadier General George V. Strong; Richard Chace Tolman, Professor of Physical Chemistry and Mathematical Physics, California Institute of Technology, physicist.

Brigadier General R. C. Moore succeeded General Strong as Army member of the Committee on January 17, 1941; otherwise the membership was unchanged during the one year and one day the Committee functioned under the Council of National Defense.

One of the most significant facts about this group was the sense of urgency with which it was imbued; the need for speed in developing new and improved weapons was the central core of all its operations. The fact that the civilian members were well known to each other, both personally and professionally, made it easy for them to work together effectively with a minimum loss of time.
Authority of the NDRC

The Committee was directed to correlate and support scientific research on the mechanisms and devices of warfare, except those relating to problems of flight included in the field of activities of the National Advisory Committee for Aeronautics. It was directed to aid and supplement the experimental and research activities of the War and Navy Departments; and it was authorized to “conduct research for the creation and improvement of instrumentalities, methods and materials of warfare.” The Committee was authorized in carrying out its functions to utilize, to the extent that such facilities were available for the purpose, the laboratories, equipment and services of the National Bureau of Standards and other Government institutions. Within the limits of appropriations allocated to it, it was authorized to transfer funds to such institutions and to enter into contracts with individuals, educational or scientific institutions (including the National Academy of Sciences and the National Research Council), and industrial organizations for studies, experimental investigations, and reports.

The final paragraph of the order authorized the Committee to promulgate rules and regulations for the conduct of its work, which rules and regulations were to be subject to the approval of the Council and the President. The Committee never exercised the authority granted in this paragraph, the only rules which it adopted being of a procedural nature not requiring such approval.

In his letter of June 15, 1940, appointing Bush Chairman of the Committee, President Roosevelt stated specifically that it was not intended that the work of the Committee should replace any of the “excellent work” which the Army and Navy were carrying on either in their own laboratories or by contract with industry. The Committee was directed to “supplement this activity by extending the research base and enlisting the aid of the scientists who can effectively contribute to the more rapid improvement of important devices, and by study determine where new effort on new instrumentalities may be usefully employed.”

Anticipating questions concerning the relation of the new Committee to existing agencies, the President in his letter pointed out that the National Academy of Sciences and the National Research Council had been formed primarily to advise the agencies of Government on scientific matters when called upon for such service. He expressed the opinion that these organizations would respond cordially to requests from the Committee for advice on “such broad scientific problems as may arise.” He thought that the National Bureau of Standards and other Government laboratories might well be able to carry on effectively some of the research which the Committee deemed necessary. Research on problems of flight having been en-
trusted earlier to the National Advisory Committee for Aeronautics, it was excluded from the jurisdiction of the NDRC, but the two committees were expected to maintain close relationship.

One field later to attract a great deal of public interest was specifically mentioned in the President’s letter. A committee headed by Dr. Lyman J. Briggs, Director of the National Bureau of Standards, which had earlier been appointed to “study into the possible relationship to national defense of recent discoveries in the field of atomistics, notably the fission of uranium” was instructed to report to Bush inasmuch as the NDRC might consider it advisable to support special studies on this subject.

**Organization of the Committee**

Although the order establishing the Committee was dated June 27, 1940, the letters of appointment from the President were dated June 15, and the members of the Committee held two informal conferences prior to the issuance of the order. Thus, prior to the first formal meeting on July 2, 1940, members of the Committee had been able to give preliminary consideration to a number of those problems which confront any new group.

At its first formal meeting on July 2, 1940, the Committee elected Tolman as its Vice-Chairman and selected as its Secretary Irvin Stewart, Director of the Committee on Scientific Aids to Learning of the National Research Council, a political scientist. At the same meeting it was decided to establish divisions for the preliminary consideration of problems, with each division being supervised by a member of the Committee. Within divisions, provision was made for the establishment of as many sections as might be needed for the handling of particular types of problems assigned to the division. The Committee member supervising a division was authorized to proceed on his own responsibility in handling the details of assignments to his division and its sections with the understanding that the Chairman of the Committee would be kept fully informed at all times and that progress reports should be made to the Committee from time to time. The Chairman was given authority to allocate problems to divisions and sections.

Bush as Chairman had the responsibility for co-ordinating the work of the Committee with that of other governmental and private agencies as well as maintaining direct supervision over a limited number of problems. To assist him, Bush selected as his Executive Assistant Carroll Louis Wilson, manager of the Boston Office of the Research Corporation, an engineer who had served with both Bush and Compton at M.I.T. Responsibility for the maintenance of close working relationships between the Committee and the military services was assigned to General Strong and Admiral Bowen.

Five divisions were created and sections were established within the divisions from time to time as the need for them became apparent. A statement
of the situation at a particular time would resemble a single frame of a moving picture. As of June 1, 1941, however, shortly before the reconstitution of the Committee as a part of the Office of Scientific Research and Development, the organization was as follows:

Division A (Armor and Ordnance)
R. C. Tolman, Chairman
Charles C. Lauritsen, Vice-Chairman (physicist, California Institute of Technology)
Section B (Structural Defense)
John E. Burchard, Chairman (architectural engineer, Massachusetts Institute of Technology)
Section H (Investigations on Propulsion)
C. N. Hickman, Chairman (physicist, Bell Telephone Laboratories)
Section S (Terminal Ballistics)
H. D. Smyth, Chairman (physicist, Princeton University)
Section T (Proximity Fuzes for Shells)
M. A. Tuve, Chairman (physicist, Carnegie Institution of Washington)
Section E (Fuzes and Guided Projectiles)
Alexander Ellett, Chairman (physicist, University of Iowa)

Division B (Bombs, Fuels, Gases, Chemical Problems)
J. B. Conant, Chairman
Roger Adams, Vice-Chairman (chemist, University of Illinois)
W. K. Lewis, Vice-Chairman (chemical engineer, M.I.T.)

Synthetic Problems
Roger Adams, Division Vice-Chairman
Section A-1 (Explosives)
G. B. Kistiakowsky, Vice-Chairman (chemist, Harvard University)
Section A-2 (Synthetic Organics)
Roger Adams, Chairman
Section A-3 (Detection of Persistent Agents)
W. C. Johnson, Chairman (chemist, University of Chicago)
Section A-4 (Toxicity)
Roger Adams, Acting Chairman

Physical Chemical Problems
W. K. Lewis, Division Vice-Chairman
Section L-1 (Aerosols)
W. H. Rodebush, Chairman (chemist, University of Illinois)
Section L-2 (Protective Coatings)
G. O. Curme, Jr., Chairman (chemist, Carbide and Carbon Chemicals Corp.)
Section L-3 (Special Inorganic Problems)
W. K. Lewis, Chairman
Section L-4 (Nitrocellulose)
W. K. Lewis, Chairman
Section L-5 (Paint Removers)
J. C. Elgin, Chairman (chemical engineer, Princeton University)
Section L-6 (Higher Oxides)
W. K. Lewis, Chairman
Section L-7 (Oxygen Storage)
C. R. Hoover, Chairman (chemist, Wesleyan University)
Section L-8 (Gas Drying)
O. A. Hougen, Chairman (chemical engineer, University of Wisconsin)
Section L-9 (Metallurgical Problems)
A. E. White, Chairman (metallurgist, University of Michigan)
Section L-10 (Exhaust Disposal)
W. H. MacAdams, Chairman (chemical engineer, M.I.T.)
Section L-11 (Absorbents)
W. A. Noyes, Jr., Chairman (chemist, University of Rochester)
Section L-12 (Oxygen for Airplanes)
E. F. DuBois, Chairman (physiologist, Cornell University)
Section L-13 (Hydraulic Fluids)
G. H. B. Davis, Chairman (chemical engineer, Standard Oil Development Co.)
Miscellaneous Chemical Problems
Section C-1 (Automotive Fuels; Special Problems)
T. Midgley, Chairman (chemist, Ethyl Gasoline Corp.)
Section C-2 (Pyrotechnics)
G. B. Kistiakowsky, Vice-Chairman
Section C-3 (Special Problems)
G. A. Richter, Chairman (chemist)

Division C (Communication and Transportation)
F. B. Jewett, Chairman
C. B. Jolliffe, Vice-Chairman (radio engineer, Radio Corporation of America)
Hartley Rowe, Vice-Chairman (chief engineer, United Fruit Company)
R. D. Booth, Vice-Chairman (electrical engineer, Jackson and More-land)
J. T. Tate, Vice-Chairman (physicist, University of Minnesota)
Section C-1 (Communications)
C. B. Jolliffe, Chairman
Section C-2 (Transportation)
Hartley Rowe, Chairman

Section C-3 (Mechanical and Electrical Equipment)
R. D. Booth, Chairman

Section C-4 (Submarine Studies)
J. T. Tate, Chairman

Section C-5 (Sound Sources)
Harvey Fletcher, Chairman (physicist, Bell Telephone Laboratories)

Division D (Detection, Controls, Instruments)
K. T. Compton, Chairman
A. L. Loomis, Vice-Chairman (physicist, Loomis Laboratories)

Section D-1 (Detection)
A. L. Loomis, Chairman

Section D-2 (Controls)
Warren Weaver, Chairman (mathematician, Rockefeller Foundation)

Section D-3 (Instruments)
G. R. Harrison, Chairman (physicist, M.I.T.)

Section D-4 (Heat Radiation)
A. C. Bemis, Chairman (physicist, M.I.T.)

Division E (Patents and Invention)
C. P. Coe, Chairman

The Committee on Uranium, with L. J. Briggs, Director of the National Bureau of Standards, as Chairman, reported directly to the Chairman of NDRC.

The names of division and section members and technical aides have been omitted from the above account and will be omitted throughout because of space limitations. They are given the recognition they deserve in the volumes reporting the activities of the divisions and sections.

At its first meeting the Committee decided to operate primarily through contracts. This decision was never modified, and at no time did the Committee establish its own laboratories or attempt to conduct scientific research through its own staff. The preliminary investigations leading to the recommendation of contracts normally originated with sections which communicated their recommendations through the chairman of the appropriate division to the Committee. The Committee reserved to itself the right to decide whether and upon what terms it would enter into contracts.

By formal resolution the Committee announced that it would make use of existing agencies wherever possible and in particular the National Academy of Sciences and the National Research Council in matters falling within their particular competence; it would act directly or create new
agencies only when it could find no existing agency competent to handle a particular problem or when the exigencies of the situation made such direct action desirable.

The quorum for the Committee was set at five members.

Arrangements were made through the Advisory Commission to the Council of National Defense for the Committee to obtain the advice of the Legal Division of the Treasury Department. The individual assigned by the Treasury Department to this task was Oscar S. Cox, assistant to the general counsel of the department. Cox appreciated the importance of the task assigned to the Committee and his advice and counsel throughout the formative days of the Committee as well as during some of its more active operations were invaluable. When he moved from the Treasury Department to the Office for Emergency Management and to the Department of Justice, the Committee continued to benefit by his advice. In particular he deserves a great deal of credit for the form of contract adopted by the Committee which proved a very successful vehicle for the conduct of research on military devices in a period of great stress.

The Committee met at intervals of approximately one month. At first it considered proposals laid before it by members at any meeting without a requirement of advance circulation. At the meeting on March 7, 1941, however, it was agreed in principle that proposals would be circulated to members sufficiently in advance of the meeting at which they were to be considered to permit the Army and Navy members to compare the proposals with research already under way in the Services in order that they might be prepared to advise the Committee on the relation of the proposals to such research. It was recognized, nevertheless, that at times it might be necessary to dispense with such advance circulation in the case of urgent projects. This procedure became standard practice; it greatly aided in speeding up the deliberations of the Committee by permitting the members to focus their discussion on those points about which they were not satisfied by the presentation in the proposal itself.

The action of the Committee in adopting a proposal constituted an authorization to the Chairman to negotiate a contract. The Chairman in turn delegated to the Secretary the responsibility for reaching an agreement with the proposed contractor and preparing the contract for signature. In most cases, preliminary discussions had already been held between the scientific personnel of NDRC and members of the scientific staff of the proposed contractor. Those conversations had established the fact that the scientific staff at the designated institution felt that it had the facilities and the manpower to undertake the proposed research and that the NDRC scientists believed that the work would be well done at the institution. The general outline of the scientific work had been agreed upon and the maximum amount of money to be expended was that which had been recom-
mended to and approved by the Committee. The Secretary’s staff put the information submitted by the division into the standard form contract which was then submitted to the division for checking to be sure that the contract adequately reflected the desires of the division. If approved by the division, the contract was then sent to the contractor for signature. After signature by the contractor, the contract was signed on behalf of the Government by the Chairman, or in his absence by the Vice-Chairman, pursuant to authorization of the Committee.

In the early days of NDRC, the arrival of a contract on the campus was apparently the first intimation the administrative authorities of some academic institutions had that they were under discussion. The first contract submitted to an institution was frequently followed by a substantial amount of correspondence before the institution was prepared to sign. Later contracts with the same institution usually went through more rapidly as the administrative authorities apparently needed merely to check with the scientific staff to be sure that the work called for by the contract was considered to be within the capabilities of the staff.

Relations with the National Academy of Sciences and the National Research Council

The relation of these two bodies to the newly created NDRC was set out in a memorandum sent by Jewett, as President of the Academy, to some 700 academic institutions on June 26, 1940. The description of the Academy and Council given in the preceding chapter was taken largely from that memorandum.

That the NDRC would have special relationships with the Academy and the Council was foreseen in the order establishing NDRC which specifically mentioned the Academy and the Council as institutions with which the NDRC might enter into contracts. Moreover, the President’s letter of June 15, 1940, appointing Bush as Chairman of the Committee expressed his confidence that the Academy and the Council would respond cordially to requests from the Committee for advice on such broad scientific problems as might arise.

At its first meeting, the Committee passed a resolution requesting the cooperation of the Academy and the Council, especially through the Council sections of physics, chemistry, and engineering and through the special committees on problems relating to national defense. A memorandum attached to the resolution stated as an example that the sections of physics, chemistry and engineering from time to time would be requested to take over certain types of problems and arrange for their allocation to various members of the academic profession working in their own laboratories on a volunteer basis. The problems would, for the most part, be basic problems
not of a confidential nature, in connection with which secrecy would be of relatively little importance. They would also be of a nature that the research need not be undertaken under great pressure and a reasonable amount of time could be allowed for the completion of the study in question.

As an illustration of the type of study which the Committee requested of the National Research Council there may be cited a resolution passed by the Committee at its meeting on August 29, 1940, requesting the Council to set up a special committee or committees to make a study of eutectic diagrams of ammonium nitrate and other substances, and of ammonium perchlorate and other substances, a study of the problem of finding a plastic that could be used as a substitute for optical glass, and a study of protective coatings to take the place of tin.

After a number of specific studies had been requested of the Council, the Committee at its meeting on January 17, 1941, authorized a general contract with the Academy for the preparation of reports by the Council upon subjects to be agreed upon by the Committee and the Council, the cost of such reports to be defrayed by the Committee in a total amount not to exceed a specified sum. Under this contract, reports were called for from time to time and the amount of the contract was adjusted accordingly. In addition, specific contracts were made for more extended studies. The Council called innumerable meetings of specialists in particular fields to assist the sections of NDRC in focussing upon particular problems the attention of competent men.

The relations between the Committee, the Academy and the Council were cordial and profitable. Especially close relations were established and maintained between the Committee on Medical Research and the Council after the creation of OSRD. To help defray the indirect costs of the Academy in meeting these requests as well as the constantly increasing requests of the Army and Navy, the OSRD appropriation bills carried an item specifically for the purpose.

Scope of Activities

The respective jurisdictions of the NDRC and of the National Advisory Committee for Aeronautics (NACA) were clarified by a memorandum jointly signed on behalf of the two organizations in February 1941. The memorandum stated that the NACA was definitely engaged in research on aerodynamics, on power plants, on materials and on structures, and that the work on power plants included aeronautical fuels and lubricants. It further recited that the NACA had not engaged in research on ordnance, on radio communications or on medical problems in connection with aeronautics. The general scope of NDRC jurisdiction was noted, and it was agreed that the language of the order creating it contemplated that the
Organizing Scientific Research for War

NDRC might engage in research on devices and mechanisms of warfare having aerodynamic or aeronautical aspects, provided the NACA was not itself engaged in that particular kind of research.

The working arrangement was summarized as follows:

The NDRC should not ordinarily enter upon research within the field of activities of the NACA as indicated by the lines of work of the present Committees and Subcommittees which direct NACA research, but may properly be concerned with research having to do with aerodynamic or aeronautical matters outside of the field thus defined. Moreover, when a problem is of such breadth that it has features within the scope of activities of the NACA and also features pertinent to nonaeronautical aspects of warfare, then either organization may properly conduct such research, provided that economies appear to result from a unitary consideration. In such cases it would appear to be desirable that the matter be discussed between officers of the two organizations before the research is undertaken.

With the scope of the Committee's activities outlined in general terms in the order creating it, borderline situations were inevitable. One spectacular problem upon which national attention was being focussed was that of the shortage of natural rubber and the need for large-scale production of synthetic rubber. Should rubber be considered a material of war to which the Committee should give attention?

The NDRC decided to place a strict interpretation upon the scope of its authorized activities. This interpretation was formalized by a resolution adopted at the fifth meeting of the Committee on November 29, 1940. The resolution read as follows:

Resolved, that the National Defense Research Committee by reason of the order of the Council of National Defense which established it, is concerned with scientific research on and development of new instrumentalities or materials of war, or of new materials or methods to be used primarily in the manufacture of instruments of war; and of the improvement of existing instrumentalities or materials of war, or of existing material or methods to be used primarily in the manufacture of instruments of war. Where a material or method is widely used or useful in industry, in addition to its use in the manufacture of instruments of war, as for example in the case of substitute materials of wide utility, the research and development involved do not lie within the province of the National Defense Research Committee, but rather within the province of many existing industrial and scientific research agencies, and in particular, when appropriate requests for investigation or research in such fields are made by government agencies, within the province of the National Academy of Sciences and the National Research Council.

This resolution was transmitted to the members of the various sections of the Committee with a letter stating that in case of doubt as to whether
a particular matter was one of primary concern to national defense, the Committee would be guided by the Army and the Navy. The resolution was also released for publication in order that scientists might become acquainted with the Committee's policy.

The initial decision limiting the scope of NDRC activities is believed to have been sound. In a period of total war it becomes difficult to say what part of the economy is not related to national defense. It would have been easy for the NDRC to have construed its charter as opening a much wider field of activities. In view of the liberality with which funds were appropriated during the war years, it is quite probable that the Committee would have been able to obtain funds to support a broader program. In practice, the limiting factor upon the Committee was always that of manpower. Widening the scope of the Committee's activities would not have added to the number of men available to work on the program. It would have resulted in a dilution of effort which might have obtained significant results in other areas, but in all probability only at the expense of work bearing more immediately on weapons. By deliberately confining its efforts to a relatively narrow field, the Committee was able to concentrate manpower in those areas which seemed most likely to be productive of the best results. It may be charged that by refusing to enter certain lines of activity, the Committee was responsible for delay in obtaining answers to other important problems confronting the nation. The easy answer to such a charge would be to point to what the Committee did with the available manpower and inquire whether the diversion of that manpower to the other problems would have been in the over-all national interest. The members of the Committee never had any doubt as to the accuracy of the original decision to limit the scope of NDRC activities.

The decision was adhered to in practice with minor exceptions. Some work in the field of metallurgy, for instance in connection with armor plate, was obviously within the Committee's scope; but once a division had been established to work on metallurgical problems, its activities tended to expand to include some of a more general nature which might well have been excluded. Similarly, at the request of the Quartermaster Corps, the Committee undertook a number of studies on Quartermaster problems with considerable reluctance. While it was felt that the problems should have been handled elsewhere, they were undertaken by the Committee because there appeared to be no other way of handling them in time to be most useful to the war effort.

One result of the strict limitation of activities adopted by the NDRC was the later establishment within the War Production Board of an Office of Production Research and Development with which NDRC maintained cordial relations.
ORIGIN OF PROJECTS

The one project specifically assigned to the Committee by the President was that of "the possible relationship to national defense of recent discoveries in the field of atomistics, notably the fission of uranium." A committee on this subject which had previously been set up by the President was directed by him to report to the NDRC.

The Committee received a flying start by the submission to it of lists of projects upon which the Services were engaged, together with lists of other projects which the Services thought were important but which they had neither funds nor manpower to handle. Those lists were studied by Compton, the projects were apportioned among the NDRC divisions, and first attention was paid to them.

From the outset, NDRC asserted the right to exercise an independent judgment as to the projects which it should start as well as the method of attack upon them. Although the Committee was established to aid the Army and the Navy, it insisted that the method of rendering that assistance was for its own decision. Thus, upon occasion it refused to undertake a particular piece of research requested by the Services because of its feeling that the manpower required could be better spent on more important projects or on those more likely to succeed. Conversely, upon occasion the NDRC initiated and supported projects in spite of the indifference or even over the opposition of the Services. Many of its projects were initiated without support from the Army and Navy, although for most of these the support of the Services was forthcoming later. In most cases, however, work undertaken by NDRC was at the direct request of either the Army, the Navy or both.

Clearly the Services were in a good position to know their own weaknesses and therefore to indicate places where results were needed. This was recognized by the Committee and every attempt was made to accomplish results requested by the Services. Similarly, when scientists working with the Committee felt that particular scientific techniques or developments might have military applications, they were brought to the attention of appropriate military authorities in an effort, usually successful, to stir up Service interest in such developments.

PROBLEMS OF CONTRACT

The decision that the Committee would not engage directly in research made the development of an effective contract essential. Research presupposes the possibility of failure and a research contract should recognize that fact. An exploration of the unknown carries an inherent possibility that the
results may not be worth the cost. If the Committee were to confine its operations to those areas with the greatest possibility of success, it would stay out of fields where successful research might yield the greatest benefit. Ideally, the best scientific imaginations in the country should be given free play on problems of military value without being harassed by excessive supervision or the observation of forms designed for other occasions.

Yet Government funds were being expended. In times past, there had been abuses in the expenditure of some Government funds, and for the prevention of such abuses in the future a formidable mass of regulations had been devised. The heart of the contract problem was to reconcile the need of the scientist for complete freedom with assurances that Government funds would not be improperly expended. One of the most significant contributions of NDRC and OSRD was the writing and administration of a form of contract which reconciled these two requirements.

The development of the contract form will be treated in detail in a later chapter. One early decision of the Committee must be mentioned here, however. It was the adoption of the principle that research should not in itself yield a financial profit. Inasmuch as academic institutions are not run to earn financial profits, no difficulty was anticipated or experienced in obtaining recognition of this principle in contracts with such institutions. In the case of industrial establishments, the same principle was applied upon the theory that profit is a function of the production activities of an industrial establishment, not of its research department. There was no difficulty in obtaining recognition of the no-profit principle on the part of large industrial concerns with well-established production departments. The principle did render it difficult for the Committee to work with small industrial organizations, especially where the desired research was of a type which would not be likely to fit into such productive capacity as the company possessed.

While the no-profit principle was accepted by the Committee, it did recognize that research should pay its own way. There was early discussion as to whether the NDRC contracts should pay the full cost of the research done under them, including a proportionate part of the indirect expenses incurred by any going concern, or only those direct costs added to operations as a result of the NDRC contract. The decision taken at the outset to pay the full cost was amply justified by experience.

A difficult problem which arose immediately was the disposition of patent rights on developments made as a result of NDRC contracts. The point is one which is treated at considerable length in later pages. It may be noted, however, that the differences of opinion with respect to patent rights constituted a serious stumbling block in the negotiation of NDRC contracts for several months. The net effect would have been seriously to delay NDRC operations except for the fact that potential contractors began research under
letters of intent issued by the Committee and expended their own funds without reimbursement for several months while a mutually acceptable patent clause was being whipped into shape.

Another element causing delay in the writing of contracts initially was the desire on the part of each prospective contractor to crystallize his own thinking as to the type of obligations he was prepared to assume. On its part, NDRC was discovering on the basis of its limited experience additional clauses which it desired to have inserted in the simple form of contract originally adopted. It was quite possible, therefore, for NDRC to send out a draft contract for signature, have that draft considered by the contractor and returned with the request for amendment, and send it again to the contractor with still further changes which the NDRC itself desired to propose. Each contractor had changes to propose in the standard form which differed from the changes proposed by other contractors. The NDRC staff drafting contracts was small while the number of new contracts and new contractors proposed by NDRC steadily increased as did the variety of changes requested by contractors. The result was a succession of hectic days until it became possible to reduce the problems to a limited number of categories which could be dealt with as such rather than as a constant succession of individual variations. The attempt originally was to draft contracts in the order in which they were proposed by the Committee. This had to be abandoned in favor of a plan for a limited type of mass production of those contracts which could follow the standard form as drafted or with very slight variations. Those contracts, of which there was a substantial number, which required prolonged negotiation because of rather decided differences of opinion between the Committee and the proposed contractors, were pulled out in a separate operation which did not interfere with the simpler contracts. One by one the more difficult contracts were disposed of, but there were many cases where the contractor worked for a number of months before receiving a signed contract upon which he could obtain reimbursement. As an indication of the time lag in the early days, it may be mentioned that as of January 17, 1941, the NDRC had recommended 184 contracts while only 50 had been signed.

**Selection of Contractors**

At the outset the Committee faced squarely the problem of the best way to utilize the scientific personnel of the country. Many leading scientists had become seriously concerned over the progress of events in Europe and were keenly desirous of engaging in scientific work which might better prepare the United States for any eventuality. There was a concurrent desire on the part of some key individuals in the military services to avail themselves of the ability and the eagerness of the scientists. In trying to bring the two
together, the Committee faced the necessity of making certain decisions. What scientists should be put to work on military problems and on what specific problems? Should scientists be left to work in their own laboratories or be brought together in other laboratories already existing or to be created? What steps should be taken to insure that laboratory work would be carried on under conditions compatible with military security?

An obvious first step was to find out what existing facilities were available for the work of the Committee, for the Committee early decided that existing agencies should be used wherever possible. A companion decision was that before any action would be taken requiring the withdrawal of a key individual from an institution for work elsewhere, the effect of the withdrawal upon the research work of the institution should be considered.

At the first preliminary meeting of the Committee on June 18, 1940, Conant was given the job of accumulating information about the research facilities and personnel of a group of leading educational institutions. Jewett, as President of the Academy, agreed to assemble similar information from a much larger group of educational institutions, while, as a member of NDRC, he investigated the available research facilities of a number of industrial organizations. At the same time Compton was to ascertain (1) military developments under way in Government laboratories with special attention to programs likely to be slowed down in the interest of immediate production, (2) developments considered desirable by the armed services but not under way, and (3) military research programs which it would be desirable to supplement.

Conant sent a letter to fifty of the leading educational research centers on June 28, 1940, pointing out that the NDRC would not replace any of the research work being carried on by the armed services and the NACA either in their own laboratories or through co-operation with civilian institutions, but would supplement those activities "by extending the research base and enlisting the co-operation of institutions and scientists who can effectively contribute to the more rapid development of important instrumentalities of warfare." The institutions were requested to supply an outline of their special facilities and personnel for research in indicated fields and also to include a description of specific research projects on which the staff were presently engaged and which might have an application in devices or mechanisms of warfare. The fields mentioned in the letter were physical chemistry, organic chemistry, physics, optics, electricity, acoustics, mechanics, physical metallurgy, and civil, mechanical, electrical and chemical engineering. The letter also requested the names of the leading staff members who might be prepared to conduct research on special problems in the fields in which the institution was exceptionally qualified for research as well as a notation on the special equipment for research in any of those fields.
Conant's letter followed by two days a letter sent out by Jewett as President of the National Academy of Sciences to approximately 700 academic institutions. Jewett's letter outlined the relations between the Academy, the Research Council and the NDRC and requested concise information with respect to special facilities for the conduct of research in the fields of science, special competence of the staff in any department of science to conduct research, and names of individuals on the staff with outstanding ability as research investigators in the fields of science.

The replies to Conant's and Jewett's letters were abstracted in a loose-leaf mimeographed document entitled "Research Facilities of Certain Educational and Scientific Institutions" which, with additions from time to time, was sent to members of the Committee, Division Chairmen, Vice-Chairmen and Section Chairmen. In the early days of the Committee particularly it was a standard reference work used to supplement the already extensive information about research facilities possessed by the key personnel of NDRC as a result of their normal activities.

Although no comparable survey of industrial research facilities was made by the Committee, members of the Committee, especially Jewett, and members of the divisions and sections possessed in the aggregate a large amount of information about such facilities and the extent to which they were being used for military research.

In placing contracts, the Committee kept constantly in mind the necessity of avoiding an overload upon those facilities which were already being called upon by the Army and the Navy directly.

One factor uppermost in the minds of the Committee was the need for speed. No one knew when the occasion would arise for the instrumentalities and weapons which the Committee hoped to create. It was desirable to have as much of this material as possible in the hands of American troops whenever they might be called upon to do battle. Before that, they should have the equipment in sufficient time to permit adequate training in its use. Before that, there must be production and in many cases, production in quantity. Before that came development, which in turn was preceded by research; and first of all was the need for the selection of the problems and the institutions to work upon them. The time interval between the inception of an idea and the use of the finished product upon the battlefield would normally run into several years. There was ever present in the minds of the Committee the possibility that the need would arise before the equipment could be completed. There was thus a sense of urgency in the selection of contractors. Of course, it would have been nice to make some kind of geographical distribution of contracts, to build up research facilities in institutions not presently possessing them, to have some mathematically determined basis for the allocation of research among institutions. But the need for speed hung like a sword over the head of the Committee and
speed meant that problems should be assigned to those institutions with the facilities and the manpower which promised the best results in the shortest possible time.

Where problems which might properly be handled by the Committee had a lower order of urgency, a wider distribution of contracts was possible. This was also the case where problems were of such a nature as to permit their division into a number of unrelated parts upon each of which a few men at a number of different institutions might be engaged. In the field of chemical warfare, for instance, there were cases where a competent chemist with a small number of assistants could attack a discrete problem. On the other hand, concentration was demanded by many problems in the field of physics where each part had an intimate connection with all other parts of an over-all system.

In the beginning the Committee attempted to place contracts with academic institutions in a manner which would cause the least disturbance to educational programs. If the contingency against which the Committee was created should occur, there would be need for all the scientists whom the academic institutions could train. Any unnecessary disruption of the training program in science was obviously to be avoided. As far as possible, contracts were placed in such a manner as to permit the key scientist to remain in his own laboratory available for consultation with advanced students.

In certain areas, disruption of educational programs could not be avoided. Thus, while the attention of the country was drawn to the losses incident to modern submarine warfare, there was no great center of information and activity with reference to underwater phenomena which could serve as the focal point of a big program of antisubmarine warfare. Two such centers were established by the Committee at an early date—one under a contract with Columbia University at New London, Connecticut; the other under a contract with the University of California at San Diego, California. A similar situation existed in the field of radar. While some work in long-wave radar had been done in this country, the field of microwave radar was unexplored. Any comprehensive program in this field would have to start from scratch. After considerable search for an appropriate contractor, the Massachusetts Institute of Technology was selected as being both qualified from the standpoint of men and facilities to initiate a microwave radar research program and willing to undertake the substantial responsibilities attached to such an undertaking. Rocket development was another backward area in which need for concentration was apparent, and there was no staff at any institution with closely related peacetime activities. The California Institute of Technology and George Washington University, separated by a continent from each other, were pressed into service on two distinct phases of rocket activity.
In each of these special cases and in others which arose from time to time, it was necessary for the contracting institution to recruit additions to its staff on a large scale. As the activities expanded, each institution added substantially to its scientific staff and even more to the supporting technical personnel below the staff level.

The headaches incident to building up the new staffs were many. Scientific staff members could be obtained for the most part only from other academic institutions. Granted a desire to assist most effectively in the defense program, each institution had its student body to consider as well as research programs in progress which it hoped to complete. Obtaining a staff was not made any easier by the fact that NDRC contracts ran for stated periods which did not correspond with the academic year, so that the scientist leaving his own institution to accept employment under NDRC contract at another institution was faced with the possibility that he might find himself without employment for several months. A real burden was thrown upon university administrative authorities who had to arrange teaching schedules and maintain a balance between those men who would be released for war work elsewhere and those who would be denied release in order that teaching obligations might be met. The institutions employing scientists from other institutions on war work were in turn confronted with occasional difficulties in the relations between the members of their teaching staffs and the men working on contract. Salary differentials began to creep in, particularly as the manpower situation became tighter and competent men had more than one opportunity to engage in war research. The steps taken by NDRC to cope with the situation so far as its contracts were concerned are reported later in the present narrative. Universities and colleges will continue to feel the effects for a number of years, although it is probable that salary increases were inevitable and that colleges are suffering no more in this respect than other segments of an economy struggling to readjust itself to the aftermath of a great war.

Inasmuch as the Radiation Laboratory at the Massachusetts Institute of Technology grew to be the largest single activity of NDRC, a word as to the method of selection of the contractor is indicated. On October 25, 1940, when the contract was originally proposed, Bush reported that both he and the Microwave Section of Division D, acting independently of each other, had made surveys of Government laboratories, including those of the Bureau of Standards and of the Army and Navy, as well as of commercial laboratories and had come to the conclusion that no existing laboratory was equipped or manned to carry out the research contemplated under the microwave program. The requirements for the laboratory involved an immediate need for substantial space, the equipment of a subsidiary hangar laboratory at a nearby airport, top-flight scientific staff capable of expansion and the ability and willingness on the part of the contractor to under-
take a substantial expansion which was almost inevitable if the research program should prove successful. The investigation by the Microwave Section led it to conclude that the only available institution at which the work could be done with the desired speed was the Massachusetts Institute of Technology. Although Compton was President of Massachusetts Institute of Technology, he informed the Committee that he had taken no part in the discussions leading to the recommendation of the Microwave Section; and following the practice uniformly observed by the Committee, he took no part in the decision to locate the laboratory at the institution which he headed.

**FISCAL CONSIDERATIONS**

A considerable portion of the first meeting of the Committee was devoted to a discussion of the amount of money which it should request be allocated to it. One method of approach was that of estimating the number of scientists who could effectively be employed on new research on instruments of warfare without disrupting other academic or industrial research to an unwarranted extent, together with an average total cost of maintaining a scientist effectively employed with proper aid and materials. Another approach was that of estimating the number of problems before the Committee members as a result of preliminary studies and the probable extension of that number. Comparisons were made with the total research budgets of academic institutions, industries and Government. The Committee endeavored to arrive at an amount which would be sufficient to permit an adequate attack on the problems facing it and yet would be no greater than probably could be expended effectively under its direction. After extended discussion, it was agreed that $10,000,000 would be the proper amount and the Chairman was authorized to request the allocation of that sum by the Bureau of the Budget and the President.

In retrospect, the requested amount appears low in view of the fact that in their five most active years the NDRC and OSRD contracted for the expenditure of over $500,000,000. Much of this amount, however, went for purposes not contemplated by the Committee at its first meeting; expenditures mounted rapidly when the emphasis was changed from research to development following the attack on Pearl Harbor. Although the Committee received only approximately $6,500,000 of the requested $10,000,000 for its first year’s operation, its activities were not hampered by lack of funds; and it is unlikely that the cost of its operations would have been much different had the allocated amount been two or three times as great as it was.

The order establishing the Committee contemplated that use would be made of existing Government laboratories and that funds would be trans-
ferred from the Committee to the agency operating a laboratory to defray the cost of the requested work. A procedure for effecting such transfers worked out in conjunction with the Council of National Defense and the Bureau of the Budget was adopted at the second meeting of the Committee. Under it, the Committee initiated negotiations with the appropriate Federal agencies for the provision of specialized services necessary to the Committee's research program. After agreement with the servicing agency, a statement of the project was transmitted to the Council of National Defense for administrative clearance, for clearance as to the availability of funds and for accounting purposes. After this it was reviewed by the Bureau of the Budget primarily to insure that funds were not transferred to an agency to support work for which that agency had already received appropriations. The most significant point about the rather detailed procedure was that it recognized the finality of the NDRC decision as to the desirability of the scientific program.

**Personnel**

In setting up the NDRC, President Roosevelt set the pattern for availing the Government of the services of top scientists without compensation. The order specifically provided that the members of the Committee should serve as such without compensation. This was one of the most important elements contributing to the success of NDRC. An arrangement which left Bush at the Carnegie Institution of Washington, Conant at Harvard and Compton at Massachusetts Institute of Technology made it possible for the Government to use the services of these men at a critical time when it might not have been possible to get them if they had been called upon to surrender their regular positions.

When the NDRC started functioning, it found itself in a similar position. It was frequently possible to obtain the services of a top-flight scientist for one or two days a week without compensation when it would have been impossible to get him had there been a requirement that he be employed full time by the Government.

It cannot be too often stated that a large part of the success which attended the efforts of the NDRC and the OSRD is due to the services of persons serving without compensation from the Government. Only a few whose activities touched upon administration can be named in the present volume. Many of their colleagues are named in other volumes reporting in detail the activities of the NDRC and OSRD in specific subject fields.

In building its personnel the Committee started from scratch. The Advisory Commission of the Council of National Defense was instructed by the President to lend assistance in the recruiting of personnel for the Committee. Initial recruitment was for secretarial and clerical assistance, as the
first scientists were serving as volunteers. Arrangements were made with the Civil Service Commission for the establishment of a series of positions as Technical Aide to be filled by qualified scientists. The Technical Aides were an important element in the scientific staff; they furnished the continuity needed for the day-to-day operations. While many were younger men who operated under the supervision of their seniors, others were men of distinction comparable to the volunteer scientists heading the organization.

The story of the recruiting and retention of scientific personnel is told in a later chapter as is the story of the administrative personnel. Note need be made here only of the fact that at no time during the five years of its very active existence was the NDRC or its successor OSRD adequately manned. Starting from nothing, the staff was built gradually only after the need for particular positions became clear. By the time individuals were trained in particular jobs, the organization had grown to the point where further recruiting was necessary and additional types of activities were added. The outbreak of the war which mushroomed the OSRD program and expenditures was accompanied by a general tightening of the manpower situation which made it impossible to recruit personnel in adequate numbers.

**Security**

The Committee recognized that the Army and the Navy would have to be convinced that it could make use of civilian scientists under conditions compatible with military security; for, after all, to be most useful the Committee should work in areas of military weakness, and it would hardly be appropriate to indicate those areas to a potential enemy. At the same time, it recognized the equal importance of convincing scientists that ways could be found to permit them to work effectively within the limits of military security.

As a first step the members of the Committee took an oath of allegiance to the United States and required each person accepting appointment in any division or section to do so. Clerical personnel were required to take an oath not to divulge any secret or confidential information acquired by reason of their connection with the Committee unless authorized to do so by the Chairman or a member of the Committee. Each person receiving an appointment from the Committee received a letter stressing the need for the utmost secrecy in regard to all the activities which would come to his attention in connection with the appointment. The letter pointed out that the problems with which the Committee was concerned originated in the Army and the Navy and that only high officers of those Services were in a position to decide to whom the results obtained should be communi-
cated even within the Services themselves. Appointees were further advised that the Committee's investigations could not be discussed with any persons, civilian, military or naval, except as designated by the Committee or its duly authorized representatives.

In order better to impress upon scientists in laboratories the need for secrecy, the Committee adopted the policy of appointing the chief investigator under each contract as "official investigator" and requiring him to sign a pledge of secrecy binding him not to disclose any confidential information regarding the research except to others engaged in work on the specific problem under direction of the Committee, or to persons approved by representatives of the Committee. Each official investigator was given a commission of appointment which among other things stated that he had taken an oath of allegiance to the United States and subscribed to the pledge of secrecy.

The appointment of official investigators led to some administrative complications, but there is no reason to doubt that the appointments served their express purpose of impressing upon the appointee the need for secrecy. The Committee felt it desirable to place such stress upon secrecy because the tradition of scientists in academic institutions is to give wide distribution to the results of their research.

Another step in the maintenance of security was that of compartmentalization of information. The Committee adopted as a guiding principle that no person associated with it desired to have or would be given any classified information except that needed for the performance of the particular tasks which had been entrusted to him. In practice this meant that relatively few individuals were acquainted with the entire program of operations of NDRC. Only the members and Secretary of the Committee and a few members of the central staff had a picture of the over-all operations of the organization; members of a division were given information relating only to the problems of that division and members of a section only information relating to the problems of the section. Such compartmentalization had within it the seeds of inefficiency inasmuch as it was quite possible for one section to be in possession of information which might be valuable to another section. In theory the Committee members and later the Office of the Chairman had the responsibility for seeing that information crossed divisional lines whenever research would be speeded thereby. In numerous cases transmission of information across divisional lines was authorized and it was always the prerogative of the Division Chief to request information which he believed to be in the possession of another division and which would be useful to his activities. Unfortunately, however, there were cases in which information in the possession of one division of NDRC was not known to another division, although it would have been very useful to the second division.
Compartmentalization of information had as its purpose the restriction of the amount of damage which could be caused if any individual became indiscreet. In view of the fact that there were apparently no serious indiscretions of NDRC or OSRD personnel resulting in the unauthorized disclosure of information, it appears in retrospect that compartmentalization of information to the extent practiced was not in fact needed. It is highly probable, however, that the existence of compartmentalization made the armed services more willing to entrust their classified information to the NDRC during the early period when the ability of the organization to keep secrets had not yet been demonstrated.

Another aspect of the security problem related to the handling of classified information within NDRC. At its first meeting the Committee instructed the Secretary to review the Army and Navy regulations regarding secret, confidential and restricted matters and to submit a draft of a resolution on the subject for the consideration of the Committee. Such a resolution was adopted at the second meeting on August 29, 1940. It provided (1) that any matter of such nature that special precautions should be taken to insure that information concerning it should be permanently or temporarily limited in circulation should be classified as secret, confidential or restricted; (2) that matter originating with the Army or the Navy should be placed in the classification suggested by the originating department and handled in accordance with the procedure established by that department for matter of its class except as indicated below; (3) that matter originating outside the Army and Navy should be classified by the Secretary after consultation with the Army and the Navy; (4) that when classification was applied by the Committee, the Army and Navy rules as to handling procedure should apply, and in case of conflict between those rules the more stringent should be used; (5) that material originating with a section or division might be tentatively classified by the originating unit which should transmit it to the Secretary for permanent classification; (6) that the Secretary, in consultation with the Chairman of the division or section handling the particular matter, should be responsible for determining the individuals entitled to receive classified information; and (7) that copies of the applicable Army or Navy regulations regarding classified matter should be furnished to each person authorized to receive classified information.

A further aspect of the security problem had to do with the acceptability of particular individuals to the armed services from the standpoint of their loyalty and discretion. This rapidly became one of the principal headaches of NDRC and was the source of irritation and delay throughout the history of NDRC and OSRD. The problem was loosely defined as one of "clearance," a term which had different meanings at different times. The problem, which became particularly acute in connection with personnel of
contractors, is treated at some length in the chapter on maintaining security.

It was also troublesome in connection with the building of the original staff of NDRC. A brief biographical sketch of each individual whom NDRC desired to appoint was submitted to the Army and Navy as the basis for a ruling by the Services as to whether they were willing that classified information be given to the individuals named. As similar requests were being submitted by other organizations engaged in war work, the investigating agencies soon found themselves overloaded; and the length of time required to obtain a report became longer and longer. On the one hand, the NDRC was being urged to proceed rapidly and on the other it became increasingly difficult to get reports upon which to base the release to the individuals whose services were needed of information bearing a security classification. In view of the outstanding character of the men brought into the organization, clearance could be counted upon to be forthcoming eventually, but many a headache was occasioned by the necessity of excluding certain individuals from particular meetings because clearance reports had not yet been received. One particular source of annoyance arose from cases of mistaken identity in which the person wanted by the NDRC happened to bear the same name as some other person whose record was not such as to endear him either to the military services or to any other organization interested in honest operations.

At the second meeting on August 29, 1940, members of the Committee had already begun to report that the work of their divisions had been seriously handicapped by the delay in obtaining Army and Navy clearance of key personnel. The Committee continued in its opinion, however, that, in spite of the unfortunate delays, it was desirable to have all key personnel cleared by the Services.

The following table gives an indication of the extent and persistence of the problem:

<table>
<thead>
<tr>
<th>Date</th>
<th>Total number of names submitted</th>
<th>Total number of names reported by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Army</td>
</tr>
<tr>
<td>Sept. 26, 1940</td>
<td>443</td>
<td>253</td>
</tr>
<tr>
<td>Oct. 24, 1940</td>
<td>550</td>
<td>331</td>
</tr>
<tr>
<td>Jan. 15, 1941</td>
<td>1087</td>
<td>633</td>
</tr>
<tr>
<td>Mar. 5, 1941</td>
<td>1218</td>
<td>978</td>
</tr>
<tr>
<td>April 15, 1941</td>
<td>1391</td>
<td>1131</td>
</tr>
<tr>
<td>June 10, 1941</td>
<td>1567</td>
<td>1329</td>
</tr>
</tbody>
</table>

Discussions were continually going on in an endeavor to improve the situation, and it never again became as bad as it was in January 1941. The whole story is not revealed by the totals. Thus, as of June 10, 1941, reports were still outstanding from the Army, the Navy or both on 2 names submitted in July, 5 in September, 23 in October and 16 in November 1940.

Delay in clearance did not prevent progress in the preliminary assessment of facilities. Division and Section Chairmen discussed facilities and
manpower with men from many institutions. They were free to be rather specific in outlining fields of research of possible interest, and, of course, were free to receive complete information as to lines of attack which occurred to the men with whom they were talking. These discussions indicated the men whose names should be submitted for clearance. It was feasible for a Section Chief to encourage an individual to go ahead on his own in developing his idea with the expectation that with the receipt of clearance a contract would be forthcoming and with it classified information which would aid in focusing the military aspects of the problem.

At its third meeting on September 27, 1940, the Committee gave further consideration to the need of special investigators for consultation with their colleagues. The basic principle adopted was that the Committee would arrange for the security clearance of key individuals and rely upon their judgment as to the persons to whom and the extent to which classified information should be disclosed in order that a contract might be carried out effectively. Reports of disclosures to persons not yet cleared were required to be made through the Section and Division Chief and the Secretary of NDRC to the Service primarily interested in the work under contract.

As a further check on the possibility of leaks of information, arrangements were made early in 1941 for a thorough check by the Secret Service of the procedures being followed in the Committee's central offices. This was the first of a number of such checks made in the central office and in certain of the other more important offices.

Space

Although Washington was not so crowded as it was to become later, the problem of acquiring space for any new organization was acute even in the summer of 1940. NDRC was particularly fortunate in being able to acquire most of its quarters without coming into direct competition with other Government agencies which were expanding all over the city at an increasing rate. At the first informal meeting of the Committee on June 18, 1940, Jewett offered the Committee space in the building of the National Academy of Sciences, and Bush offered space in the Carnegie Institution of Washington. Stewart was asked to look into probable requirements and recommend the acceptance of one of the offers, both of which were rent-free.

The Academy building had the advantage of being located across the street from the War and Navy Departments. It had the disadvantage, however, that if the United States should go into the war, the demands upon the Academy and the National Research Council might increase to the point that the Academy might need all of its space for its own operations; and the chance of the NDRC obtaining additional space within the
building, in the event that war required an expansion of its activities, was very slight.

The Carnegie Institution building at 1530 P Street, N.W., was less conveniently located relative to the War and Navy Departments, but more space was available initially than was to be had at the Academy. Furthermore, if the NDRC offices were in the Carnegie Institution building where Bush had his offices, he would be able to devote more time to the Committee's business than if the offices were situated elsewhere. Of great importance also was the fact that in the event of war more space rather than less would be available at C.I.W. as members of the staff of the Institution would leave their normal assignment for war work.

Upon Stewart's recommendation the Committee accepted Bush's invitation and established its central offices in 1530 P Street, N.W. As the activities of the NDRC and its successor OSRD continued to expand under the pressure of impending and actual war, more and more space was surrendered to those activities by the Carnegie Institution. The Committee owes a debt of gratitude to Walter M. Gilbert, Executive Officer of C.I.W., who willingly volunteered successive contractions of the space available for his operations in order that more space might be available for the NDRC; and to Charles Smallwood, the building superintendent, who remained cheerful under five years of constant demands made upon a building used for purposes far different from those for which it was originally designed.

Although Jewett's offer of space was not accepted for the central offices of NDRC, at all times a considerable part of NDRC and OSRD operations were housed in the Academy building. In particular, after the establishment of the Committee on Medical Research, the Washington operations of that Committee were carried on from the Academy building in space willingly made available, though at considerable inconvenience to the Academy.

The expanding operations of NDRC and of OSRD soon outran the space available in the Carnegie Institution and Academy buildings. Harvard University came to the rescue by turning over, without charge to the Committee, a large part of the space at Dumbarton Oaks, a magnificent estate in the heart of Washington given to the University by Robert Woods Bliss and housing some of the Harvard collections. Even this addition was soon outgrown and it became necessary for the Committee to set up parts of its activities in different locations in Washington. For most of its life, the Committee was carrying on its operations in inadequate space in areas too widely separated for the most efficient operation. Even at that, however, due largely to the generosity of the Carnegie Institution of Washington, the National Academy of Sciences, and Harvard University, the Committee fared better in the matter of space than did many of the wartime agencies in the Capital.
Handling Suggestions from the Public

Americans are an inventive people and quite properly see no reason why any small group of individuals should be considered to have a monopoly of good ideas on any subject. The war in Europe had naturally turned public imagination toward the invention of instruments of warfare; and the creation of the NDRC made it inevitably the target for inventions. At the first informal meeting of the Committee, Coe pointed out that during World War I such suggestions were received at the rate of approximately 2000 per week. Obviously the handling of such suggestions would require a substantial staff and if it were to be done by NDRC would leave little time for original thinking by the members and staff of the Committee.

Fortunately, plans were being considered for handling suggestions from the public in a different manner. On July 11, 1940, the Secretary of Commerce created the National Inventors Council within the Department of Commerce. The Council performed a valuable service but one quite different from that which NDRC had been established to perform. Cordial relations were established between the Committee and the Council. Commissioner Coe was a member both of the Committee and of the Council and so was in a position to keep each informed of the activities of the other. Even after the creation of the National Inventors Council suggestions continued to be received by NDRC from the public. These were normally sent direct to the Council for evaluation and reply to the sender, although in a few cases suggestions from persons of established reputation bearing directly upon some project under way under NDRC auspices were sent directly to the division supervising the project.

It may be noted in passing that the Inventors Council established a procedure for referring to the Army and Navy suggestions which had passed through its screening process. The method by which the Army and Navy submitted requests to the NDRC will be discussed later; that procedure envisaged the possibility that one of the Services might request the NDRC to do further work upon a suggestion referred to the Services by the Council and upon which the Services wished additional work to be done.

The Beginnings of Liaison

Close working relations with the Army and Navy were of prime importance to successful NDRC operations. Both Services had been consulted in detail prior to the establishment of NDRC and the order establishing the Committee was issued with their full concurrence. High Army and Navy
officers were appointed as members of the Committee. In addition, the Secretary of War and the Secretary of the Navy appointed liaison officers to serve with the Committee in order that there might be direct channels which could operate with a minimum of delay.

As the NDRC grew and divisions and sections were established, liaison officers were appointed to follow specific projects or groups of projects. The purpose of the liaison at the project level was to assist the scientist to operate within the framework of possible military requirements and conversely to give the armed services in some detail a glimpse of what science might offer in the various fields of military operation. The story of the liaison with the military is told in detail in a later chapter. It is mentioned here because it was one of the important points to which the Committee devoted its attention from the beginning.

By the time the NDRC was established, the United States was well committed to assist the Allies against the Axis. The British were feeling the effect of the weapons and instrumentalities developed by Germany and were acquiring invaluable experience in devising and testing countermeasures for those weapons. An exchange of information with the British would have the advantage of giving the United States the benefit of the British experience and the additional advantage of an early trial of weapons and equipment which might be developed for the protection of the United States. The importance of the object was one which made it desirable to start the exchange of information at a high level. This was accomplished when President Roosevelt commissioned Conant to proceed to London in February 1941, to make arrangements for an exchange of information and the establishment of an NDRC office in London. This commission was given, of course, only after the matter had been thoroughly canvassed with the Army and the Navy. Shortly thereafter the British established a comparable office in Washington.

During the first year of its existence, NDRC succeeded in solving a number of perplexing problems in the introduction of civilian scientists into a program of research on military devices in a time of rapidly mounting crisis. Its success led to a change in the form of its organization brought about largely by President Roosevelt's desire for a similar achievement in the field of medical research.
CHAPTER III

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

While NDRC was doing an excellent job in its field, big gaps remained in the program of preparation for the scientific aspects of modern war. A step toward closing those gaps was taken with the issuance of Executive Order No. 8807 of June 28, 1941, which established the Office of Scientific Research and Development. Bush was a leader in urging the issuance of the order, the need for which had become apparent on at least three counts.

In the first place, the program of the National Defense Research Committee was one designed to stress research on instruments of warfare. Between the completion of research and the initiation of a procurement program there was a substantial gap which the armed services were slow to fill. It was becoming increasingly apparent that for the research sponsored by NDRC to become most effective, it was essential that the research group carry its projects through the intermediate phase represented by engineering development. It is significant that while the original NDRC carried only research in its title, the new office covered both research and development.

In the second place, there was but little machinery for the correlation of research carried on by NDRC with that carried directly by the Services or by the National Advisory Committee for Aeronautics. The Advisory Council provided for in the order creating the OSRD helped fill a need by providing a place where men conversant with the research programs of the Army, Navy, NDRC and NACA might discuss their various programs and their relation to each other.

In the third place, no satisfactory provision had been made for the stimulation of research in the field of military medicine. The need for such research had been apparent for some time but it had been impossible to get agreement on a program satisfactory to the various groups involved. The success of NDRC in the field of weapons suggested to President Roosevelt the desirability of a comparable committee in military medicine, and led to the creation of OSRD with parallel committees on weapons and medicine.
ORGANIZING SCIENTIFIC RESEARCH FOR WAR

PROVISIONS OF THE EXECUTIVE ORDER

The Office of Scientific Research and Development was brought into existence by Executive Order No. 8807 signed by President Roosevelt on June 28, 1941, the text of which is printed in the Appendix. The order stated that it was issued for the purpose of assuring adequate provision for research on scientific and medical problems relating to national defense.

OSRD was placed within the Office for Emergency Management of the Executive Office of the President. It was to be headed by a Director appointed by the President, who should discharge his responsibilities and perform his duties under the direction and supervision of the President. Compensation of the Director was to be at a rate determined by the President; in practice, the Director served without compensation. It was made the duty of OSRD, subject to such policies, regulations and directions as the President might prescribe and with such advice and assistance as might be necessary from other departments and agencies of the Government to:

a. Advise the President with regard to the status of scientific and medical research relating to national defense and the measures necessary to assure continued and increasing progress in this field.

b. Serve as the center for mobilization of the scientific personnel and resources of the Nation in order to assure maximum utilization of such personnel and resources in developing and applying the results of scientific research to defense purposes.

c. Co-ordinate, aid, and, where desirable, supplement the experimental and other scientific and medical research activities relating to national defense carried on by the Departments of War and Navy and other departments and agencies of the Federal Government.

d. Develop broad and co-ordinated plans for the conduct of scientific research in the defense program, in collaboration with representatives of the War and Navy Departments; review existing scientific research programs formulated by the Departments of War and Navy and other agencies of the Government, and advise them with respect to the relationship of their proposed activities to the total research program.

e. Initiate and support scientific research on the mechanisms and devices of warfare with the objective of creating, developing, and improving instrumentalities, methods, and materials required for national defense.

f. Initiate and support scientific research on medical problems affecting the national defense.

g. Initiate and support such scientific and medical research as may be requested by the government of any country whose defense the President deems vital to the defense of the United States under the terms of the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States"; and serve as the central liaison office for the conduct of such scientific and medical research for such countries.
h. Perform such other duties relating to scientific and medical research and development as the President may from time to time assign to or delegate to it.

The Director was authorized to provide for the internal organization and management of the OSRD. He was further authorized to appoint advisory committees subject to the condition that he should obtain the President's approval for the establishment of the principal subdivisions of the agency and the appointment of the heads thereof. (The requirement of presidential approval was dropped by Executive Order No. 9389 of October 18, 1943.) The principal subdivisions at the outset were the Advisory Council, the National Defense Research Committee, the Committee on Medical Research (all three specifically mentioned in the Executive Order), the Administrative Office which handled administrative affairs, and the Liaison Office through which exchange of information with Allied governments was centralized. Two other principal subdivisions, the Scientific Personnel Office and the Office of Field Service, were created later, and minor subdivisions were established from time to time.

The order directed the OSRD to utilize laboratories, equipment and services of governmental agencies and institutions to the extent that such facilities were available for its purposes; transfers of funds for this purpose were specifically authorized. The Office was further authorized to enter into contracts and agreements with individuals, educational and scientific institutions (including specifically the National Academy of Sciences and the National Research Council), industrial organizations and other agencies for "studies, experimental investigations, and reports."

The Director was authorized to take over contracts falling within the scope of the order which had heretofore been entered into by (1) the NDRC, (2) the Health and Medical Committee established by order of the Council of National Defense on September 19, 1940, and (3) the Federal Security Administrator in his capacity of Co-ordinator of Health, Medical Welfare, Nutrition, Recreation, and other related activities as authorized by order of the Council of National Defense on November 28, 1940. He was further authorized to assume any obligations or responsibilities theretofore undertaken by these agencies which fell within the scope of the order. Under this authority the OSRD assumed the contracts of the NDRC and proceeded to enter into contracts pursuant to letters of intent which had been issued by NDRC. The volume of contracts assumed from the other agencies was negligible.

Paragraph 6 of the order created an Advisory Council whose function was to advise and assist the Director with respect to the co-ordination of research activities carried on by private and governmental research groups as well as to facilitate the interchange of information and data between such groups and agencies. The Council consisted of the Director as Chair-
man, the Chairman of the National Advisory Committee for Aeronautics, the Chairman of the National Defense Research Committee, the Chairman of the Committee on Medical Research, one representative of the Army designated by the Secretary of War and one representative of the Navy designated by the Secretary of the Navy. This Council, which will be discussed later in the present chapter, proved useful not only for its direct activities, but also because of the co-ordination it implied of research activities within the War and Navy Departments respectively.

The National Defense Research Committee was created by Paragraph 7 of the Executive Order. Selection of the eight members followed the pattern of the earlier order of the Council of National Defense, except that the four civilians not serving ex-officio were not named in the Executive Order. The order also envisaged the possibility that the President might later appoint additional members of the Committee, but this was never done. The only change in the membership of the NDRC made as a result of the establishment of OSRD was the consequence of Bush’s selection as Director of OSRD. Conant became Chairman of NDRC and Roger Adams, who had been a Vice-Chairman of Division B, was appointed to the vacancy on the Committee.

The language of Paragraph 7 which points up the changed character of the functions of the NDRC is as follows:

The National Defense Research Committee shall advise and assist the Director in the performance of his scientific research duties with special reference to the mobilization of the scientific personnel and resources of the Nation. To this end it shall be the responsibility of the Committee to recommend to the Director the need for and character of contracts to be entered into with universities, research institutes, and industrial laboratories for research and development on instrumentalities of warfare to supplement such research and development activities of the Departments of War and Navy. Furthermore, the Committee shall from time to time make findings, and submit recommendations to the Director with respect to the adequacy, progress, and results of research on scientific problems related to national defense.

It will be noted that a fundamental change was made in the character of NDRC. As a committee of the Council of National Defense it had the authority to act; as a committee of OSRD it had only the authority to recommend. In practice, the Director accepted most of the recommendations made by the NDRC as might be expected in view of the caliber of men constituting that Committee and the fact that the Director had worked closely with them for a year as Chairman of the Committee. It should be emphasized, however, that at no time did the Director become a rubber stamp for the Committee; nor did the Committee shirk its responsibilities on the theory that its actions were merely advisory. Where the reasons for a particular recommendation were not clear or convincing to the Director,
he would go back to the Committee for additional information and consideration. In some cases, the additional information was sufficient to bring the Director's approval; in others, the additional consideration resulted in a modification or withdrawal of the recommendation. It is a tribute to the caliber and intellectual integrity of the men involved that this close relationship continued for well over four years of intensive work under great stress with cordial relations on all sides.

The most conspicuous change brought about by the Executive Order was the establishment within OSRD of a Committee on Medical Research (CMR) consisting of a Chairman and three members to be appointed by the President and three other members to be designated respectively by the Secretary of War, the Secretary of Navy and the Administrator of the Federal Security Agency, with the latter three members to be selected from the staffs of the respective Surgeons General with particular reference to their qualifications in the field of medical research. The authority of the CMR in the field of military medicine was comparable to that of the NDRC in the field of weapons. The provision of Paragraph 8 with respect to the authority of the Committee was as follows:

The Committee on Medical Research shall advise and assist the Director in the performance of his medical research duties with special reference to the mobilization of medical and scientific personnel of the nation. To this end it shall be the responsibility of the Committee to recommend to the Director the need for and character of contracts to be entered into with the universities, hospitals, and other agencies conducting medical research activities for research and development in the field of the medical sciences. Furthermore, the Committee shall from time to time, on request by the Director, make findings and submit recommendations with respect to the adequacy, progress, and results of research on medical problems related to national defense.

Concurrent with the establishment of OSRD, the Council of National Defense amended its order of November 28, 1940, providing for the coordination of health, welfare and related defense activities to terminate the duties, functions, and activities of the Health and Medical Committee relating to medical research on problems affecting the national defense. This responsibility was assumed by CMR.

Following the precedent of the original NDRC, the order provided that the members of the Advisory Council, the National Defense Research Committee, the Committee on Medical Research and such other committees and subcommittees as the Director might appoint with the approval of the President should serve as such without compensation but with reimbursement for necessary expenses incident to the performance of their duties.

In a final paragraph, the order authorized the Director within the limits of appropriated or allocated funds to employ necessary personnel and
make provision for necessary supplies, facilities and services. He was also instructed, however, to use such statistical, informational, fiscal, personnel, and other general business services and facilities as might be made available to him through the Office for Emergency Management.

Executive Order No. 8807 was amended by Executive Order No. 9389 on October 18, 1943. The purpose of the amendment was to permit the Director to provide for the internal organization and management of OSRD without the need to obtain the approval of the President for the establishment of the subdivisions of the agency and the appointment of the heads thereof.

**Legal Basis of OSRD Operations**

The authority conferred upon OSRD by the order creating it was expanded from time to time by other executive orders and by legislation in connection with OSRD appropriations.

By Executive Order No. 9218 of August 11, 1942, OSRD was authorized to exercise the authority contained in Title II of the Second War Powers Act, 1942, to “acquire, use, and dispose of any real property, temporary use thereof, or other interest therein, together with any personal property located thereon, or used therewith, which the Office of Scientific Research and Development shall deem necessary for military, naval, and other war purposes.”

Executive Order No. 9219, also signed on August 11, 1942, extended to the Office of Scientific Research and Development the provisions of Executive Order No. 9001 of December 27, 1941. That order had given the War and Navy Departments and the Maritime Commission certain broad powers authorized in Title II of the act of December 18, 1941, entitled “An Act to Expedite the Prosecution of the War Effort.” The effect of the order was to exempt the OSRD from certain statutory restrictions upon contracts.

The two orders of August 11, 1942, contributed materially to the flexibility with which OSRD operated. It is difficult to see how OSRD could have operated effectively without the powers they conferred.

Needed authority was also conferred by legislation in connection with appropriation acts. Thus the First Supplemental Civil Functions Appropriation Act, 1941 (Public Law No. 812, 76th Congress) paved the way for acceptance of voluntary services which played such an important part in NDRC and OSRD operations.

The Third Supplemental National Defense Appropriation Act, 1942, approved December 17, 1941, gave the OSRD power to make advance payments on contracts—a power absolutely necessary if academic institutions were to continue to operate the rapidly growing central laboratories. It also specifically authorized Government agencies with funds for research
purposes to transfer such funds to OSRD. This and succeeding appropriation acts also authorized OSRD to pay varying sums to the National Academy of Sciences for administrative and overhead expenses incurred by the Academy in carrying out research projects for Federal agencies. These payments were a material factor in enabling the Academy to meet the numerous calls upon it during the war years.

Authority to agree to indemnify OSRD contractors from funds later to be appropriated for the purpose, against loss or damage to persons or property arising from OSRD work was conferred by the First Supplemental National Defense Appropriation Act, 1943, approved July 25, 1942. This authority was useful in persuading academic contractors to undertake exceptionally hazardous work; but fortunately it never became necessary to seek any appropriations under this provision.

Additional authority was conferred by the National War Agencies Appropriation Act, 1944, approved July 12, 1943. The authority to employ technical personnel by contract without regard to civil service or classification laws paved the way for the operation of the Office of Field Service; and in accordance with a statement made in connection with the request for the authority, it was used only for that purpose. Another provision authorized the Director to dispose of personal property of all kinds produced or acquired in connection with the performance of contracts under such terms and conditions as he might deem advisable, the principal restriction being that receipts from disposition to nongovernmental agencies should be covered into the Treasury as miscellaneous receipts. This broad power was the basis for the rapid shifting of equipment and components to places where they were most needed in the completion of critical projects.

Several Administrative Orders were issued by the Director pursuant to the authority contained in Executive Order No. 8807. Administrative Order No. 1 was approved by the President on August 20, 1941, to give the presidential approval required by Paragraph 3 of the Executive Order to the establishment of the principal subdivisions of OSRD. They were the National Defense Research Committee with Conant as Chairman; the Committee on Medical Research with A. N. Richards (Vice-President in charge of Medical Affairs, University of Pennsylvania, pharmacologist) as Chairman; the Administrative Office under Stewart as Executive Secretary, and the Liaison Office under Carroll L. Wilson as Senior Liaison Officer. NDRC and CMR were charged with advising the Director as specified in the executive order and with supervising the performance of research in their respective fields; and the Liaison Office with conducting scientific liaison with countries in the defense of which the President had deemed vital to the defense of the United States under the terms of the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States." The chart accompanying the order also carried the four divisions of NDRC: Division
A under Tolman, Division B under Roger Adams (replacing Conant), Division C under Jewett, and Division D under Compton. Aside from approving the subdivisions, the administrative order conferred upon the Chairman of the NDRC the duties and powers of the Director in the absence or disability of the Director. It further placed the Executive Secretary in charge of administrative affairs and established him as the contracting officer for the agency subject to all the limitations and restrictions applicable to acts of the Director.

Administrative Order No. 2 of September 24, 1942, which superseded Order No. 1, reaffirmed the principal subdivisions established in the earlier order. In addition, it specifically authorized the Chairmen of the National Defense Research Committee and the Committee on Medical Research to discharge such duties and to exercise such powers of the Director in the field of the respective committees as might be delegated to them from time to time by the Director; and further provided that each might delegate any of his powers or duties as Chairman to such assistant as he might designate with the approval of the Director. It also extended the authority of the Executive Secretary as contracting officer and authorized him to delegate any of his powers or duties to such assistant as he might designate with the approval of the Director. On the chart which accompanied the order Caryl P. Haskins (physicist, Haskins Laboratories) replaced Wilson as Senior Liaison Officer, Wilson having returned to his old post as Executive Assistant to Bush.

Administrative Order No. 3, dated August 21, 1943, was designed to supersede Order No. 2. It repeated the substance of the earlier order, substituted Franklin S. Cooper (physicist, Haskins Laboratories) for Haskins as Senior Liaison Officer, and established a new principal subdivision, the Scientific Personnel Office with John V. L. Hogan (radio engineer) as its head with the title of Special Assistant to the Director. The new office had as its principal duties (1) handling the relationship between OSRD and other governmental agencies with respect to scientific personnel; and (2) dealing with the problems relating to scientific personnel employed by or associated with OSRD or its contractors, particularly problems in connection with policies and procedures relating to the evaluation, training, allocation, compensation and requests for deferment by the Selective Service System of such scientific personnel. The head of the Scientific Personnel Office was authorized to delegate any of his powers or duties to such assistant as he might designate with the approval of the Director. There is some question as to whether the approval of the President to Order No. 3 was indicated in the manner required by Executive Order No. 8807; but OSRD proceeded on the assumption that the order was effective.

Administrative Order No. 4, issued on November 8, 1943, was the first
one that did not require the approval of the President. In addition to the four original offices and the Scientific Personnel Office established under Administrative Order No. 3, it provided for the creation of the Office of Field Service, the operations of which are described in the chapter of that name. Karl T. Compton was designated Chief of the Office of Field Service; he was authorized to delegate any of his powers or duties to such assistant as he might designate with the approval of the Director.

Administrative Order No. 4 was amended on April 25, 1945, to require approval by the Office of Scientific Research and Development Contract Settlement Review Board (established by Administrative Order No. 5) of contract or subcontract termination claims in excess of $25,000. Certain additional administrative authority was conferred upon the Executive Secretary by the same amendment. A further amendment of the same order on July 26, 1945, provided that in the absence or disability of the Director and the Chairman of the National Defense Research Committee the Executive Secretary should discharge all the duties and exercise all the powers of the Director of OSRD. A further amendment of the same order on December 18, 1945, provided for a Deputy Director of OSRD who should become Acting Director in the absence or disability of the Director and the Chairman of the National Defense Research Committee. The provision with respect to the Executive Secretary was modified to remove him from the line of succession. Stewart resigned as Executive Secretary and was appointed Deputy Director on December 18.

Administrative Order No. 5 of April 30, 1945, provided for the establishment of the Office of Scientific Research and Development Contract Settlement Review Board to consist of five members appointed by the Director. The function of the Board was to examine and review all proposed termination claim settlements under OSRD contracts and subcontracts where the amount of the termination claim exceeded $25,000. The Board’s recommendation was to be communicated to the contracting officer who was authorized to submit to the Board for recommendation other termination claims or matters not otherwise falling within the jurisdiction of the Board.

The original composition of the Board was O. M. Ruebhausen (General Counsel), Chairman; W. F. Davidson (Deputy Executive Officer, NDRC); Cleveland Norcross (Executive Assistant to the Executive Secretary); C. G. Cruikshank (Fiscal Officer), and R. C. Bowker (in charge of Priorities and Property Control). When Norcross became Acting Executive Secretary following Stewart’s resignation, he was succeeded as a member of the Board by Paul A. Scherer (Chief, Engineering and Transition Office). Davidson became Chairman on February 1, 1946, upon Ruebhausen’s resignation as General Counsel; the vacancy on the Board was filled by E. T. Barker, the new General Counsel.
RELATION OF OSRD TO THE NATIONAL ACADEMY OF SCIENCES AND THE NATIONAL RESEARCH COUNCIL

On July 16, 1941, President Roosevelt addressed a letter to Jewett as President of the National Academy of Sciences requesting the Academy to aid the recently established Office of Scientific Research and Development in the performance of its duties in every way possible. He pointed out that the Academy had been organized for the primary purpose of rendering scientific advice to the Government. In the existing emergency, the services of the Academy and of the National Research Council were again essential to the defense of the country; and he expressed the hope that they would respond "with the same spirit which resulted in a fine record of accomplishment under previous stress." The President stated that the creation of OSRD was not intended in any way to inhibit the Academy's important function of rendering to the agencies of Government the best scientific advice possible. On the contrary, it was intended to further this important service by better co-ordination with other agencies responsible for specific aspects of the application of science to defense. He ended with an expression of his hope that the Academy, the Council and their respective officers would render all assistance in their power to the OSRD as well as to other agencies of Government which they already advised or which might call for their aid.

Jewett's reply of July 19 to the President's cordial letter was equally cordial. In it he assured the President that the Academy, the Council, Dr. Ross Harrison as Chairman of the Council, and he, as President of the Academy, would do everything within their power to aid and facilitate OSRD in its task of co-ordinating the nation's scientific research facilities in all matters involved in the national defense.

The close contacts which NDRC had established with the Academy and the Council were continued and expanded under OSRD. Particularly close relations were established between the CMR and the Council, as the latter had built up an organization in its Division of Medical Sciences which greatly aided CMR in getting under way without loss of valuable time.

STAFF OPERATIONS

Although the responsibility for advising the Director on scientific matters was divided between the NDRC and the CMR, business operations were handled by a single office. Immediately upon the issuance of the Executive Order, Bush appointed Stewart as Executive Secretary of the Office of Scientific Research and Development. At their first meetings, both NDRC and CMR recommended to Bush that he also appoint Stewart as Executive Secretary of the respective Committees, and these appointments were made.
This threefold secretaryship in the same individual made possible a high degree of uniformity in administrative matters while the two Committees pursued quite different paths in scientific affairs.

As Secretary of the Committees, Stewart attended all their meetings and prepared minutes of their actions which were submitted to the Director for his approval of the recommendations contained therein. When the Director had questions about particular recommendations, he normally took them up directly with the Chairman of the Committee involved. The Director's approval of recommendations was communicated to the Executive Secretary in a memorandum directing him to take the steps necessary to put the recommendations into effect. The necessary authority had previously been given in an administrative order designating the Executive Secretary as contracting officer for the agency. There were a few differences in the practices of the two Committees which were reflected in the contracts drafted upon their recommendation. These differences had been approved in principle by the Director and the drafting staff were well acquainted with them. The routine of drafting contracts was the same for NDRC and CMR recommendations and the same form was used for both. The Administrative Office was organized along functional lines and served the two Committees with equal facility.

The Director's immediate staff was kept small at all times. The NDRC was so organized that the central scientific staff reported to the Chairman of the Committee. The same was true of the Committee on Medical Research. Wide latitude in the handling of the administrative affairs of the office was entrusted to the Executive Secretary. When the Office of Field Service was established, the immediate responsibility for its operations was placed upon its chief who organized his own staff. The exchange of scientific information with the British was handled through the Liaison Office and the problems of scientific personnel through the Scientific Personnel Office. Section T was for a while an anomaly in that it supervised a scientific operation reporting to the Director outside the framework of NDRC and CMR; it was closely organized, however, by Merle A. Tuve, its Chairman.

The heads of various groups reported to Bush as Director of OSRD. He was given invaluable assistance by Carroll Wilson, who had originally been appointed as Executive Assistant to Bush as Chairman of NDRC, had organized the Liaison Office and served as the first Senior Liaison Officer, and then had been brought back into Bush's immediate office as Executive Assistant to the Director. In addition to serving as Secretary of the Advisory Council, Wilson possessed Bush's complete confidence and served as his alter ego in matters to which Bush could not give his personal attention. When the load became too heavy for Wilson to carry alone, Lyman Chalkley, who came to OSRD from the Foreign Economic Administration, was
appointed as Assistant to the Director. He was especially valuable in following particular assignments for the Director. A few other persons received appointments of limited duration as Assistants to the Director. They are mentioned where appropriate in connection with the operations for which they received appointments.

**The Advisory Council**

The original members of the Advisory Council were Bush, as Chairman; Conant, for NDRC; Richards, for CMR; Harvey H. Bundy, representing the War Department; and Jerome C. Hunsaker, representing the Navy and the National Advisory Committee for Aeronautics (NACA). Bundy was an attorney serving as Special Assistant to the Secretary of War. His close relations with Secretary Stimson were invaluable at times in getting action out of the very complex organization of the War Department. Hunsaker was an aeronautical engineer on the faculty of the Massachusetts Institute of Technology who had succeeded Bush as Chairman of NACA. He was also serving briefly as Co-ordinator of Research and Development in the Office of the Secretary of the Navy until the proper man could be found to assume that newly established post. When Rear Admiral Julius A. Furer succeeded Hunsaker as Co-ordinator of Research and Development, he was designated as the Navy member on the Advisory Council in December 1941. The effect of this designation was to bring the Council up to its full strength as Hunsaker remained as the NACA member. The membership of the Council remained unchanged until near the end of the war. Rear Admiral A. H. Van Keuren, Director of the Naval Research Laboratory, succeeded Admiral Furer in July 1945, and was in turn succeeded by Commodore H. A. Schade in November 1945, after the latter had succeeded him as Director of the Laboratory. With Secretary Stimson’s resignation as Secretary of War after the end of hostilities, Mr. Bundy also resigned and was succeeded as a member of the Advisory Council by Brigadier General William A. Borden, Director of the New Developments Division, who was in turn succeeded by Colonel Gervais W. Trichel on April 3, 1946.

The Advisory Council held a total of twenty-eight meetings—ten of them between August 8 and December 31, 1941; thirteen during the calendar year 1942; two in 1943; two in 1944; and one in 1945.

During the first eighteen months of OSRD operations there were a number of important relations with the Services which required top-level handling. The Advisory Council performed an important function in this connection as the members were in a position within their respective organizations to get needed information or to press for a particular bit of action, the absence of which was holding up a program. By the end of 1942, the
principal lines of activity were well in hand and the need for major action by the Advisory Council had passed.

For a time in 1942 it appeared that the Advisory Council would play an important role in obtaining top-level consideration of the adoption for field use of OSRD-developed devices in cases where OSRD personnel felt that those devices were not receiving adequate consideration within the Services. However, the problem of the introduction of new devices had much broader aspects than that of the introduction of those of which development had been completed. To meet this problem, the Joint Chiefs of Staff on May 4, 1942, established the Joint Committee on New Weapons and Equipment. Bush was promptly appointed Chairman of the new Committee. The other members originally were a general officer of the Army and a flag officer of the Navy; later a general and an admiral were added to represent Army and Navy aviation.

With the creation of the Joint Committee on New Weapons and Equipment it was no longer either necessary or appropriate for the Advisory Council of OSRD to consider the introduction of new weapons into field use. Accordingly, the need for frequent meetings of the Council ceased to exist, and the five meetings held during 1943, 1944 and 1945 were devoted to the consideration of specific problems in the consideration of which the Director sought the advice of his colleagues on the Council.

The usefulness of the Council was not confined to its deliberations in formal meetings. The members of the Council were always available for consultation by telephone. The fact that they represented particular agencies having specific contacts with each other and with OSRD made it an easy matter for the Director to handle by telephone conversations matters which, in the absence of such a convenient contact, might have resulted in considerable delays to important programs. Meetings of the Council were informal and quite frank.

One of the most effective devices employed by the Advisory Council was the creation of *ad hoc* committees. When two or more of the agencies represented on the Advisory Council were engaged in the same field of work in a manner which resulted in confusion, overlap or conflicting demands for manpower, or where it was apparent that some unitary consideration should be given to diverse programs in the same field, the Council availed itself of the services of an *ad hoc* committee to survey the field and make recommendations. The first of these committees was appointed early in the life of the Advisory Council. By May 25, 1942, the number and importance of *ad hoc* committees had reached the point that the procedure with respect to them was somewhat formalized. According to an outline prepared under that date, proposals for *ad hoc* committees might originate by spontaneous action of the Council as a body, but were more generally
the result of a proposal by one of its members. In general, they might be expected to cover NDRC, Army and/or Navy areas; CMR, Army and/or Navy areas; and sometimes might include the NACA. The scope of the *ad hoc* inquiry and the terms of reference of the committee were determined by the Council.

Depending upon whether the OSRD interest was primarily NDRC or CMR, arrangements for the *ad hoc* committee were handled either by the Chairman of the NDRC or by the Chairman of the CMR, the designation of the responsible Council member being made by the Director. Civilian members of an *ad hoc* committee might be selected from within or outside OSRD. The preliminary choice of civilian members by the responsible Council member was subject to review by the Army and Navy members of the Council and by the Director. Army and Navy members were designated by the Service representative and where the NACA was involved, the NACA member was selected by Hunsaker. The responsible Council member also co-operated with the Chairman of the *ad hoc* committee by attending the first meeting and advising the committee as to the general mode of operation and such background of the problem as might be pertinent. When the committee submitted its report, it was dissolved and copies of its report were circulated to the members of the Council. Bundy and Furer were charged with conveying to their respective Services any recommendations of the committee with respect to the work of the Army and Navy; Hunsaker had a similar position with respect to NACA; and the responsible Council member had the initiative in carrying out the recommendations with respect to OSRD.

Clearance of individuals for military research was a continuing topic upon which the individual members of the Council were quite helpful. Troublesome problems of liaison with the military services were frequently smoothed with the assistance of the Council. Ways in which to speed up the production of newly developed weapons received a great deal of attention. Major changes in the organization and procedure of OSRD were discussed by the Director with the Council prior to their being put into effect. The proper handling of an increasingly inadequate supply of scientific manpower was a perennial subject for discussion which was paralleled in the early days by discussions of ways by which research laboratories could be assisted in obtaining badly needed equipment.

At one time or another, nearly everything within the jurisdiction of OSRD was considered in some of its aspects by the Advisory Council. The greatest contribution of that body, however, was the fact that its members individually provided an important high-level contact with the agencies with which they were associated. Another important contribution of the Council as a group was the series of *ad hoc* committees appointed to study critical problems from time to time. Although the function of the Council
was quite different from that performed by the NDRC and the CMR, its existence helped materially in smoothing the way for the operation of those committees.

**Related Assignments of the Director**

The effectiveness of the Office of Scientific Research and Development was materially strengthened by other activities of its Director. In addition to a number of temporary assignments during the period of OSRD operations, he had four wartime assignments and one postwar one which bore directly upon the work of the OSRD. Prior to the creation of the National Defense Research Committee, Bush had been Chairman of the National Advisory Committee for Aeronautics, and he continued as a member of that body. In consequence he was well acquainted with its personnel, scope of activities and methods of procedure. The contacts which he had made with the military departments as a member of NACA for some years prior to the establishment of NDRC stood him in good stead in his new position. Furthermore, his knowledge of the NACA program and operations aided the NDRC in avoiding conflicts of jurisdiction with the NACA.

The establishment of the Joint Committee on New Weapons and Equipment of the Joint Chiefs of Staff (JNW) has already been mentioned. Bush’s chairmanship of that committee meant that the scientific point of view could be introduced fairly close to the top levels of military strategy. JNW was an appropriate supplement to the activities of OSRD, making it possible during the war to get strategic consideration of OSRD-developed equipment in a way which otherwise might have been impossible.

The third principal assignment of the Director of OSRD during the war was that of scientific adviser to the Manhattan District. The uranium program was put under the NDRC at the time of the Committee’s creation in June 1940. When OSRD was established, the subject was left with NDRC for a while and then transferred to a group outside NDRC reporting to the Director of OSRD. When the results of research under OSRD auspices had shown the possibility of the production of an atomic bomb and had indicated to some degree the magnitude of operations which would be necessary to produce the bomb, the project was transferred from OSRD to the newly created Manhattan District of the Corps of Engineers of the Army. Bush, Conant and Tolman were extremely active as advisers to the Manhattan District from the time of its origin. Bush served as a member of the Scientific Advisory Committee to Major General Leslie R. Groves, the Director of the Manhattan District, and also as a member of the Military Policy Committee of the Manhattan project.

The fourth of the principal assignments was a series of four questions asked Bush by President Roosevelt in a letter of November 17, 1944, with
a view to securing for times of peace the benefit of the experience gained by OSRD in its operations for war. The questions and their answers as embodied in the report entitled *Science—the Endless Frontier* are considered in a later chapter.

In addition to these specific assignments, Bush acted as an informal scientific adviser to President Roosevelt. He had access to the President and operated at all times with the assurance of the President’s support.

As the liquidation of OSRD progressed in 1946, it became apparent that a great gap would be left with respect to one of its most important indirect benefits, namely, that of effecting a general co-ordination of Army and Navy research through the common interest in OSRD projects and the exchange of information with regard to them. The JNW might have been expected to effect the necessary co-ordination but its actual operations in this connection, particularly in the postwar period, were ineffective. Bush was outspoken in clarifying this situation, pointing out that the committee as constituted under the Joint Chiefs of Staff was weak in that it lacked the direct authority to establish policies or to resolve differences between the Services. A basic weakness was the requirement of unanimity for decisions of JCS committees and the necessity for referring to the Chiefs themselves all matters upon which a dissent was made. Furthermore, the Joint Chiefs themselves could act only by unanimous action. This meant that differences could not be settled short of the President.

To meet these difficulties, the Joint Research and Development Board was established on June 6, 1946, by action of the Secretaries of War and Navy. This Board of five members was given a direct grant of authority within its field by the two Secretaries and was so constituted as to rule by majority vote. It was specifically granted final authority to make allocation of responsibility for research and development programs between the Army and Navy. In addition, the Board was charged with the responsibility for giving advice and recommendations on the broad problems of scope and emphasis of Army and Navy research and development. Perhaps its most important function was to consider the implications of strategic planning upon research and development, and vice versa. One of the first actions of the Board was to organize a Policy Council on which the top Army and Navy planners would confer with those responsible for research and development policy. Under the auspices of this Council, the opportunity existed for scientists to participate in military planning and strategic thinking at the highest level. Bush accepted the chairmanship of JRDB, which proceeded promptly to organize a series of committees and panels to cover the broad field under its jurisdiction.

It was the genius of OSRD that Bush left it flexible, moulding the organization to meet the requirements of the situation and the personalities with
whom he had to deal rather than attempting to shape the program to fit
the organization. In the discussion of instrumentalities, mechanics and prob-
lems occupying the remainder of the present volume, this point should
always be remembered. The objective was to get the best results in the
hands of the troops at the earliest possible moment. The means employed
were those which in the light of the surrounding circumstances seemed
best calculated to achieve this objective.
CHAPTER IV

NDRC OF OSRD—THE COMMITTEE

THE ONLY change in the membership of NDRC (of OSRD) from its establishment on June 28, 1941, to the end of hostilities with Japan was in the representatives of the Army and Navy. Shortly after the end of hostilities there was a change in the Office of the Commissioner of Patents leading to a shift in NDRC membership. Otherwise the same group of men who started with the Committee remained with it until the Committee adjourned its meeting on January 20, 1947 sine die.

Even the Service membership was relatively constant during the most crucial period of the Committee’s activities. Captain Lybrand P. Smith for the Navy joined the Committee about two months after its establishment and remained until approximately two months before the surrender of Germany. For the Army, the eighteen months of General Williams’s membership were notably productive in stimulating cordial top-level relations between NDRC and the Army.

The complete list of members of the Committee, reconstituted as an advisory committee of the Office of Scientific Research and Development, is as follows:

J. B. Conant, Chairman
R. C. Tolman, Vice-Chairman
Roger Adams
K. T. Compton
F. B. Jewett
Commissioner of Patents
Conway P. Coe June 28, 1941, to September 14, 1945
Casper W. Ooms September 15, 1945—

Army Member
Brigadier General R. C. Moore June 28, 1941, to March 31, 1942
Major General C. C. Williams March 31, 1942, to September 22, 1943
Brigadier General Walter A. Wood, Jr. September 22, 1943 to January 7, 1944
Colonel Lee A. Denson, Jr. January 7, 1944, to February 10, 1945
Colonel P. R. Faymonville February 10, 1945, to June 28, 1945
Brigadier General E. A. Regnier June 28, 1945, to March 25, 1946
Colonel Michael M. Irvine March 25, 1946, to July 19, 1946
Colonel Edward A. Routheau July 19, 1946—

Navy Member
Rear Admiral H. G. Bowen June 28, 1941, to August 22, 1941
Captain Lybrand P. Smith August 22, 1941, to March 9, 1945
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Rear Admiral J. A. Furer March 9, 1945, to June 22, 1945
Rear Admiral A. H. Van Keuren June 22, 1945, to November 13, 1945
Commodore H. A. Schade November 13, 1945 —

The committee held monthly meetings through September 1942, then changed to a biweekly schedule through October and November, and to weekly meetings from December 1942 through the middle of July 1943, at which time the biweekly schedule was restored. This was followed until the end of the war with Germany; subsequent to that event meetings were held at irregular intervals.

Organization

With its change to an advisory capacity the National Defense Research Committee was relieved of responsibility for business operations and for scientific interchange with Allied governments. These responsibilities were entrusted to the Administrative Office with the Executive Secretary as its head and to the Liaison Office under the direction of the Senior Liaison Officer.

The reorganized Committee held its first meeting on July 18, 1941, with all members present. In a series of procedural resolutions the Committee indicated its intention of proceeding as it had during the earlier period. The Director of OSRD was requested to appoint Tolman as Vice-Chairman and Stewart as Executive Secretary of the Committee. The quorum was set at five members. The Chairmen of the several divisions were instructed to send to the Executive Secretary in advance of the meetings of the Committee summaries of items to be submitted by them for action, with each summary to carry the name of the Army and Navy liaison officers who participated in discussions leading to the recommendation. The summaries were to be circulated to the members of the Committee in advance of meetings insofar as practicable.

In another series of resolutions the Committee recommended that the Director of OSRD take over existing contracts entered into by the original NDRC and carry out the projects for which formal contracts had not been completed; that OSRD employ a contract form similar to that which NDRC had used; that the compensation of persons working directly for the Committee or for its contractors should be so fixed that the employee would neither gain nor lose financially from such employment and that the maximum consideration paid under contract be so fixed as not to result in a profit to the contractor; and that the policies followed by the former NDRC with reference to classified matter, overhead allowances in contracts, deferments and other procedural matters be adopted by the Director to the extent that they were applicable.

Neither the change in the nature of function of NDRC nor the entry of the United States into the war brought an immediate change in the organiza-
tion of NDRC. A major change was made in December 1942; prior to that date there were minor shifts within the four divisions among which the scientific work of the Committee was divided. The organization of June 15, 1941, as given previously, was changed in the following respects between that date and December 8, 1942:

Division A

Section A on "Erosion" was created with L. H. Adams (geophysicist, Carnegie Institution of Washington) as Chairman.

Section S on "Terminal Ballistics" was consolidated with Section B under the new title "Structural Defense and Terminal Ballistics." This title was later changed to "Terminal Ballistics and Structural Defense and Offense."

Section C on "Antisubmarine and Other Ordnance Developments" was established with J. T. Tate as Chairman. Tate was also Chairman of the section on "Antisubmarine Warfare" in Division C.

Division B

With Roger Adams moving up from Vice-Chairman to Chairman of Division B, a new system of nomenclature was adopted together with some shifting of functions among sections. The final organization was as follows:

Section B-1 Explosives, Physical
  G. B. Kistiakowsky, Chairman

Section B-1-a Testing and Physical Problems
  D. P. MacDougall, Chairman (chemist, Clark University)

Section B-1-b Theory of Detonations and Shock Waves
  E. B. Wilson, Jr., Chairman (chemist, Harvard University)

Section B-1-c Pyrotechnics (October 8, 1941 — August 2, 1942)
  Organic Research (August 2, 1942 — December 9, 1942)
  G. P. Baxter, Chairman, October 8, 1941 — July 7, 1942 (chemist, Harvard University)
  Homer Adkins, Chairman, August 3, 1942 — December 9, 1942 (chemist, University of Wisconsin)

Section B-1-d Unrotated Projectile Propellants
  L. P. Hammett, Chairman (chemist, Columbia University)

Section B-1-e Development Problems
  R. C. Elderfield, Chairman (chemist, Columbia University)

Section B-2 Explosives, Organic
  F. C. Whitmore, Chairman to July 8, 1942 (chemist, Pennsylvania State College)
  R. A. Connor, Chairman, September 15, 1942 — December 9, 1942 (chemist, University of Pennsylvania)

Section B-2-a Synthetic Problems
  F. C. Whitmore, Chairman, August 12, 1941 — July 8, 1942
  R. A. Connor, Chairman, October 15, 1942 — December 9, 1942
Section B-2-b Development Problems
  F. C. Whitmore, Chairman, August 12, 1941 — July 8, 1942
  R. A. Connor, Chairman, October 15, 1942 — December 9, 1942
Section B-3 Synthetic, Analytical and Inorganic Problems
  C. S. Marvel, Chairman (chemist, University of Illinois)
Section B-3-a Synthetic Organic
  C. S. Marvel, Chairman
Section B-3-b Analytical and Inorganic Problems
  W. C. Johnson, Chairman
Section B-3-c Protective Agents and Fabrics
  Homer Adkins, Chairman
Section B-3-d Fluorocarbons
  W. S. Calcott, Chairman (chemist, E. I. du Pont de Nemours)
Section B-4 Toxicity
  H. S. Gasser, Chairman (physiologist, Rockefeller Institute for Medical Research)
Section B-4-a Testing
  H. S. Gasser, Chairman
Section B-4-b Immunology
  H. S. Gasser, Chairman
Section B-4-c Physiological Mechanism
  H. S. Gasser, Chairman, October 7, 1941 — October 13, 1942
  Homer W. Smith, Chairman, October 13, 1942 — December 9, 1942
  (physiologist, New York University)
Section B-5 Aerosols
  W. H. Rodebush, Chairman
Section B-6 Absorbents
  W. A. Noyes, Jr., Chairman, August 12, 1941 — August 19, 1942
  D. M. Yost, Chairman, August 19, 1942 — December 9, 1942 (chemist, California Institute of Technology)
Section B-7 Physical, Chemical and Engineering Problems
  E. P. Stevenson, Chairman (chemist, A. D. Little Co.)
Section B-7-a Hydraulic Fluids (transferred April 24, 1942 to B-8)
  G. H. B. Davis, Chairman
Section B-7-b Oxygen Problems
  E. P. Stevenson, Chairman
Section B-7-c Oxygen Mask Development (transferred April 24, 1942 to B-8)
  E. F. DuBois, Chairman
Section B-7-d Flame Throwers, Incendiaries and Flares
  E. P. Stevenson, Chairman
Section B-7-e Miscellaneous Problems
  E. P. Stevenson, Chairman
Section B-8 (Untitled)
W. K. Lewis, Chairman, October 9, 1941 — June 30, 1942
T. K. Sherwood, Chairman, July 1, 1942 — December 9, 1942
Section B-8-a Canister Development in Co-operation with CWS Development Laboratory
W. K. Lewis, Chairman
Section B-8-b Protective Coatings
W. K. Lewis, Chairman, October 9, 1941 — November 19, 1941
G. O. Curme, Jr., Chairman, November 19, 1941 — May 28, 1942
A. J. Weith, Chairman, May 28, 1942 — December 9, 1942 (chemist, Bakelite Corp.)
Section B-8-c Metallurgy (discontinued February 15, 1942)
A. E. White, Chairman
Section B-8-c Hydraulic Fluids
G. H. B. Davis, Chairman
Section B-8-d Vesicant Spray
W. K. Lewis, Chairman
Section B-8-e Aviation Breathing Equipment
C. K. Drinker, Chairman (physiologist, Harvard University)
Section B-8-f Miscellaneous Problems
W. K. Lewis, Chairman, April 24, 1942 — June 30, 1942
T. K. Sherwood, Chairman, July 1, 1942 — December 9, 1942
Section B-9 (Untitled)
Roger Adams, Chairman
Section B-9-a Automotive Fuels, Special Problems
T. Midgely, Chairman
Section B-9-b Special Navy Problems
G. A. Richter, Chairman
Section B-9-c Special Problems
Roger Adams, Chairman
Section B-9-d Quartermaster Corps Problems
Roger Adams, Chairman
Section B-10 Petroleum Warfare
R. P. Russell, Chairman (chemist, Standard Oil Development Co.)

Division C
The following new sections were organized in Division C between July 1941 and December 1942:
Section C-4-a Oceanographic Studies
C. O'D. Iselin, Chairman (oceanographer, Woods Hole Oceanographic Institution)
Section C-6 Illumination
H. E. Ives, Chairman (physicist, Bell Telephone Laboratories)
Section C-7 Naval Architecture
  J. T. Tate, Chairman
Section C-8 Camouflage
  A. C. Hardy, Chairman (physicist, M.I.T.)
Section C-9 Sound Control
  P. M. Morse, Chairman (physicist, M.I.T.)
Committee on Mine Warfare
  J. T. Tate, Chairman

Division D
  Alan T. Waterman (physicist, Yale University) became a Vice-Chairman of the Division and Section D–M with Melville Eastham (electrical engineer, General Radio Co.) as Chairman was created to supervise the model shop established in connection with the Radiation Laboratory.

Committee on Uranium
  This committee was reorganized as a Section on Uranium with L. J. Briggs continuing as Chairman. It passed out of the jurisdiction of NDRC in December 1941.

Division F
  This new division was established in November 1942, shortly before the reorganization of the NDRC, with C. G. Suits (physicist, General Electric Co.) as Chairman, to supervise a program of radar countermeasures.

Outside the regular organization of NDRC, the Chairman appointed ad hoc committees from time to time at the suggestion of the Advisory Council. The reports of those committees influenced the work of NDRC; and in two cases — metallurgy and camouflage — had a direct bearing upon the way in which the Committee organized to handle its work.

Distribution of Contracts

NDRC was a highly decentralized organization. Specific fields of activity had been assigned to the several divisions and sections and the initiative as to the placing of contracts in each field rested with the division or section concerned. The central office had distributed to the Division Chiefs in the first few weeks of NDRC operation a loose leaf volume listing specialized academic facilities which might be available for NDRC work. As additional facilities came to the attention of the central office, information concerning them was disseminated to divisions which might make use of them.

With the initiative as to the selection of contractors left to the divisions and sections, it would have been remarkable had the over-all distribution of contracts exactly followed any path which might have been laid out in
advance. Each Division and Section Chief wanted to place contracts with institutions which in his opinion could best contribute to the solution of his problems; and he was not concerned with the fact that OSRD contracts in other fields might have been placed with those institutions. A fairly heavy concentration of contracts among institutions in the northeastern part of the United States and on the Pacific Coast began to develop, and members of the Committee were aware of the fact they were open to possible criticism because of this concentration. Inasmuch as the NDRC was seeking to bring into defense research the best scientific talent in the country, Conant had a study made to see how effectively this was being accomplished. As a rough measure of leadership in science, he took the starring of names in *American Men of Science*. As the selection of names to be starred in a particular field is made by scientists in that field, this gives the scientists' own estimate of the standing of their colleagues. Conant's study showed that as of October 15, 1941, 52 per cent of the starred chemists were engaged in defense work for OSRD, for industry or for the Government. The corresponding figure for starred physicists was 78 per cent. The difference between the two figures was a reflection of the fact that modern war calls upon the physicist to a greater extent than upon the chemist. Conant pointed out that the figures on physicists, when considered in the light of the expanding interest in electronics, pointed to the probability of a very serious shortage of physicists.

An analysis of the distribution of starred physicists and chemists showed that OSRD was already contracting with institutions employing 98 per cent of them. The amount of money in OSRD contracts with the various institutions naturally did not correspond exactly with the distribution of the starred scientists among those institutions; and one result of the survey was to indicate to the Division Chiefs particular institutions which might be able profitably to absorb more OSRD work.

When war came and with it an expansion of the OSRD program and of the Army, Navy and industrial research and development programs, the demands for physicists far exceeded the supply, and institutions with competent physicists either took military research contracts or released men to institutions which had contracts. As gas was not used in the war, the demand for chemists never reached the proportions of the demand for physicists and less difficulty was experienced in placing contracts for needed chemical research. Engineering colleges and engineering departments of universities were not used as fully as they wished to be. In the early days of NDRC when the emphasis was upon research, the heavy demand was for physicists and chemists. As emphasis switched to development in the later days of NDRC, it might have been possible to make more effective use of the staffs of engineering departments and engineering colleges; but by that time the pattern had been pretty well set and the pressure under which everyone
was working made it difficult for Division and Section Chiefs to bring in new groups.

Following Pearl Harbor, the NDRC started aggressively to bring more industrial concerns into this contracting framework. In a letter addressed to a number of industrial organizations on December 30, 1941, Jewett, who was the Committee's principal contact with industrial organizations, wrote that when NDRC was created some eighteen months previously, it had approached academic laboratories and a few industrial laboratories whose normal work was closely akin to specific military problems. The reason for this selection was partly because it was thought that industrial laboratories were largely engaged on urgent problems which might interfere with taking on additional work and partly because the most urgent problems confronting NDRC at the time appeared to be largely in highly specialized fields or in the fundamental stage which university laboratories could tackle. Jewett pointed out that the result had been a heavy drain on the personnel and facilities of academic institutions and a heavy load on a few industrial laboratories. While recognizing that the military services might have made substantial direct use of industrial laboratories, he was seeking untouched potential resources in that field. He pointed out that with the change from a defense philosophy to one of all-out war the number and urgency of military development problems were greatly increased, while the inevitable restrictions on civil life seemed likely to lessen the pressure of normal research and development activities and to make more facilities available for the solution of strictly war problems. The letter concluded with a request for information as to facilities which the addressees might have available for NDRC work.

A summary of the responses to Jewett's letter was distributed to members of the NDRC as well as to Division and Section Chairmen and Technical Aides for their use in recommending contracts, particularly those in the stage which intervenes between the completion of laboratory trials and the undertaking of large-scale production. Jewett also prepared and distributed a key to National Research Council Bulletin No. 104, entitled "Industrial Research Laboratories," to call to the attention of the divisions some of the more prominent physical research listings out of the approximately 2200 firms recorded in that Bulletin.

When NDRC was reorganized late in 1942 a memorandum of general instructions was issued for the benefit of the new Division and Section Chiefs. It enumerated the following points for consideration in the selection of contractors: (1) primary emphasis in the selection of contractors should be placed on their ability to provide the highest standard of work in the least possible time; (2) contracts should be placed with organizations requiring a minimum of new personnel, machinery, equipment or facilities to perform the work; (3) contracts leading to developing of devices which
may eventually go into large scale production should be carefully placed in order to avoid areas already overloaded with war contracts or faced with acute labor shortage; (4) contracts should be spread among as many organizations as is reasonable and feasible; (5) all other things being equal, the contract should be placed where the cost is lowest.

**Reorganization of the Divisions**

The first and only major reorganization within NDRC came in December 1942. The tremendous increase in the Committee's activities which followed the outbreak of hostilities and the accelerated pressure to produce useful results quickly threw a heavy burden upon the members of the Committee. Undoubtedly the original scheme of making the civilian members Chairmen of divisions had resulted in greater speed than would have been had if this had not been done. With the enormous increase in the Committee's program, however, this divisional organization had thrown a heavy administrative burden upon the members, which prevented them from giving sufficient attention to the broader policies which were a part of their responsibilities. After a preliminary series of conferences with the Division chairmen in October 1942, Conant and Edward L. Moreland (Dean of Engineering, M.I.T., and Executive Officer of NDRC) submitted to the Committee a proposal for a complete reorganization of NDRC. This proposal became the basis of a recommendation to the Director adopted by the Committee at a special meeting on October 15, 1942. The several parts of that recommendation were: (1) that the Director abolish the present divisions and sections of NDRC as of a date to be determined by the Chairman of NDRC; (2) that the Director create approximately fifteen divisions of NDRC with a tentative allocation of functions set out in the recommendation; (3) that a subcommittee consisting of Conant, Adams, Compton, Jewett and Tolman examine all NDRC projects and contracts and allocate each to one of the new divisions or sections; (4) that the same subcommittee recommend budgets for the new divisions; (5) that the same subcommittee be empowered to recommend to the Director technical personnel of each division and section and the creation of new divisions and sections with appropriate personnel; (6) that after the reorganization, divisional proposals be submitted in typewritten form for circulation to the Committee members, the proposals to contain all pertinent information and to show the relation of the proposed contract to the general scheme of operation of the division both from a scientific and a budgetary point of view; (7) that the proposals would not be acted upon at the first meeting at which they are reviewed unless the need for immediate action is clearly demonstrated and unanimous consent obtained. In general where proposals involve an important new departure from policy or large sums of money,
a subcommittee will review the situation and report to the full committee; (8) that the Director of OSRD modify existing administrative machinery to conform with the new organization.

Appended to the resolution was a tentatively proposed new divisional organization calling for fifteen divisions designated by name with indications of the assignment of specific parts of the current program to each of the proposed divisions. In submitting the recommendation, Conant suggested that after the reorganization the Committee should meet at weekly intervals to consider proposals for contract and to function actively in reviewing the activities of the several divisions.

Following the Committee meeting Jewett wrote Conant on October 21 at some length about the difficulty of organizing NDRC for more efficient operations. He described NDRC responsibilities in the following language:

We must realize that the thing we are charged to administer is the greatest industrial research and development project man has ever attempted; that it is the most diffuse in the variety of its interests; has the largest funds; is the most difficult to operate because of the necessarily wide scattering of its units and projects, and is something in which time is more the essense of the job than anywhere else.

In Jewett’s opinion, effective organization required that the Chairman or the chief operating officer of NDRC should have a sufficient staff to supervise all the work adequately. The members of that staff should be intimately familiar with the sectors of the work for which they were responsible and should be in a position to present matters in their fields for consideration by the Committee.

On October 28, 1942, Bush gave his approval to the general lines upon which reorganization was proceeding. The subcommittee appointed by the Committee on October 15 made its report on November 6. Upon the basis of that report, the full Committee, with Jewett dissenting, recommended the establishment of eighteen named divisions and two named panels with designated persons as their respective chiefs. The Committee indicated that it would report at a later date with reference to the method of handling matters relating to physiology and psychology.

This was one of the few times when the Committee did not act unanimously, and Jewett’s dissent was concerned solely with the question of the adequacy of provisions for administrative work in the proposed new divisions and in the office of the Chairman. He believed that more adequate provision for the staffs of the divisions and of the Chairman should have preceded the establishment of new divisions.

Moreland, on November 10, 1942, wrote the persons who had been recommended as Division Chiefs to tell them of the recommendation and to state that when the reorganization had been approved and the Chiefs of the new divisions formally appointed, they would be asked to make recom-
mendations to the Chairman of NDRC as to the organization of their respective divisions. The recommendations would cover the number and scope of sections into which it was proposed to divide the work of the division. Personnel of the division would be made up of Section Chiefs as ex officio members and members at large appointed upon the recommendations of the Division Chief. The persons addressed were requested to proceed informally in order to be able to move promptly with the establishment of the new organization as soon as formal approval should be forthcoming. On November 10, Bush sent Conant a long letter of interpretation of the NDRC action. In it he indicated that he was prepared to work with Conant in steps to strengthen the Chairman's Office by adding to it a number of persons charged with the duty of closely following the affairs of groups of divisions. At the same time he gave his approval of the proposed reorganization to take effect at a future date when the stage had been set for it.

At its meeting on November 20, 1942, the Committee proceeded a step further in the reorganization by adopting principles of procedure to be followed after the reorganization was complete. Those principles recited that the Committee would meet every Friday. Reviewing subcommittees were appointed for each division and panel. Each reviewing subcommittee consisted of three members of the NDRC (later increased to four for some divisions). Divisions and sections were instructed to notify members of the appropriate subcommittees of all meetings, tests and demonstrations so that the members might attend such meetings as far as possible and thus keep in close touch with the activities of the division. Each reviewing subcommittee was directed to report at least twice a year on the activities of the division under review and in addition to make such brief reports from time to time as it might deem appropriate. At the meeting at which the reviewing subcommittee made its semiannual report, the Division Chief was also to report at length outlining the program he proposed for the division for the next six months together with a tentative budget. NDRC would approve the program as presented or with suitable modifications with the understanding that the approval was in principle only and that details of the budget would not be binding upon either the Committee or the division. In connection with each contract proposal, the Chairman's Office was instructed to report whether the proposed contract was a part of the program already approved by the Committee. In those cases in which the contracts were a part of the approved program, it was anticipated that no detailed discussion would be necessary in the absence of a specific request by a member of the Committee for such discussion. Each contract proposal for more than $20,000 involving a substantial departure from the approved program and total budget would be given special consideration with the Division Chief normally expected to appear before the Committee to explain the proposal. In order that they might be fully in-
formed it was stated that members of the Committee would have access to any and all reports and might visit any of the contractors.

Committee members were to have no executive authority or responsibility. All information concerning the progress of work was to flow to the Director of OSRD through the Chairman's Office and similarly, communications from the Director's Office and decisions on matters of policy should flow from the Director's Office through the Chairman's Office to the Division Chiefs. Administrative problems handled by the Administrative Office of OSRD would flow directly to the Division Chiefs.

The new organization was made effective as of December 9, 1942, for most of the divisions and panels and shortly thereafter for the remainder of the eighteen original divisions. Division 19 was added April 12, 1943. The Engineering Panel, one of the two original panels, was soon dropped in favor of the Engineering and Transition Office which was originally placed under the Director of OSRD but later became a part of the Office of the Chairman of NDRC. Matters of psychology, which had been reserved under the initial plan for reorganization, were turned over to the Applied Psychology Panel upon its creation on September 18, 1943.

**Functioning under the New Organization**

In practice, Division Chiefs submitted proposals for contracts so as to reach the Executive Secretary by 10 a.m. on Wednesday of each week. The proposals were given a preliminary review at a conference attended by the Executive Officer, Deputy Executive Officers, and staff aides of NDRC and the Executive Secretary. The proposals were then bound together and laid before the Committee on Friday, at which time the Executive Officer would invite particular attention to proposals which might seem open to question. In cases where urgency had been established by the Division Chief, the Committee by unanimous consent could give immediate consideration to a proposal just laid before it. The normal procedure, however, was for the proposals to lay over until the following Friday to give the members of the Committee an opportunity to analyze the proposals. It was not unusual for a Committee member upon reviewing a particular proposal to desire further information which he would seek from the Chairman's Office. When that proposal was called up for action, the Executive Officer either would have the requested information or he would have arranged for the Division Chief or a Technical Aide to appear in person before the Committee for further exposition of the proposal. Occasionally the Committee would have sufficient doubt as to the course of action it should take to ask the appropriate reviewing subcommittee to meet with the division and canvass the program in detail with a report back to the full Committee at a subsequent date.
The semiannual reviews of division programs threw a substantial burden upon members of the Committee. Each of the twenty-one divisions and panels presented its program to the appropriate reviewing subcommittee. Some days later the Division Chief accompanied usually by some members of his staff appeared before the full Committee to explain his program. In the course of the exposition, he reported upon the progress made since his last appearance before the Committee and answered such questions as the Committee wished to ask. He then proceeded to outline his program for the next six months and to present his estimate of the cost of carrying the program into effect. In a subsequent executive session the reviewing subcommittee would make its report based upon its analysis of the program, following which the Committee would approve the program with such modifications as it deemed desirable. The Division Chief was then informed of this approval and of the tentative allocation of a designated amount of money for his program for the six-month period. These allocations were normally made after the Committee had heard all of the division and panels.

In order that the divisional budgets might be on a comparable basis, the Committee normally crowded the twenty-one reviewing sessions into a two-week period which provided a very heavy schedule for the members, all of whom had other duties in addition to their membership in NDRC. In view of the pressure under which the program was being carried, it was obviously impossible for the division estimates to be exact. In practice, the Committee reserved approximately 10 per cent of its funds for allocation to emergency programs arising between the semiannual reviews and relied upon the underexpenditures on some budgets to counterbalance the overexpenditures on others to take care of programs which could not be covered by the 10 per cent margin. In this way the Committee kept fairly well on top of the budgetary situation without unduly restricting the initiative of the divisions.

A memorandum of general instructions dated November 23, 1942, emphasized the importance of suitable and adequate reports on the part of Division and Panel Chiefs in keeping the Committee informed.

The following five kinds of technical and scientific reports were required for the information of the Services as well as the Committee:

1. Bimonthly division and panel summaries. These were designed to give a clear over-all picture of the status of all projects in the division with special emphasis on progress during the period since the last report.

2. Contractor's progress reports. These were to be prepared as required by the contract or by the Division Chief within the terms of the contract, and were to be accompanied by a brief summary and comment prepared by the division or section.

3. Contractor's final report.
(4) Division and panel reports on special subjects as requested from time to time for the information of the Committee or the Services.

(5) Reports on service demonstrations and tests.

In addition, special reports were to be submitted as requested by the Chairman, the Director, or the Services (through the Chairman).

At the time of the reorganization it had been decided to require the submission of monthly administrative reports from the Division and Panel Chiefs to keep the Chairman and NDRC informed of the progress of the work, its cost and any significant developments that might justify further research along parallel or divergent lines. A re-examination of the situation a month later led to the conclusion that the other means of obtaining this information, such as the meetings of the reviewing subcommittees, were sufficient and hence the reports were not required.

Division Chiefs were required to see that notice of all proposed Service trials and tests (other than routine) of NDRC developments was sent to the Chairman's Office in order that arrangements might be made for representatives from that office as well as members of NDRC if they desired to attend the demonstration.

The operation of NDRC was described at some length by Conant in a memorandum to Bush on April 26, 1944. He pointed out that historically the divisions of NDRC were the basic units, with the basic decision on scientific policy and the immediate supervision of scientific results resting with them. The function of the NDRC itself was to review the judgment of the divisions by three different mechanisms: (1) specific contracts, (2) reviewing subcommittees, and (3) periodical reviews by the full Committee, usually with the Division Chief appearing before it. He concluded:

The ramifications of the research program being conducted under the National Defense Research Committee are obviously so great as to make it impossible for such Committee to have any detailed knowledge or pass detailed judgment on the week by week development. The Committee is able, however, to review the judgments of the individual divisions and to make suggestions to the divisions as to the conduct of their work and to the propriety of the contracts which they recommend. In particular, they must be concerned with the question of whether certain projects should be expanded or contracted or abandoned. The fact that the Committee includes an Army and Navy representative closely in touch with the research work of these Services enables the Committee to have available intimate knowledge of the Army and Navy programs in passing an over-all judgment on the recommendations of the separate divisions.

**EXPEDITED OR "CRASH" PROCUREMENT**

Prior to Pearl Harbor, and in the earlier phases of the war, Service project requests were predominantly requests for research and development. In the later phases of the war, many of the requests tended to become
emergency requests for the production of items on which the NDRC had already done research and development. Such requests in reality amounted to procurement for the Services but they were submitted sometimes in the form of "new projects" and more often in the form of extensions to existing projects. Finally these requests reached such proportions that it became necessary to review the whole problem administratively and to set up certain rules to regulate it. The resultant program was variously known as "crash procurement" and the "Red Ticket Program."

In May 1944 discussions were held by representatives of the NDRC with the Office of the Chief Signal Officer and the Navy Department for the purpose of reaching an agreement as to the conditions under which OSRD would accept such procurement. The definition agreed upon was "a small quantity production of an item which is urgently needed in the field and which can be completed or deliveries started several months in advance of the date when the manufacturer can commence production line deliveries."

It was agreed further that such procurement would be undertaken by the NDRC only upon receipt from the Services of assurance on the following points: (1) a statement from the using arm that sufficient military urgency exists within the Services to warrant Expedited Procurement by NDRC; (2) that the using arm cannot procure the desired equipment within the time required to meet the military urgency schedule as set up in (1), except through NDRC; (3) that transfer of funds will be available for this procurement.

In considering the acceptance of "crash procurement," the NDRC considered whether adequate manpower existed to produce the required equipment within the time specified and the procurement could be accepted without causing material interference to other projects of equal importance. The Army and Navy agreed that the expedited procurement programs should be given sufficiently high precedence ratings to make possible the satisfactory procurement of components to meet the desired delivery schedules.

The Director of OSRD felt very strongly that procurement by NDRC for the Services should be on a very restricted basis. In a letter of March 19, 1945, he expressed himself as follows:

It is my feeling that OSRD should not be called upon to act as a procurement agency for the Services, except in very unusual circumstances when we shall undertake small quantity production to meet advanced dates required by a military urgency, but rather that we should confine our activity to research and development as well as to act in a consulting capacity for the Services on the production of equipment.

The crash procurement program resulted in equipment getting into significant use at critical periods; from that standpoint it must be adjudged
a success. While it was resorted to in connection with developments of several divisions, it was most generally used in connection with rockets for the Navy and radar for both Army and Navy, in both of which cases the procurement ran well into the millions of dollars. The situation, however, was not a happy one for NDRC and OSRD, since it was one for which the agencies had not been intended and which required inefficient use of scientific manpower. Crash procurement hence was embarked upon reluctantly, and for the sole reason that there seemed no practical alternative which would deliver needed new equipment to the front as quickly.

Absence of such an alternative was not owing to lack of legal power on the part of the Army and Navy; both had the same powers as OSRD and more. The great size and complexity of organization necessary to the armed establishment in total war carried with them as an inevitable consequence both the necessity for mass procurement and also the necessity for extremes of specific detail which can be secured only at the expense of swift action. Service procurement procedures, built to obtain large numbers of definitely specified items, were highly effective in obtaining millions of identical objects which could be specified to the last detail; they were ineffective when the problem was one of securing a small number of items the detailed specification of which had not been worked out to the final decimal and which were wanted in a hurry. Had OSRD declined to enter the field of crash procurement, a revision of Service procurement procedures might have overcome this difficulty. Such revision would of itself have required time and might have delayed the delivery of critical equipment to the fighting fronts.

As a Committee it was possible for NDRC to advise Bush on matters of policy and to instruct its agents along broad lines. Obviously the detailed supervision of a research program could not be exercised by the Committee as such. The next two chapters will be devoted to the agents used by the NDRC in supervising the research program—the Chairman’s Office and the divisions.
CHAPTER V

NDRC OF OSRD: THE CHAIRMAN'S OFFICE AND THE ENGINEERING AND TRANSITION OFFICE

The Chairman's Office

In addition to presiding over its sessions, the Chairman of NDRC was the chief executive in charge of its operations. The role of the Chairman's Office was in an almost continual state of flux as a result both of the tremendous expansion of program and of the changing character of the program and of the organization itself.

In spite of the heavy demands on his time in connection with other war activities — the Rubber Survey Committee and the atomic bomb project among others — Conant made great personal contributions to NDRC, particularly in connection with policy matters, with anticipating needed changes in organization and steering the Committee through them, and with the selection of a staff effectively headed by Dean E. L. Moreland to handle the heavy burden of regular operations.

Initially there was no Chairman's Office organization as such. The civilian members of the Committee as Chiefs of the NDRC divisions assumed responsibility for the administration of the programs within their respective fields, except as the contractual and business arrangements were handled by the Executive Secretary. With the acceleration of program following the entry of the United States into the war there was need for greater co-ordination of scientific and technical matters, especially in those fields which had not yet developed as the clear responsibility of one of the divisions or where there might be overlapping interests. Accordingly, additions were made to the staff of the Chairman's Office from time to time as need arose and suitable men could be found. Arranged in order of their appointment the following persons were members of the staff at one time or another: *

* In addition, the following persons were appointed as Consultants or Special Assistants to the Chairman for the purpose of assisting in the preparation of the Summary Technical Reports and the "long history" of OSRD (see Chapter XX) during 1945 and 1946; but they did not participate in the general operations of the Chairman's Office: Consultants: K. H. Condit, J. Rinchart; Special Assistants: L. H. Adams, J. C. Boyce, C. W. Bray, L. H. Farinholt, W. A. Noyes, Jr., H. Rowe.
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<td>George W. Bailey</td>
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<td>Ward F. Davidson</td>
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<td>R. W. King</td>
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<td>Marston Morse</td>
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<td>Louis Jordan</td>
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<td>L. W. Bass</td>
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<td>Wendell O. Gould</td>
<td>Special Assistant</td>
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* On detail from U. S. Army.

With his appointment as Executive Officer on August 10, 1942, Moreland moved to Washington and became the active executive head of NDRC. In establishing the position Bush had provided that the incumbent should exercise, under the direction of the Chairman, such functions of the Chairman of NDRC as executive head of NDRC as should be delegated to him by the Chairman and that he should represent the Chairman in his absence in all matters concerning NDRC business. Conant followed this up
on December 31, 1942, by delegating to Moreland all the executive powers and duties vested in him.

One function which steadily increased in importance was the assignment of Service projects to divisions for action. As established in June 1942, the procedure called for routing all Service requests to the Chairman’s Office for determination as to which division (or divisions) should be asked to consider the proposed work. To insure consistency in assignments, the responsibility for these decisions was vested in one person within the Office, initially the Executive Officer and later a Deputy Executive Officer.

In a memorandum on OSRD operations dated July 29, 1942, Bush stipulated that the supervision of work under contracts entered into pursuant to NDRC proposals should be the responsibility in the first instance of the division with which the proposal had originated and that the ultimate responsibility for decision on any questions involved should lie with the Chairman of NDRC, except for such matters as the latter believed to require final determination by the Director. The Chairman was made responsible for the co-ordination of the activities of groups working within NDRC on similar projects so as to achieve a minimum of duplication. It was thus made specific, as previously it had been understood, that the Chairman’s Office should provide the link which would minimize the delays and duplication resulting from the policy of compartmentalization of information. This carried the responsibility both for acting upon any requests for interdivisional projects to divisions for action. As established in June 1942, the procedure called for routing all Service requests to the Chairman’s Office for determination as to which division (or divisions) should be asked to consider the proposed work. To insure consistency in assignments, the responsibility for these decisions was vested in one person within the Office, initially the Executive Officer and later a Deputy Executive Officer.

A memorandum of general instructions was issued on November 23, 1942, to clarify the relation of the various parts of the organization to each other, as part of the reorganization then being effected. It stated that the control of the technical and scientific work done under a contract was the responsibility of the Chairman and Executive Officer of NDRC. In a later paragraph it also stated that when a contract had been executed or a letter of intent issued, the direction and control of the technical and scientific work became a responsibility of the Division Chief. The two statements can be reconciled on the theory that the Chairman received his authority from the Director and that he re-delegated (with the consent of the Director) to the Division Chief. When Conant reviewed the organization and distribution of functions of OSRD as far as NDRC was concerned in a memorandum of April 26, 1944, however, he considered the Division Chiefs as agents of the Director rather than of the Chairman of NDRC.
The reorganization of NDRC in December 1942, with the resultant increase in the number of divisions and the withdrawal of administrative duties from the members of NDRC, threw an increased burden on the Chairman’s Office, which, it will be recalled, Jewett was not satisfied it was equipped to handle. To meet this situation, primary responsibility for following the work of the new divisions was assigned to staff members as follows: Hovde, Divisions 3, 5 and 8; Davidson, Divisions 1, 2, 4, 7, 18 and the Applied Mathematics Panel; Chadwell, Divisions 9, 10, 11, personnel and relations with the Office of Strategic Services (this later was the field of Division 19); Jackson, Divisions 6, 12, 16 and 17; and Murray, Divisions 13, 14 and 15. These individuals operated in the name of the Chairman. They kept the Chairman and the Executive Officer informed of the activities of the divisions, and they interpreted to the divisions the policies of NDRC. They also worked closely with the Chairmen of the several reviewing subcommittees of NDRC.

From time to time special assistants were added to the Chairman’s Office to follow new activities until they could be fitted into the regular plan of NDRC operation. This was the case with L. P. Jordan, who followed metallurgical problems from May 1, 1942 to July 1, 1943, by which time Division 18 was well under way; L. W. Bass, who followed Quartermaster Corps problems from June 30, 1943 to June 12, 1944, when they were made the responsibility of a section in Division 11; and C. W. Bray, who followed psychological problems from July 24, 1942 to October 18, 1943, at which time the Applied Psychology Panel was set up. Information concerning the progress of work of the several divisions flowed to the Director of OSRD through the Chairman’s Office and, similarly, instructions and decisions on matters of policy flowed from the Director through the Chairman to the Division Chiefs.

The Chairman’s Office prepared the agenda for the biweekly Committee meetings. In preparation for these meetings, staff conferences were held on Wednesday before the Friday committee meetings for a preliminary review of contract proposals. Any additional details which the staff considered necessary for a full consideration of the proposed contracts were then procured by the appropriate staff member prior to the Committee meeting. Contract proposals originating in the divisions were normally presented to NDRC by the Executive Officer although in special cases either he or the Committee might invite the Division Chief to appear in person or by representative. To guard against delay in handling urgent contract proposals between Committee meetings, the Chairman and the Executive Officer were authorized to recommend to the Director contract authorizations not exceeding a stipulated amount, usually $100,000, between meetings, provided that at least one member of the Committee had given prior approval to each recommendation.
Activities of the Chairman’s Office were woven all through the operations of the divisions. Thus appointments of all NDRC personnel required the approval of that Office as did the distribution of reports. The semiannual divisional budget requests were reviewed; and the recommendations of the Chairman’s Office usually resulted in a downward revision of the requested funds because of the better picture of the over-all situation possessed by that Office. Based on this review and the action of NDRC, the Office prepared the justification of the NDRC portion of the OSRD budget estimates for presentation to the Bureau of the Budget and Congress.

In view of the progress of the war and the shifting of personnel, a reorganization of the Chairman’s Office took place in the spring of 1944. Designed to provide more effective service to the divisions, closer supervision of divisional programs and budgets, and greater assistance to the full Committee in its decisions on policies, it divided responsibility among Conant, Moreland and three Deputy Executive Officers as follows: Conant, Divisions 9, 10, 11; Moreland, Divisions 1, 2, 3, 4, 6, 7, 8 and 12; Davidson, Administration, Engineering and Transition Office, and Applied Mathematics Panel; Hogan, Divisions 5, 13, 14, 15, Vacuum Tube Development Committee and the Committee on Propagation; and Haskins, Divisions 16, 17, 18, 19 and the Applied Psychology Panel. There was a somewhat comparable assignment of divisions among the staff aides whose function it was to keep fully informed of the technical and scientific aspects of the work of the divisions and panels. In general, they limited their direct activities to the divisions to which they were specifically assigned but they were also charged with knowing as much as possible about what was going on in the other divisions so that as a group they might provide for cross fertilization between divisions.

The selection of Davidson to handle administration left the Executive Officer and the other Deputy Executive Officers free to devote more attention to the division programs and to broad policy matters. It also meant a considerable increase in the speed of handling the great volume of paper work necessarily involved in a program of the magnitude which the NDRC program had attained; it included such items as consideration of extension of time on contracts, assignment of Service projects to divisions, recommendation to the Director of the appointment of persons serving without compensation, general review of NDRC personnel requirements and appointments, review of budget requests, and general supervision of the Chairman’s Office. Davidson devoted full time to the task until December 1945, by which time the volume had declined substantially and Paul A. Scherer, Chief of the Engineering and Transition Office, was able to take it on in addition to his other activities.

In a memorandum dated May 24, 1944, to members, and Division and Panel Chiefs of NDRC, Bush outlined the functions of the Chairman’s Office
as follows: (1) It should keep NDRC fully informed as to the progress of the divisions in carrying out their programs. (2) It should supplement the work of the reviewing subcommittees in interpreting to the divisions the policies and programs of NDRC. (3) It should review any borderline matter handled by a division, that is, any matter not clearly within the established program and policy of NDRC, referring to NDRC important matters on which it might be in doubt as to policy. (4) It should recommend for consideration by NDRC policies which it considered advisable for general conduct of affairs in the field of research and development of instrumentalities of warfare. (5) It should insure that the divisions were properly constituted to carry out the functions delegated to them under contracts recommended by NDRC. There was a corresponding obligation on the Division and Section Chiefs acting as the technical representatives on contracts to keep in close contact with the Chairman’s Office.

The review of Service projects forced by the tightening manpower situation late in 1944 threw a substantial burden on the Chairman’s Office. Both new projects and those already under way were reviewed from the standpoint of priority and for their probable usefulness in the current war. The Committee consistently followed the recommendation of the Chairman’s Office in determining which projects would be continued.

With the cessation of hostilities there was no occasion for additional NDRC meetings and the Chairman was authorized to work out termination schedules within the framework of the OSRD demobilization program. Programs requested from the divisions and panels were reviewed and revised in the Chairman’s Office. One by one the division offices were closed as the technical work under contract was terminated, transferred to the Services or abandoned and the usual flow of reports diminished to a trickle. As each division folded, its residual work was transferred to a Division Administrative Group set up in the Chairman’s Office. Finally, the Chairman’s Office itself was terminated on December 31, 1946, and the Division Administrative Group was transferred to the office of the Executive Secretary of OSRD.

The position of the Chairman’s Office was one of great influence but relatively little power. The Division Chiefs were able men of high standing, leaders in the fields within which their divisions operated. They were accustomed to independence in research and felt little need for the interposition of any body between them and the NDRC. The fact that Conant and Moreland were recognized as leaders in their respective fields made it possible for the Chairman’s Office to wield great influence although they were careful not to take any position which might be construed as one of compulsion over the divisions. The Office was especially effective in keeping a program from being bogged down within a divi-
sion because of competition with other programs in that division, or because of the failure of a Section Chief or responsible section member to pursue it with sufficient vigor. With the staff aides keeping him well posted on the status of the various programs, Moreland was able by discussions (sometimes vigorous) with the Division Chiefs to dislodge programs which had been delayed. He was continually on the alert for ways to speed programs entrusted to the divisions.

Moreland also made a great contribution in the relations with the Services carried on through his Office. He participated in interminable conferences with officers of all ranks in both Services. He injected realism into the formulation of Service requests and was a vigorous advocate of the NDRC position with reference to the proper relations between the Services and the Committee. On the one hand he stimulated the Services to submit problems to NDRC and to make provision for adequate testing and use of the results of NDRC research, while on the other he stimulated the proper handling of those requests within the divisions.

The position of the Chairman’s Office was one in which tact combined at the proper times with a certain amount of vigor accomplished what authority and discipline could not have done. The opinions of Conant and Moreland carried weight because of their authors rather than because of any authority which they were in a position to or desired to exercise. The formal records of the Office and the administrative devices told in the preceding paragraphs fall far short of presenting a complete picture of what in fact was a substantial problem in human relations.

THE ENGINEERING AND TRANSITION OFFICE

In November 1941 the length of time which it took to put into use the new and improved military devices emerging from the laboratories prompted Bush to become interested in some aspects of production, particularly that of small quantities of what might be termed “custom made” apparatus. Some equipment of this type (certain radar is an example) was termed by Conant to be “catalytic,” because in small quantities it might produce a major military or naval effect.

Shortly before the attack on Pearl Harbor, Elihu Root, Jr., at Bush’s request formulated a plan for an organization headed by a special representative of the Director to be charged with responsibility for stimulating contracts by the Army and Navy for the production of devices which were ready to come from the laboratory. The group appointed in December 1941 pursuant to this recommendation and headed by F. S. Gordon (Vice-President, United States Pipe and Foundry Co.) as Special Assistant to the Director, was known colloquially as “few-quick.” It was intended that it would suggest to the appropriate officers of the armed services immediate
production by hand methods of specific devices as they were evolved. Where possible, such suggestions were to be accompanied by recommendations as to satisfactory contractors. In turn, the Army and Navy proposed to set up special procedures for contracting for such equipment. It was not intended that the usual orderly production of the same equipment should be in any way affected. The material obtained under the few-quick was intended as a stopgap to fill in before completely engineered materials became available by production methods.

The few-quick organization got off to a flying start with assurances of co-operation from Division Chiefs, Army, Navy, and WPB. The groundwork consisted of surveying and setting up a file on facilities and personnel of small organizations of all sorts distributed about the country. Informal contact was established with OSRD division, section, and laboratory personnel for the purpose of learning of developments at or near the completion stage. Recommendations of few-quick production facilities were offered them and the Services, together with any co-operation desired in establishing a suitable contact and prosecution of the actual construction of the devices.

Failure of the Services to set up the special procedures immediately resulted in OSRD undertaking to procure limited quantities of the new devices. A basic flaw in the scheme of operation soon became apparent. It was that physical duplication of the laboratory model of a device does not necessarily assure duplication of laboratory performance; in addition, extensive modifications of an engineering nature were sometimes necessary to enable the equipment to perform under other than laboratory conditions. Correction of this flaw entailed a change of concept for the few-quick operation, shifting the emphasis to procurement of engineering abilities as well as model shop facilities. Through close co-operation with the various technical, procuring, and using branches of the Services, a plan was set up whereby preproduction engineering and model shop production under the auspices of OSRD were followed, or possibly overlapped, by Service procurement at the same source. The "crash programs," in which OSRD during a later phase of the war served as a procurement agency for the armed forces in having equipment produced on time schedules otherwise impossible, were based on these principles.

At Bush's request Root made another survey of the transition function in March 1942. Following Root's report, Bush in April 1942 created a "Transition Office" under Gordon, reporting directly to him, which was to: (1) inform itself as to the available facilities for the production of materials or devices developed under OSRD auspices; (2) collect information regarding the status with respect to production of various OSRD research projects; (3) endeavor to obviate unnecessary overcrowding of particular facilities for engineering design and production; (4) arrange for the in-
roduction of engineers from producers satisfactory to the Services and to OSRD into the laboratories before the completion of research, so that the education of the producers might begin at an early stage; (5) assist in shortening the period between the satisfactory completion of tests and the placing of contracts by the Services, and (6) co-operate in arranging for the rapid hand production of limited quantities.

During most of 1942, the Transition Office served primarily in a staff capacity as an advisory and fact-finding agency in OSRD, with most of its work in the electronics field. Facility surveys, establishment of procedures with Army and Navy procurement offices for the placement of OSRD educational orders for radar equipment, and maintaining current information on critical materials for circular distribution in OSRD consumed most of the available man-hours.

In the middle of July, 1942, the Transition Office was transferred from the Director's Office to the Office of the Chairman of NDRC under Moreland as Executive Officer and an Engineering Office headed by F. T. Letchfield was created under the same authority. In the NDRC reorganization of December 1942, the Transition Office continued under Gordon and an Engineering Panel was established under Letchfield. The Engineering Panel consisted of appointees by the NDRC divisions from their own personnel. The Panel held a few meetings, but the heavy load of their own specific problems which its members were already carrying prevented its becoming a fully effective operating organization.

The general instructions to NDRC personnel, divisions, and panels issued on November 23, 1942, stated that the Transition Office should be consulted on all matters relating to the production on a small or large scale, or on planning for such production, of devices or materials developed under NDRC, with consultation to be inaugurated when research reached the point that a successful result appeared probable. While this established the position of the Office on all matters regarding production under NDRC auspices, lack of sufficient personnel prevented its covering the entire field.

During this period, individuals in the Transition Office were set up as specialists, each having specific cognizance of groups of loosely related fields of activity. At the appropriate time, the facilities of the Office were offered to assist in Service relations, selection of facilities, supervision of contract, and provision of materials, priorities, etc., for the specific job.

In March 1943, Gordon resigned on urgent demand for his return to the organization which had loaned his services originally. R. J. Woodrow was appointed Deputy Chief of the Transition Office and assumed its administration for several critical months. In November 1943, Paul A. Scherer became Chief of the combined Engineering and Transition Office, and the Engineering Panel was abolished. The activities of the Office, other
than in the field of electronics, were primarily in the nature of offering advice and information. Attempts were made to assemble lists of electronic components of devices under development by NDRC so that advance planning for production could be carried on, or the necessity of design change due to future unavailability of critical materials could be pointed out.

In the fall of 1943, the Office began to operate on a project basis, through aiding specific devices in the transition stage rather than offering advisory services on an over-all basis. This necessitated close contact for varying periods of time with each device going through this phase. A contract with New England Power Service Company provided for the supply, at the request of the Transition Office and under its supervision, of engineering, expediting, and administrative personnel for project work. The success of this method of operation led to the establishment of a large manpower pool, securing for the Office the services of personnel made available by several public utility companies. At the same time a central engineering group under E. M. Wagner was built up rapidly to cover various phases of electrical, mechanical, and electronic engineering.

A California branch of the Engineering and Transition Office was organized in April 1944. It operated as an entity on the West Coast, to initiate contacts and develop useful lines of endeavor with contractors and laboratories in that area. The California office continued on an expanding plane of usefulness until it was closed on December 31, 1945.

In June 1944, Woodrow resigned as Deputy Chief of the Transition Office to go to the Radiation Laboratory in connection with an urgent project of substantial magnitude. C. H. Schauer, who had been on the staff of the Office since the middle of 1942, was appointed Assistant Chief of the Engineering and Transition Office and served as second in command to Scherer in the direction of the combined offices and as active administrator for the Transition Office.

Originally established as few-quick with a staff of three, the Engineering and Transition Office prior to the war's end consisted of a full-time staff of about 50, an additional part-time group of about 20, and an available manpower pool of nearly 200. The assistance rendered to laboratories and the divisions concerned primarily with work in the electronic field was particularly valuable; there can be no doubt that its operations advanced the field use of many new devices of an electronic nature by days, weeks, and even months in some cases.

Two major factors continuously shaped and reshaped the evolution of the transition function. One of these was rooted in a fundamental of human nature: that feeling of the creator that only he can fully and effectively oversee the completion and perfection of his creation. The second stemmed from the lines of authority and responsibility within the OSRD-NDRC
organization. Responsibility for expenditure of funds and for results rested squarely on the Division Chief at all times. As a result, while he could delegate his authority for supervision of few-quick or transition type of work to another group, he could not delegate his ultimate responsibility. It was necessary to assure the Chief of each division for whom transition work was undertaken not only of the ability of the transition group but also of its responsibility to him for work undertaken on his behalf.

The Chairman’s Office (which later included the Engineering and Transition Office) was an essential part of the NDRC organization, providing that minimum of central supervision necessary to hold together, however lightly, the highly diversified and rapidly expanding research and development program. That program was largely shaped within the divisions and panels, the organization and operations of which are discussed in the next chapter.
CHAPTER VI

NDRC: THE DIVISIONS, PANELS AND COMMITTEES

The story of success of NDRC as an agency for the development of instruments and weapons of warfare is primarily the story of the divisions, which were the operating units through which partnership of military and scientific men was consummated. The story has been told with the broadest sweep in the outcome of the war. Releases by the Services have recounted many specific aspects of it. In the case of most divisions, it is being preserved in volumes written by persons attached to the divisions. For a brief account of the major accomplishments of NDRC, fortunately there already exists the well written and informative volume prepared by President James Phinney Baxter, 3rd, of Williams College, entitled Scientists Against Time.

The story of the results obtained through the activities of the divisions, panels and committees is well worth the reading. President Baxter’s volume contains a fascinating overview. While it would require a hardy soul (and a considerable amount of time) to read all the divisional histories being prepared for publication, specialists in the various fields covered who are interested from the standpoint either of military research or of subject matter broadly will find one or more of the volumes on the “must” list.

The speed which was the keynote of NDRC operations was possible only through decentralization of the scientific program. Having picked capable men as Division Chiefs, NDRC gave them wide latitude in the formulation and execution of their respective programs subject to general supervision by the Committee. In the present volume, written from the standpoint of administration rather than from that of accomplishment, only a generalized account of the divisions can be given. There was considerable variation in the methods of their operation, which will appear from a perusal of the histories of divisional activities. Every activity of the central office was predicated upon the existence of the divisions and every procedure reported in the present volume tied into the divisions at some place. No attempt will be made here to single out all the things the divisions did; rather the present chapter will be confined to matters concerning the divisions which are not included as a matter of course in the operations reported elsewhere.
GENERAL ORGANIZATION

The reorganization of NDRC which took place in December 1942 has already been described. That reorganization became effective as of December 9, 1942, for most of the divisions and for the remainder shortly thereafter. Nineteen divisions and two panels were formed as a result of the reorganization and several special committees operating outside the divisional framework were created as the need for them appeared.

The Division Chief was the administrative and executive head of a division, responsible for its organization and operation, a task which experience showed to require full time in most cases. Initially he recommended the establishment of sections within the division and nominated members of the division, section chiefs, and members of sections. In administering the division he was instructed to take into account the general policies laid down by the Director and the NDRC, the scope of particular contracts and the general guidance of and any special emphasis recommended by the division members. At least one member of each division handling matters calling for engineering skill in a prominent manner was required to be an engineer familiar with the engineering and production problems in the division's field of operation. Those divisions requiring extensive mathematical investigations, computing, or statistical work included in their membership at least one person, nominated in consultation with the Chief of the Mathematics Panel, who also served as a member of that panel.

Cross membership between divisions concerned with common or closely related problems was permitted; but the rule of compartmentalization of information applied, and persons who were members of more than one division were instructed to divulge only pertinent and necessary information on the work of one division to the members and workers in another division. Where joint division action seemed advisable, arrangements for it were made through the Chairman's Office.

The position of a Panel Chief was comparable to that of a Division Chief. An important function of the panels was to provide expert consulting service to the divisions. In addition, they carried out such studies in various fields, including the performance of equipment in service, as were authorized through appropriate projects.

It will be recalled that projects could be initiated by the Army, the Navy, a lend-lease government or by OSRD itself. Regardless of how a project was initiated, the divisions and sections were responsible for formulating a program for its prosecution, proposing suitable contractors and determining the approximate cost and duration of the work. Every contract was required to be recommended by a section with the approval
of the Division Chief, or by a division. The recommendation was based upon a consideration of the program, the available contractors and the equitableness of the contract. The proposed program and resulting contract proposals were then considered by NDRC which normally recommended them to the Director for action. In the case of projects where there was a question as to policy or justification, the Division Chief in person, with such aid as he chose to bring, presented the proposal to NDRC and was subject to questioning by the members. In the case of a project of small magnitude or one not involving questions of policy or justification, the Executive Officer of NDRC submitted the proposal on the basis of information furnished by the Division Chief.

In some divisions, individual members undertook to follow the work under particular contracts, but in most cases the primary supervision of contract operations was the task of the Technical Aides who were full time employees selected for this purpose. The Technical Aides ranged from young scientists whose task it was to operate under the eyes of their seniors to older men of distinction equal to that of the Division Chiefs. Taken as a whole the Technical Aides were an exceedingly capable group who deserve a large share of the credit for the successful execution of the broad policies laid down by the Director and the NDRC.

All divisions and panels held meetings, for the most part at monthly intervals, although each division made its own decisions as to the frequency of meetings. At some meetings Army and Navy Liaison Officers were in attendance; and the division sought to bring them up to date on the progress of research projects, to get Service views on specific aspects of the various programs and to get information about operational aspects of new developments. Other meetings were held with only division members and Technical Aides present; these afforded opportunity for searching reviews of the details of particular projects as well as for vigorous discussion of directions in which the division was, or should have been, headed. Technical Aides or members following particular contracts reported on developments since the last previous meeting and were instructed as to future lines of research.

Newly submitted projects were reviewed at the divisional meetings and the recommendations of the Division Chief as to lines of attack and potential contractors discussed at length. In the case of prospective academic contractors, the discussion frequently hinged around the relative competence of particular investigators who were available for additional war work. Through the attendance of members of its staff, the NDRC Chairman’s Office acquired information useful both in assessing the divisional program and in discussions of divisional proposals when they reached the NDRC.

In some cases the divisional meeting was the battleground upon which
the controversy over the relative urgency of various projects was waged. The normal tendency of each man to assign top urgency to the problem upon which he is engaged was true of Technical Aides following different aspects of the same general program; it was even more true of the Army and Navy Liaison Officers when their projects were in competition for the same manpower. The monthly divisional meetings afforded opportunity for periodic review of urgency ratings and contributed to keeping attention focussed on problems of greatest urgency.

One important function of the division was the preparation of the divisional budgets which were reviewed by the NDRC and, as modified, became the basis of the NDRC portion of the OSRD budget. These budgets were prepared at six-month intervals and they required an assessment of the projects under way as well as those which might reasonably be expected within the next budget period.

The main work of a division was done between meetings. Divisional staffs varied in size, with each Chief being given as much technical assistance as he required, within the limits imposed by the shortage of scientific manpower. Some divisional programs were carried out through large central laboratory contracts with a few smaller supporting contracts; others involved many widely scattered contracts. The type of divisional organization varied with the type of work done by the division. Some divisions had no sections, with all programs being reviewed by the entire division membership. Others had sections with varying amounts of autonomy. Where there were sections, the statements made about divisional activity apply as well to the activity of the sections. Close supervision of contracts was a function of the section concerned, although the division meeting afforded an opportunity for the division members to review sectional programs at length.

The first contact with a potential contractor was usually made by the Division Chief, accompanied by the Technical Aide who would be assigned to the immediate supervision of the contract if one were to be written. This contact was normally with the research director in the case of an industrial establishment or the appropriate department head in the case of an academic institution; he might be accompanied by one or more technical people who would be involved in the research program. The OSRD representative would outline the desired program and the reasons for its urgency. In the later days of OSRD operations when scientific manpower was at a premium, the real job was to convince the research director that the proposed program was more important than some of the things his staff was presently engaged upon. When agreement had been reached to proceed with the program, various persons familiar with the problem were brought into the discussion, and the program was planned jointly by divisional and contractor's personnel. The contractor’s monthly progress reports, supplemented by visits to the plants by the Technical Aide and occasionally the
Division Chief and others, served to keep the division apprised of the progress being made by the contractor.

While the NDRC retained the exclusive right to make recommendations to the Director with reference to NDRC activities, it respected the autonomy of the divisions. No attempt was made to force a program upon a division contrary to its best judgment, though upon occasion the Committee would suggest lines of approach which were adopted by a division when it was impressed with the reasoning behind the suggestions. At varying intervals Division Chiefs appeared before reviewing subcommittees of the NDRC and before the Committee itself to present their programs in their entirety, reciting accomplishments to date and outlining plans for the future. Upon occasion, the Committee withheld its approval from particular lines of action or from particular contracts, but in the main the divisions could be fairly confident that the programs which they recommended would be approved by the NDRC. This was in part a reflection of the care with which the Division Chiefs and members were originally selected.

For several months prior to the end of hostilities the civilian members of NDRC were impressed with the need for making plans for the eventual demobilization of the Committee and they reviewed each proposal from a division from the standpoint of its probable eventuation in a form which would be useful in the war against Japan. This, of course, involved an assumption as to the date upon which the war with Japan would end and upon that the Committee never definitely committed itself. However, the fact that the Committee took this point of view undoubtedly influenced the proposals presented by the divisions as it was quite apparent that the Committee was more receptive to programs which would be completed in a relatively short time than it would be toward longer range programs.

This attitude of the Committee, however, was not a completely new one to the divisions inasmuch as for some months previously, the problem of scientific manpower had become so acute that the Committee was insisting upon the concentration of effort in areas which promised results in time to be useful against Japan. Exceptions were made in a few cases for projects of fundamental importance where the Committee was persuaded that the project possessed a long range importance which justified the diversion of scientific manpower from projects promising more immediate results.

The great autonomy allowed divisions was designed to permit the freest possible play of the scientific imagination of competent scientists upon problems of military research. Review by the NDRC and the Director acted as a curb upon the excessive zeal of the protagonist, by requiring the program to pass the scrutiny of equally competent scientists with a better view of the over-all defense picture. The problem of the administrative side of OSRD was to fit all this within the long established framework for the expenditure of public funds.
RÉSUMÉ OF ACTIVITIES

To give in detail the jurisdiction of all the divisions and panels and to pay proper credit to all the individuals who contributed to their programs is beyond the compass of the present volume. All that will be attempted here is to indicate generally the primary field of activity of each division and panel, and to name the Division, Panel, and Section Chiefs, together with their Deputy Chiefs. Unfortunately this requires the omission of the names of many of the men who contributed in large measure to the excellent work of the divisions with which they were associated; but this omission will be atoned for by the divisional histories where due acknowledgment can be made for their contributions.

The United States had been at war approximately one year when the reorganization took place. For the most part the divisions took over the active programs of the sections from which they developed. The authorizations for the fiscal year ending June 30, 1945, were somewhat lower than the estimates for the same period due to the collapse of Germany. The effect of the end of hostilities with Japan is apparent from a comparison of the estimates for the eight months period beginning July 1, 1945 (prepared while the war was still on) and the actual expenditures for the fiscal year beginning on that date. With the end of hostilities the OSRD demobilization program began in earnest, and only those expenditures were approved which fitted into the demobilization pattern.

The activities of the several divisions, panels and committees are described briefly in the following paragraphs. The scale of those activities is indicated by the amounts of the contract funds that were authorized by OSRD on their recommendations. Each division was in existence from December 9, 1942 to June 30, 1946, except that Division 19 was not organized until April 12, 1943 and Division 12 was terminated on June 30, 1945.

DIVISION 1

Title: Ballistic Research
L. H. Adams, Chief
H. B. Allen, Deputy Chief

Division 1 was concerned primarily with studies of the control of gun erosion, involving the causes of erosion and the use of erosion-resistant materials, and the development of hypervelocity guns. Erosion of gun barrels presents a serious problem to the military services. A decrease in erosion simplifies the problem of maintenance and makes possible the use of higher velocities which increases accuracy of fire against moving targets and improves armor penetration.

The scale of the division’s activities is indicated by the following authorizations upon its recommendation:
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January 1, 1943, to June 30, 1943 $665,000.00
July 1, 1943, to June 30, 1944 $1,723,000.00
July 1, 1944, to June 30, 1945 $2,669,500.00
July 1, 1945, to February 28, 1946 (estimated) $1,280,000.00
July 1, 1945, to June 30, 1946 (actual) $269,684.84

Division 2

Title: 1. Structural Defense and Offense (December 9, 1942 — August 15, 1944)
2. Effects of Impact and Explosion (August 15, 1944 — June 30, 1946)
John E. Burchard, Chief, December 9, 1942 — June 3, 1944
E. Bright Wilson, Chief, June 3, 1944 — March 15, 1946
Eugene W. Scott, Acting Chief, March 16, 1946 — June 30, 1946
Walker Bleakney, Deputy Chief, December 9, 1942 — September 1, 1945

Division 2 studied theoretically and experimentally the effects of explosive waves in air, earth and water and the effects of explosions and of projectiles on targets such as armor plate or pillboxes. It also handled a number of problems bearing on the design of specific weapons as a result of the basic knowledge it acquired. The original emphasis was on defense but with the progress of the war the effort was focussed on determining the best means of destroying enemy defenses and industrial targets.

Authorizations:

January 1, 1943, to June 30, 1943 $370,202.29
July 1, 1943, to June 30, 1944 $639,500.00
July 1, 1944, to June 30, 1945 $1,459,155.59
July 1, 1945, to February 28, 1946 (estimated) $479,000.00
July 1, 1945, to June 30, 1946 (actual) $232,500.00

Division 3

Title: 1. Special Projectiles (December 9, 1942 — September 15, 1944)
2. Rocket Ordnance (September 15, 1944 — June 30, 1946)
John T. Tate, Chief, December 9, 1942 — July 15, 1943
C. C. Lauritsen, Acting Chief, July 15, 1943 — September 6, 1943
Frederick L. Hovde, Chief, September 6, 1943 — June 30, 1946

Section H
C. N. Hickman, Chief, September 30, 1943 — June 30, 1946
R. E. Gibson, Deputy Chief, September 30, 1943 — December 31, 1943

Section L
Frederick L. Hovde, Acting Chief, September 30, 1943 — June 30, 1946
Division 3 engaged in rocket development as essential to the development of specific rocket weapons. It studied interior and exterior ballistics of rockets, carried out basic research on rocket powders, including methods of processing, and developed designs of rocket launchers. A considerable portion of the funds available to the division between 1943 and 1945 was transferred by the Services to the OSRD because of the speed with which the division could arrange for the procurement of substantial quantities of rockets, launchers and accessories.

Authorizations:

<table>
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<td>$3,321,000.00</td>
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<tr>
<td>July 1, 1945, to June 30, 1946 (actual)</td>
<td>$349,000.00</td>
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**Division 4**

**Title:** Ordnance Accessories  
Alexander Ellett, Chief

The major activity of Division 4 was the development of more effective types of fuzes for bombs, rockets and mortars.

Authorizations:

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<th>Period</th>
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<td>July 1, 1944, to June 30, 1945</td>
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<td>July 1, 1945, to February 28, 1946 (estimated)</td>
<td>$1,890,000.00</td>
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<td>July 1, 1945, to June 30, 1946 (actual)</td>
<td>$62,623.20</td>
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**Division 5**

**Title:** New Missiles  
H. B. Richmond, Chief, December 9, 1942 — January 2, 1945  
Hugh H. Spencer, Deputy Chief, June 22, 1944 — January 2, 1945  
——, Chief, January 2, 1945 — June 30, 1946

Section 5.1 Washington Project (December 9, 1942 — May 1945)  
H. L. Dryden, Chief

Section 5.2 Pittsburgh Project (December 9, 1942 — May 1945)  
L. O. Grondahl, Chief

Section 5.3 Block Equipment (December 9, 1942 — May 1945)  
O. E. Buckley, Chief, December 9, 1942 — June 27, 1944  
Pierre Mertz, Chief, June 27, 1944 — May 7, 1945
Division 5 was concerned with the development of special bombs which could be controlled after their release from the bomber or which had some form of automatic target-seeking mechanism to guide them to their objective. The work included both the development of the vehicle and the development of controls.

Authorizations:

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<td>July 1, 1945, to June 30, 1946 (actual)</td>
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Division 6

Title: Subsurface Warfare

John T. Tate, Chief

Division 6 was primarily concerned with the field of subsurface warfare. Its original emphasis was upon means, methods and devices useful in anti-submarine warfare. As the submarine menace in the Atlantic came under control, the emphasis of the division was shifted to pro-submarine activities.

Authorizations:

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<td>July 1, 1945, to June 30, 1946 (actual)</td>
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Division 7

Title: Fire Control

Harold L. Hazen, Chief

Section 7.1 Surface Systems

Duncan J. Stewart, Chief
Section 7.2 Airborne Systems
S. H. Caldwell, Chief

Section 7.3 Servomechanaisms
E. J. Poitras, Chief

Section 7.4 Optical Range Finders
Thornton C. Fry, Chief, December 9, 1942 — January 11, 1944
P. R. Bassett, Chief, January 11, 1944 — May 31, 1946

Section 7.5 Fire Control Analysis (January 11, 1943 — April 1, 1945)
Warren Weaver, Chief

Section 7.6 Seaborne Fire Control (November 16, 1943 — June 30, 1946)
I. A. Getting, Chief

The field covered by Division 7 included directors for airborne, land based and shipborne uses; servomechanisms for transmitting data to and from the guns and for elevating and traversing the guns; special range finders and testing equipment for assessing aerial gunnery and for evaluating the performance of directors, and the development of gun sights for special purposes.

Authorizations:

January 1, 1943, to June 30, 1943 $2,627,701.00
July 1, 1943, to June 30, 1944 $1,626,585.00
July 1, 1944, to June 30, 1945 $2,952,621.00
July 1, 1945, to February 28, 1946 (estimated) $1,299,000.00
July 1, 1945, to June 30, 1946 (actual) $ 504,784.51

Division 8

Title: Explosives
G. B. Kistiakowsky, Chief, December 9, 1942 — February 15, 1944
Ralph A. Connor, Chief, February 15, 1944 — July 2, 1944
C. A. Thomas, Deputy Chief, December 9, 1942 — July 31, 1943

Section 8.1 Physical (December 9, 1942 — March 1, 1945)
C. A. Thomas, Acting Chief, December 9, 1942 — January 14, 1943
G. B. Kistiakowsky, Acting Chief, January 18, 1943 — February 15, 1944
Ralph A. Connor, Acting Chief, February 15, 1944 — March 1, 1945

Section 8.2 Organic (December 9, 1942 — March 1, 1945)
Ralph A. Connor, Chief, December 9, 1942 — February 15, 1944
J. R. Johnson, Chief, February 15, 1944 — March 1, 1945

Division 8 worked primarily on gun propellants, high explosives, shaped charges, special types of explosive weapons, propellants for rockets and jet propulsion, and a number of related projects.
Authorizations:

January 1, 1943, to June 30, 1943 $1,798,000.00
July 1, 1943, to June 30, 1944 $3,314,700.00
July 1, 1944, to June 30, 1945 $5,046,200.00
July 1, 1945, to February 28, 1946 (estimated) $1,942,000.00
July 1, 1945, to June 30, 1946 (actual) $921,048.16

Division 9

Title: Chemistry
Walter R. Kirner, Chief

Divisions 9 and 10 worked closely together and divided the field of chemical warfare between them. In the main, Division 9 concentrated on the offensive aspects, investigating the possibility of developing new agents and working on problems of detection and analysis; in addition it worked on the impregnation of clothing for protection against poison gas.

Authorizations:

January 1, 1943, to June 30, 1943 $1,356,172.87
July 1, 1943, to June 30, 1944 $2,219,988.00
July 1, 1944, to June 30, 1945 $1,068,300.00
July 1, 1945, to February 28, 1946 (estimated) $278,000.00
July 1, 1945, to June 30, 1946 (actual) $53,768.15

Division 10

Title: Absorbents and Aerosols
W. A. Noyes, Jr., Chief

Section 10.1 Protective Devices (July 13, 1944 — September 30, 1945)
W. C. Pierce, Chief

Under the division of fields with Division 9, the work of Division 10 in the field of chemical warfare was largely devoted to the defensive problem of developing absorbents for chemical warfare gases. In addition, it engaged in fundamental studies of aerosols, the behavior of gas clouds and the development of screening smokes and smoke generators.

Authorizations:

January 1, 1943, to June 30, 1943 $999,900.00
July 1, 1943, to June 30, 1944 $1,634,000.00
July 1, 1944, to June 30, 1945 $849,539.30
July 1, 1945, to February 28, 1946 (estimated) $300,000.00
July 1, 1945, to June 30, 1946 (actual) $40,800.94
**Division II**

Title: Chemical Engineering  
R. P. Russell, Chief, December 9, 1942 — March 1, 1943  
E. P. Stevenson, Chief, March 1, 1943 — March 1, 1945  
H. M. Chadwell, Chief, March 1, 1945 — June 30, 1946

Section 11.1 Oxygen Problems  
E. P. Stevenson, Chief, December 9, 1942 — May 2, 1944  
John R. Rushton, Chief, May 2, 1944 — May 31, 1946

Section 11.2 Miscellaneous Chemical Engineering Problems  
T. K. Sherwood, Chief

Section 11.3 Incendiaries and Petroleum Warfare  
E. P. Stevenson, Chief, December 9, 1942 — December 22, 1942  
Norval F. Myers, Chief, December 22, 1942 — April 1, 1943  
H. C. Hottel, Chief, April 1, 1943 — May 31, 1946

The chemical engineering problems handled by Division II included among others the development of oxygen-producing equipment, incendiaries, fuels and equipment for flame throwing, hydraulic fluids for various special applications, oxygen masks and photoflash bombs for aerial photography.

Authorizations:

- January 1, 1943, to June 30, 1943 $2,801,500.00
- July 1, 1943, to June 30, 1944 $3,450,250.00
- July 1, 1944, to June 30, 1945 $2,903,564.72
- July 1, 1945, to February 28, 1946 (estimated) $580,000.00
- July 1, 1945, to June 30, 1946 (actual) $60,908.81

**Division 12**

Title: Transportation Development  
Hartley Rowe, Chief

Section 12.1 Nocturnal Logistics (February 10, 1943 — July 1, 1943)  
H. E. Ives, Chief  
On July 1, 1943, Section 12.1 was superseded by Section 16.5 with Dr. Ives as Chief.

Section 12.2 Turning Basin (February 18, 1944 — February 12, 1945)  
W. F. Durand, Chief

The principal attention of Division 12 was devoted to the development of various combat vehicles, including the ¼-ton amphibious jeep, the 2½-ton amphibious truck popularly known as the “Duck,” the snow vehicle known
as the "Weasel," and a modified amphibious "Weasel" for the use of rescue parties in mud, swamps and other difficult terrain. In addition, the division operated a large model basin where tests were made on the turning characteristics of naval vessels, on marine propulsion problems and on power boat hull design.

Authorizations:

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**Division 13**

**Title: Electrical Communication**

C. B. Jolliffe, Chief, December 9, 1942 — April 21, 1944

Haraden Pratt, Acting Chief, April 21, 1944 — February 10, 1945

———, Chief, February 10, 1945 — June 30, 1946

Section 13.1 Direction Finding (December 9, 1942 — July 6, 1944)

Loren F. Jones, Chief

Section 13.2 Radio Propagation Problems (December 9, 1942 — July 6, 1944)

J. H. Dellinger, Chief

Section 13.3 Secrecy (December 9, 1942 — July 6, 1944)

R. K. Potter, Chief

Section 13.4 Special Communications Problems (December 9, 1942 — July 6, 1944)

C. A. Priest, Chief, December 9, 1942 — September 25, 1943

Section 13.5 Precipitation Static (December 9, 1942 — July 6, 1944)

Haraden Pratt, Chief

Section 13.6 Miscellaneous (December 9, 1942 — July 6, 1944)

D. G. Little, Chief

Section 13.7 Systems (February 23, 1943 — July 6, 1944)

A. B. Clark, Chief

The principal activities of Division 13 were in the field of direction finding, radio propagation, speech secrecy, very high-frequency transmission and technical problems of communications system layout and organization.

Authorizations:

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<th>Date Range</th>
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<tr>
<td>July 1, 1945, to June 30, 1946 (actual)</td>
<td>$61,548.38</td>
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D\textsc{ivision 14}

Title: Radar  
Alfred L. Loomis, Chief

Section 14.1 R. C. C. Model Shop (December 9, 1942 — April 6, 1944)  
Melville Eastham, Chief

Section 14.2 Navigation (December 9, 1942 — April 6, 1944)  
Melville Eastham, Chief

Division 14 served as the focal point of research and development in the microwave radar field. In addition to fundamental research on and basic development of radar, the division devoted a major part of its effort to the design of equipment to meet particular military problems and to the more effective use of equipment already made. The division supervised a radar laboratory established in England which worked in close co-operation with the Eighth Air Force. A substantial part of the funds allocated to the division between 1943 and 1945 is accounted for by transfers to OSRD from the Army and the Navy for the procurement of radar equipment which the division could obtain more rapidly than the Services.

Authorizations:

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<td>July 1, 1945, to June 30, 1946 (actual)</td>
<td>$303,519.31</td>
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D\textsc{ivision 15}

Title: Radio Co-ordination  
C. G. Suits, Chief  
J. H. Moore, Deputy Chief

The work of Division 15 fell into two general fields: developing countermeasures against enemy radio communications, radar and guided missiles; and determining the susceptibility of American equipment to enemy jamming or countermeasures and pointing ways to designing less susceptible equipment. Countermeasures took the form of “jamming” (sending out signals of such strength and character as to mask the wanted signals) or the form of a decoy or false signal of some kind. The division supervised the operation of a laboratory in England working in continuous contact with the Eighth Air Force.
The work of Division 16 embraced optical instruments including aerial cameras, glasses and glass substitutes, camouflage materials and camouflage detecting methods and various other devices.

Authorizations:

January 1, 1943, to June 30, 1943  $ 1,592,700.00
July 1, 1943, to June 30, 1944  $ 2,018,350.00
July 1, 1944, to June 30, 1945  $ 2,078,200.00
July 1, 1945, to February 28, 1946 (estimated)  $ 727,000.00
July 1, 1945, to June 30, 1946 (actual)  $ 234,675.63

Division 16

Title: Optics
George R. Harrison, Chief
Paul E. Klopsteg, Deputy Chief, March 15, 1945 — June 30, 1946

Section 16.1 Optical Instruments
Theodore Dunham, Jr., Chief

Section 16.2 Illumination and Vision (December 9, 1942 — October 1, 1943)
Brian O’Brien, Chief, December 22, 1942 — October 1, 1943
(Consolidated with 16.5)

Section 16.3 Camouflage
A. C. Hardy, Chief, December 9, 1942 — April 23, 1945

Section 16.4 Infrared
O. S. Duffendack, Chief

Section 16.5 Nocturnal Logistics (Transferred from Division 12, Section 12.1 on July 1, 1943)
H. E. Ives, Chief, July 1, 1943 — October 11, 1943
W. E. Forsythe, Deputy Chief, July 1, 1943 — October 11, 1943
(Consolidated with 16.2 in October 1943)
W. E. Forsythe, Chief, October 11, 1943 — June 30, 1946
Brian O’Brien, Deputy Chief, October 11, 1943 — January 31, 1946

Authorizations:

January 1, 1943, to June 30, 1943  $ 5,974,000.00
July 1, 1943, to June 30, 1944  $12,253,880.00
July 1, 1944, to June 30, 1945  $ 8,002,070.00
July 1, 1945, to February 28, 1946 (estimated)  $ 3,142,000.00
July 1, 1945, to June 30, 1946 (actual)  $ 113,000.00
Title: Physics
Paul E. Klopsteg, Chief, December 9, 1942 — March 14, 1945
—, Deputy Chief, March 15, 1945 — June 30, 1946
George R. Harrison, Chief, March 14, 1945 — June 30, 1946
E. A. Eckhardt, Deputy Chief, December 9, 1942 — March 14, 1945

Section 17.1 Instruments
E. A. Eckhardt, Chief
H. E. Bragg, Deputy Chief

Section 17.2 Electrical Equipment (December 9, 1942 — August 14, 1945)
I. M. Stein, Chief
(Consolidated with 17.1 August 14, 1945)

Section 17.3 Acoustics
Harvey Fletcher, Chief

The investigations and developments of Division 17 embraced a wide range of physics problems in the field of instruments including, among others, land mine detectors, telemetering equipment and strain gauges for airplanes, testing the production, perception and control of sound in air (including sound ranging), and a concerted attack upon the problems of a combat information center in naval vessels.

Authorizations:

- January 1, 1943, to June 30, 1943: $1,967,369.52
- July 1, 1943, to June 30, 1944: $2,686,062.60
- July 1, 1944, to June 30, 1945: $2,775,783.95
- July 1, 1945, to February 28, 1946 (estimated): $761,000.00
- July 1, 1945, to June 30, 1946 (actual): $226,073.38

Title: War Metallurgy
Clyde Williams, Chief

Among the studies made by Division 18 were those on armor plate, gun steel and gun forgings, heat resistant alloys, and materials for aircraft construction, as well as the metallurgical examination of captured enemy matériel.

Authorizations:

- January 1, 1943, to June 30, 1943: $942,097.36
- July 1, 1943, to June 30, 1944: $1,387,725.00
- July 1, 1944, to June 30, 1945: $1,341,845.00
- July 1, 1945, to February 28, 1946 (estimated): $508,000.00
- July 1, 1945, to June 30, 1946 (actual): $122,685.10
Division 19

Title: Miscellaneous Weapons
H. M. Chadwell, Chief

Section 19.1 (February 15, 1944 — March 1, 1946)
G. A. Richter, Chief

Division 19 developed weapons and devices primarily for the Office of Strategic Services, for which it also supervised the work of a central research and development laboratory. The division called upon the other divisions of NDRC for assistance on problems relating to their specialties.

Authorizations:

April 1, 1943, to June 30, 1943 $788,500.00
July 1, 1943, to June 30, 1944 $878,500.00
July 1, 1944, to June 30, 1945 $726,500.00
July 1, 1945, to February 28, 1946 (estimated) $95,000.00
July 1, 1945, to June 30, 1946 (actual) $22,552.11

Applied Mathematics Panel
(December 9, 1942 — June 30, 1946)

Warren Weaver, Chief
Thorton C. Fry, Deputy Chief, January 30, 1943 — April 5, 1946

This panel was established to aid NDRC divisions and the Services by providing assistance in the handling of problems needing the special training of mathematicians.

Authorizations:

January 1, 1943, to June 30, 1943 $355,000.00
July 1, 1943, to June 30, 1944 $630,000.00
July 1, 1944, to June 30, 1945 $1,477,350.00
July 1, 1945, to February 28, 1946 (estimated) $443,000.00
July 1, 1945, to June 30, 1946 (actual) $60,500.00

Applied Psychology Panel
(September 18, 1943 — June 30, 1946)

W. S. Hunter, Chief, September 18, 1943 — September 1, 1945
Charles W. Bray, Chief, September 11, 1945 — June 30, 1946

The work of this panel fell into three general categories: (1) the development of tests to aid in the selection of military personnel for various spe-
cialized types of duty or for general classification purposes; (2) projects in connection with Army and Navy training programs including the development of details of training methods for particular tasks, and (3) projects concerned primarily with new equipment. The latter were designed in part to assist the equipment designer to lay out his equipment so that it would make the minimum demands on the abilities of the operator and in part to assist with the development of operational and instructional doctrine so that it would be ready for Service use when the equipment came off the production line.

Authorizations:

- September 18, 1943, to June 30, 1944: $658,000.00
- July 1, 1944, to June 30, 1945: $831,000.00
- July 1, 1945, to February 28, 1946 (estimated): $211,000.00
- July 1, 1945, to June 30, 1946 (actual): $53,502.53

**Vacuum Tube Development Committee**

(July 19, 1943 — March 27, 1945)

I. I. Rabi, Chairman

The endeavor of this committee was to co-ordinate and standardize the design and production of vacuum tubes, the diversity of which had become a considerable problem in production and procurement.

Authorizations:

- July 19, 1943, to June 30, 1944: $66,000.00
- July 1, 1944, to March 27, 1945: $45,000.00

**Committee on Propagation**

(January 22, 1944 — June 30, 1946)

C. R. Burrows, Chairman

This committee conducted a comprehensive study of radio wave propagation under varying atmospheric conditions and including a wide band of frequencies.

Authorizations:

- January 22, 1944, to June 30, 1944: $20,000.00
- July 1, 1944, to June 30, 1945: $360,000.00
- July 1, 1945, to February 28, 1946 (estimated): $315,000.00
- July 1, 1945, to June 30, 1946 (actual): $73,000.00
Tropical Deterioration Committee
(May 18, 1944 — June 30, 1946)

G. J. Esselen, Chairman

The task of this committee was to co-ordinate the work being done on tropic-proofing military and naval equipment and included the supervision of a number of fundamental studies and tests in the field.

Authorizations:

- May 18, 1944, to June 30, 1944: $43,000.00
- July 1, 1944, to June 30, 1945: $182,161.00
- July 1, 1945, to February 28, 1946 (estimated): $242,000.00
- July 1, 1945, to June 30, 1946 (actual): $ 7,192.08

Division Administrative Group

In May 1946, with the end of active division operations in sight, a small group of technical and clerical personnel was established as the "Division Administrative Group" in the Chairman’s Office to carry on the remaining activities of the divisions and panels. Consequently, on June 30 the divisions and panels were terminated. The DAG’s activities covered the same scope as the divisions, which by this time was largely one of terminating in an orderly manner the existing technical and administrative phases of the outstanding contracts and to prepare the division records in such a manner as to preserve the values attained by the divisions and their contractors.

These activities included obtaining the final technical reports from contractors and approving them for distribution; the examination and technical approval of vouchers; the technical recommendations for the disposal of property acquired under the contract; the recommendation of technical reports for declassification, as well as the arrangement of the files in such a manner as to preserve the valuable work accomplished by the divisions so that future reference to the subject work will enable one immediately to capitalize on the previous experience. The files of each division, when completed, were sent to the Central Records Section of the Administrative Division of OSRD for review prior to being transferred to the National Archives. When the Chairman’s Office was closed on December 31, 1946, the DAG was transferred to the office of the Executive Secretary of OSRD, where it functioned until it, too, was terminated on March 31, 1947.
CHAPTER VII

COMMITTEE ON MEDICAL RESEARCH

The Committee on Medical Research (CMR) was established as a principal subdivision of OSRD by Article 8 of Executive Order No. 8807 of June 28, 1941. As stated in that Article:

The Committee on Medical Research shall advise and assist the Director in the performance of his medical research duties with special reference to the mobilization of medical and scientific personnel of the nation. To this end it shall be the responsibility of the Committee to recommend to the Director the need for and character of contracts to be entered into with universities, hospitals, and other agencies conducting medical research activities for research and development in the field of the medical sciences. Furthermore, the Committee shall from time to time, on request by the Director, make findings and submit recommendations with respect to the adequacy, progress, and results of research on medical problems related to national defense.

The Committee consisted of four members appointed by the President and three others designated respectively by the Secretary of War, the Secretary of the Navy and the Administrator of the Federal Security Agency. The latter three were selected from the staffs of the respective Surgeons General with particular reference to their qualifications in the field of medical research.

The membership of the Committee was as follows: Alfred Newton Richards, Chairman (pharmacologist, University of Pennsylvania); Lewis H. Weed, Vice-Chairman (anatomist, Johns Hopkins University; Chairman, Division of Medical Sciences, National Research Council); Alphonse R. Dochez (professor of medicine, Columbia University); A. Baird Hastings (biochemist, Harvard University); Colonel (later Brigadier General) James Stevens Simmons (Chief, Division of Preventive Medicine, Office of the Surgeon General); Rear Admiral Harold W. Smith (Chief, Research Division, Bureau of Medicine and Surgery); Lewis R. Thompson, to November 1942 (Director, National Institute of Health); Rolla E. Dyer, from November 1942 (Director, National Institute of Health).

At its first meeting on July 31, 1941, the Committee requested Bush to appoint Weed as its Vice-Chairman and Stewart as Executive Secretary, and these appointments were made.

Although the practice varied somewhat from time to time, the Commit-
tee normally met every two weeks, with occasional meetings at weekly intervals or even more frequently when there was need. After the cessation of hostilities the Committee met infrequently until the meeting of January 20, 1947, which was adjourned sine die.

**Antecedent Committees Concerned with Medical Problems**

*Health and Medical Committee.* A Health and Medical Committee had been formed on September 19, 1940, under the Council of National Defense, to "co-ordinate health and medical activities affecting national defense." Two months later the Committee was transferred to the Federal Security Agency when the Administrator became co-ordinator of health, medical welfare, and related activities. The Committee concerned itself with the broader aspects of medical care as the roll of its subcommittees indicates: dentistry, medical education, hospitals, industrial medicine, Negro health, nursing. It formulated plans for the Office of Procurement and Assignment of Physicians and Nurses and made various recommendations for changes in medical school curricula, internships and residencies, deferment of medical students and enrollment of nurses. Although it lay within the province of the Health and Medical Committee to enter into contracts with educational and research institutions for studies and experimental investigations, the Committee decided to leave problems of medical research to the National Research Council. The Committee had made one contract with the National Academy of Sciences under which the Division of Medical Sciences of the National Research Council had initiated work in the field of aviation medicine.

*Division of Medical Sciences, National Research Council.* In May 1940, the Surgeon General of the Army requested advice from the Chairman of the Division of Medical Sciences on certain medical problems. In response to this request two committees were promptly formed to advise the Surgeons General in the field of transfusions and chemotherapy. As these committees met during the succeeding year and as further requests for occasional and continuing advice were received from the Services, additional groups were created. At the time the CMR was formed there were eight major committees and thirty-three subcommittees on military medicine.

These committees had performed important services for the Surgeons General. They made numerous recommendations regarding therapeutic procedures, particularly in chemotherapy and in venereal and tropical diseases. They assisted in revising the standards for physical examination of recruits (MR 1-9). They co-operated with the American Medical Association in preparing a roster of medical graduates and supplied an evaluation of specialists to the Surgeons General. To the Red Cross they gave
professional advice and supervision in the procurement of human blood plasma for the armed forces. In response to a request of the Services they commenced the preparation of six military surgical and three military medical manuals which were published in 1942 and thereafter. The Surgeons General designated Colonel (later Major General) Charles C. Hillman, Colonel (later Brigadier General) James Stevens Simmons, and Captain (later Rear Admiral) Charles S. Stephenson as their official representatives to the Division of Medical Sciences and medical officers were delegated to attend meetings of the various committees.

**Relations between CMR and NRC**

It was against this background that the CMR was formed. There existed an integrated and active organization within the NRC which had given advice to the Surgeons General for more than a year. It had been established for this advisory function and continued to exercise it throughout the war. In the course of this activity, members of the NRC committees had established cordial personal relationships with the representatives of the Surgeons General who attended their meetings and had become somewhat familiar with the questions and problems that faced the Services. It was clear at the outset, and became clearer as meetings succeeded one another, that many of these questions could not be answered *ex cathedra*, that many problems could not be solved without research. Devoting their time to a consideration of these matters, the several committees had evolved programs for research: some of them precise and detailed, some rather nebulous, all of them recognizing a common necessity. It had been impossible to embark upon this research with vigor because adequate funds were not available.

The major question of policy which confronted the CMR at its first meeting on July 31, 1941, was that of its relationship to the NRC. CMR would obviously need advice in the formulation of its program. It was perfectly free to seek this advice from individuals or committees of its own choosing. While it might have ignored the plans and the accumulated experience of the NRC committees, CMR decided to utilize the advice of these committees in formulating its own research plans, a decision which Bush approved. The Committee at once took several steps to formalize this relationship and make it a cornerstone of future policy. It established its working offices within the building occupied by the NRC at 2101 Constitution Avenue. It recommended a contract with the National Academy of Sciences to cover expenses incident to meetings of the NRC committees and the preparation and distribution of reports. CMR appointed the Chairmen of the eight major NRC committees on military medicine as Consultants. These Consultants met with CMR at its second
meeting on August 7, 1941, and outlined the research programs which they had planned or envisaged in their various fields. It was declared at that time that CMR would lean heavily upon the advice of the NRC committees and subcommittees in formulating its program and the Consultants undertook to inform their subcommittee Chairmen of the relationship between CMR and NRC and of their responsibility to initiate and recommend research projects.

From July 1941 till the end of the war, the NRC committees met frequently in Washington, the more active groups as often as once a month, to consider proposals for research in their special fields. The members attended these meetings regularly, with considerable interruption to their civilian responsibilities and with no financial compensation beyond traveling and maintenance expenses. As the requirements for research changed, expanding in many directions, contracting in some, the organization of the committees changed similarly. In August 1945, there were 12 major committees and 34 subcommittees with 315 members. The major committees, whose Chairmen served as Consultants to CMR, dealt with the following subjects: aviation medicine; chemotherapeutic and other agents; convalescence and rehabilitation; industrial medicine; information; medicine; neuropsychiatry; pathology; sanitary engineering; shock and transfusions; surgery, and treatment of gas casualties.

There were disadvantages to this relationship between CMR and NRC, stemming from the dual functions which the NRC committee members were required to exercise. They had been appointed by the NRC to NRC committees. Insofar as they sat around a table and formulated advice for the Surgeons General they were functioning in their capacity as members of the NRC committees. When, sitting around the same table, they recommended proposals for research to CMR, they were functioning as advisers or consultants of CMR. When they advised the Surgeons General on the basis of CMR research it would be difficult to define their capacity. This situation led to some confusion; several members of NRC committees went through the war only vaguely familiar with CMR, unaware that it paid the expenses of their meetings and incompletely aware that the ultimate responsibility and entire expense of the research program was its province. It is fair to say that this confusion was an annoyance rather than a hindrance to the success of the program and that it was minimized by general confidence in the integrity of the principals. Given the situation as it existed in July 1941, the collaboration was an obvious and desirable arrangement. The advantages outweighed the disadvantages by far. Initiation of research was expedited by months at a moment when time was of the essence. CMR gained the advice of several hundred men, who were specialists in their fields, already organized, and somewhat familiar with the needs of the military.
INITIATION AND IMPLEMENTATION OF THE RESEARCH PROGRAM

The assignment of CMR was to utilize the scientific resources of the country for medical research. The necessity for research in military medicine may, at first glance, seem less real than that in the weapons of warfare assigned to NDRC. Radar, the proximity fuze, and the atomic bomb are new and must be developed to be used. But the subjects of military medicine are the subjects of civilian medicine. Pneumonia is not new, nor malaria, nor burns, nor wounds, nor shock. Medicine has concerned itself with their physiology and treatment for years. To the extent that this is true, the role of CMR was relatively simple. It is considerably less than a half truth. The shift in emphasis and even in direction was enormous. Many subjects of minor importance in peacetime become of controlling importance in war. Some subjects are born of war. Tropical medicine had been considered of rather academic interest to the health of the United States. Even the machine age had not adapted our younger generation to flying at 40,000 feet or diving at 400 miles an hour. The necessity of medical research had been demonstrated by the expressed and visible needs of the Services. The Committee on Medical Research was established to resolve this necessity.

The Committee’s aims were to recognize the problems of military importance, to see that work upon them was undertaken by competent investigators in laboratories throughout the country, to support the investigations by Federal funds. In accomplishing the first of these aims, the Committee relied upon the personnel of the NRC committees with their Liaison Officers and upon its own staff. No list was ever published of subjects upon which the Committee wished investigations to be conducted; in classified fields such a list could only have been written in unprofitably vague terms; in unclassified fields the subjects seemed too obvious to require statement. During the first months of its existence, the Committee utilized the proposals which the NRC committees had formulated. Thereafter it relied upon laboratories, informed of the requirements by the NRC committees and its own staff, to initiate proposals. When these proposals were not initiated and when important subjects for investigation were neglected or under insufficient study, the Committee requested the personnel whom it regarded as most suitable for their performance to undertake them.

The investigations were usually implemented by contracts which involved their full support by Federal funds. Occasionally these contracts supplied only “token” funds. In certain fields CMR was able to “encourage” research without any formal contractual relationship or with contracts designed only to cover some particular point. These several arrangements will
be discussed in the succeeding paragraphs together with some problems of personnel which were incident to them.

Proposals for Contract. A form, known as a “proposal for contract,” was prepared in which the investigator was required: (1) to describe the subject of investigation with its background, present state of knowledge, significance in national defense and plan of attack; (2) to list its personnel, materials and financial requirements; (3) to state the investigative facilities available for the research; (4) to estimate its duration. The proposals were submitted by individuals, the so-called “responsible investigators,” from universities, hospitals, foundations, Federal agencies and commercial firms throughout the country. They were directed either to CMR or NRC but, in either event, were usually considered by the appropriate NRC subcommittees and parent committees before being presented to CMR.

Nine hundred fifty-one proposals for contract were examined by the NRC committees of which 638 were recommended to CMR with varying degrees of enthusiasm indicated by the grading “A,” “B,” or “C,” and 313 were disapproved. At first, rejection of a proposal was made final by NRC; later, as the incorrectness of this procedure was realized, responsibility for the rejection was assumed by CMR which uniformly upheld decisions of the NRC committees in this regard. CMR devoted a major share of the time at its meetings to scrutinizing the proposals which were recommended to it; regarding them from the point of view of their possible mediate or immediate effect in winning the war, their consistency with the program already in effect or projected, their personnel and budgets. It approved 501 of the 638 proposals recommended to it by the NRC; a majority of those which it declined had received “B” or “C” ratings by the NRC committees. In addition 92 proposals for contract were approved by CMR without prior consideration by NRC committees.

Once a proposal was approved by CMR it was formally recommended to the Director of OSRD as a subject for contract with the institution at which the work was to be carried on. With four exceptions, which he disapproved, these recommendations were adopted.

Terms of Contracts. The contracts were usually drawn for six or twelve months subject to the usual OSRD termination clause. The contractor agreed to conduct investigations in the field which the contract defined, to furnish such progress and interim reports as CMR requested and to prepare a final report upon completion of the work. Initially, a progress report was required every month; after August 1942 the requirement became bimonthly. The contracts were in the usual OSRD form, the terms of which are discussed in detail in Chapter XIII. At the termination of a contract, its renewal was considered by CMR aided, usually, by advice of the NRC committee which had originally recommended it. The progress and prospects of the research, the changing demands and resources
of the program, the wishes of the investigator, were all elements in the decision which was reached.

"Token" Contracts. CMR was frequently approached with requests for contracts to perform research in which no financial assistance was desired. In the first year of its existence it acceded to seven of these requests concerned with work in which it was properly interested. The procedure was, however, felt to be undesirable. Many of the requests appeared to be motivated by a desire to retain research personnel, or to obtain priorities for material, or to gain familiarity with the work of other OSRD contractors in the field. In May 1942, CMR therefore decided to reject such proposals as a matter of policy. Thereafter only three such contracts were accepted and those under exceptional circumstances. CMR continued to aid firms to retain key laboratory personnel on problems of particular concern to it, but did so as an expression of interest in the work rather than as a formal obligation.

Number and Distribution of Contracts. One hundred seventy-three of the 593 contracts negotiated after recommendation by CMR were made in the year ending July 1, 1942. In the two succeeding years there were 194 and 109 new contracts, respectively, and, in the period ending January 1946, 117. The 593 contracts were with 137 organizations in 30 states, the District of Columbia and the Canal Zone and involved approximately $24,690,000. This sum was distributed among fields of research as follows:

### MEDICINE
- Infectious Diseases $1,469,930.66
- Venereal Diseases 982,022.05
- Tropical Diseases (except Malaria) 421,694.12
- Convalescence 674,693.00
- Neuropsychiatry 324,929.96

### SURGERY
- Wounds and Burns 1,339,586.81
- Neurosurgery 608,887.00
- Surgical Specialties 899,114.29

### AVIATION MEDICINE
- 2,466,478.68

### PHYSIOLOGY
- Blood Substitutes 1,684,846.69
- Shock 820,333.00
- Nutrition, Acclimatization, and Water Sterilization 1,476,270.90

### CHEMISTRY
- Treatment of Gas Casualties 1,006,572.23
- Insect and Rodent Control 1,377,333.84

### MISCELLANEOUS
- Adrenal Cortical Hormones and Chemistry of Penicillin 5,501,941.45
- 630,056.00
PURCHASE OF PENICILLIN, for study in all types of infections
NATIONAL ACADEMY OF SCIENCE CONTRACT

1,885,002.60
1,120,206.14

$24,689,899.42

"Encouragement" of Research in Field of Penicillin. In the summer of 1941, Dr. Howard Florey of Oxford University came to the United States in an attempt to arrange for the large-scale production of penicillin. In his own laboratory Dr. Florey had produced enough of the drug to provide convincing evidence of its effectiveness against a wide variety of infections in small animals but the difficulties which attended its production were so great that nearly two years of work had yielded an amount sufficient to treat only five patients.

After visiting the Northern Regional Research Laboratory of the Department of Agriculture at Peoria, Illinois, and the laboratories of several commercial firms, Dr. Florey came to Washington in August to see the Chairman of CMR. The problem was one of supply. It could not, at that time, be solved in England. It might have been dismissed by CMR on the basis that the Committee's concern was with research rather than production. Fortunately, Richards appreciated the potential importance of the drug and the vigor and imagination with which he promoted its production were regarded as entitling him to the greatest credit in making penicillin available for use during the war. He arranged meetings in October and December, 1941, which were attended by representatives of the Division of Chemistry, NRC, the Department of Agriculture and the pharmaceutical firms of Merck & Company, Chas. Pfizer & Company, E. R. Squibb & Sons, and the Lederle Laboratories. The firms were encouraged to undertake the problem of penicillin production in co-operation with each other and with the Peoria Laboratory.

The firms agreed to prosecute the research. They agreed that the findings of any one group could be conveyed to the others through the medium of CMR. The Peoria Laboratory agreed to report its findings to all the other groups and to have members of its staff make periodic visits to their laboratories and give such advice and assistance as seemed indicated. During this early part of the program, the Committee's sole financial investment was to make some funds available to the Peoria Laboratory. Its moral investment was to encourage and maintain the initial interest of the commercial firms, to co-ordinate the results of their research, and to arrange with the War Production Board so that the firms might receive priorities for the equipment of their laboratories and pilot plants.

The difficulties proved nearly insuperable; but they were gradually overcome. As penicillin became available, CMR assumed the responsibility
of making a clinical evaluation of the drug. This responsibility was dis-
charged through the NRC Committee on Chemotherapeutic and Other
Agents, whose Chairman was originally Dr. Perrin H. Long. When he
entered the Army in June 1942, he was succeeded by Dr. Chester S. Keefer,
who subsequently became Medical Administrative Officer of CMR. The first
patient was treated in March 1942. By March 1943, the records of treatment
of a series of 200 cases had been collected, and sufficient penicillin was
available so that by arrangement with the Surgeon General of the Army,
a CMR investigator was invited to inaugurate an experimental study with
wounded soldiers at Bushnell General Hospital. By the spring of 1944 the
needs of the Army and Navy and, in part, those of our British Allies
could be satisfied from current production; considerable amounts became
available for civilian use. Until February 1943, penicillin for the clinical
testing program was supplied gratis to CMR by the commercial firms to a
value of several hundred thousand dollars. Thereafter CMR expended
nearly $1,900,000 in purchasing the drug for that purpose.

At the instance of CMR the War Production Board co-operated vigor-
ously and effectively in the production program. In May 1943, they pro-
vided AA–1 priorities for selected commercial firms. As a result and within
a year, 21 large plants costing some 20 million dollars had been erected
and equipped. The monthly production of penicillin, which had approxi-
mated 60 million units in pilot plants in May 1943, became 117,527 mil-
lion units in June 1944. In June 1945, it was 646,818 million units. The
WPB arranged monthly meetings of the penicillin producers at which in-
formation on production methods could be exchanged and, for purposes of
this exchange, the Department of Justice agreed to waive application of
the antitrust laws. On July 16, 1943, WPB issued allocation order M–338
partitioning all penicillin supplies among the Army, Navy, Public Health
Service and, for purposes of clinical testing, CMR. On May 1, 1944, when
the amounts available for civilian use became greater than could be han-
dled by CMR, the WPB established a Civilian Penicillin Distribution Unit
in Chicago to allocate supplies to 1000 selected hospitals. The problem of
penicillin production was on its way to certain solution and the part of
CMR in its conquest was completed.

Another and similar program was undertaken by CMR in an attempt
to synthesize penicillin. It had required eighteen months to produce enough
of the drug by culture methods to treat 200 patients even with the most
extended effort; and though production eventually overcame all difficulties,
there was grave doubt as to the outcome of the venture during the fall of
1941 and the whole of 1942. If the chemical structure of the drug could
be accurately identified, it might be produced by synthetic means and un-
limited amounts become available at inconsiderable costs. Studies towards
this end had therefore been in progress.
By the fall of 1943 it appeared that a co-ordinated attack on the problem might be successful. Upon recommendation of CMR, Bush appointed a special committee to survey the field, with Dr. Hans T. Clarke of Columbia University as its Chairman. The committee reported that such an attack was justifiable and, indeed, expressed the hope that it might yield conclusive results within six months. It designated three universities, the Department of Agriculture and eleven commercial firms as the most suitable investigators and recommended that contracts be entered into with them. This was done. The contracts with the commercial firms involved no financial support and aside from their patent provisions had the sole purpose of providing complete interchange of information among all the contractors. Each contractor agreed to give the Government all the information he had acquired concerning the purification and chemical structure of penicillin prior to signing the contract and to report the progress of his studies at monthly intervals. By this means each member of the group was apprised of the advances of all other members and, though the chemical structure of penicillin was not established by the end of the war, definite progress had been made in its elucidation.

Classification of Contracts. The classification of each contract was determined by CMR at the time it was recommended to the Director. Nineteen contracts were initially classified as secret, 62 as confidential, 134 as restricted and the remainder as open, numerous changes in classification being made during conduct of the research. Assigning a subject to the restricted category prevented publication of its results or distribution of its reports except through official channels. This was only a minor complication. Assignment to confidential or secret categories, on the other hand, involved the numerous major complications mentioned in the chapter on security.

These procedures had more than a nuisance value. They delayed the initiation of research. They interfered with its accomplishment by obstructing the acquisition and interchange of information. The eventual conclusion of CMR was that there was very little in the field of medical research which could not have been adequately protected by its classification as restricted.

Deferment of Research Personnel. During the existence of CMR some 5431 individuals were employed on its contracts, of whom 644 were Doctors of Medicine, 1038 Doctors of Philosophy or Science and 3749 technicians, animal caretakers and so on. The amount of time and energy devoted to keeping rifles off these individuals’ shoulders was out of proportion to any conceivable use they could have had to the Army. Yet, the results of the research upon atabrine alone kept 100 times as many soldiers on active duty as there were men engaged in the entire CMR program. Laboratories cannot be run by 4-F’s or women or by the Grace of God alone. Investigators cannot
undertake research without some confidence of retaining their personnel throughout its conduct.

The difficulties were partly formal ones with the Office of Procurement and Assignment and the Selective Service System. The former had no final jurisdiction; the latter was sometimes difficult to convince of the connection between research and war; in both cases the procedure for deferment was cumbersome. Within the limitations imposed upon them both agencies co-operated willingly and well with CMR. There were very few losses of research personnel by induction. Greater difficulty was encountered with the personnel themselves who were understandably loath to request repeated deferment against the apparent wishes of the Services. The problem was by no means peculiar to CMR but was part of a very large and formidable one which is discussed at some length in the chapter on scientific manpower.

The procedure to obtain deferment differed with medical and nonmedical personnel. In the case of medical personnel, the avenue of approach was through the Office of Procurement and Assignment of the War Manpower Commission. Responsible investigators under each contract were instructed to see that the names of their staff were included on the roster of essential teaching and scientific personnel which was prepared by each institution and sent to the State Chairman of Procurement and Assignment. CMR appreciated that Procurement and Assignment was under compulsion to supply a monthly quota of doctors to the armed forces. It therefore instructed investigators to utilize 4–F personnel and women as far as possible in their research and to include on the roster only those individuals who were devoting a large part of their time to the investigation and who were, in fact, essential to its effective prosecution. If, despite the presence of his name on this list, the individual was classified as 1–A or was directed to apply for a commission in the Medical Corps by the local Selective Service Board, his institution was directed to appeal the decision and to write both the State Chairman of Procurement and Assignment and CMR about the case. CMR thereupon communicated with both Selective Service and Procurement and Assignment, endorsing the request for deferment and asserting its interest in the individual.

The deferment of nonmedical personnel is discussed in the chapter on scientific manpower. Beginning in August 1944 the deferment of this group was handled for CMR by the Scientific Personnel Office of OSRD. Prior to that date CMR had its own contacts with the Selective Service Boards.

One method of operation would have been to concede the induction of personnel and then have Army or Navy assign them to work on research projects as long as their contribution to it was vital. In cases of special urgency this was attempted. The Navy was able to arrange such assign-
ments in a number of instances. Though the Army felt that it could not grant requests of this kind, twelve Medical Officers were made available in February 1944 on Bush’s request to the Commanding General, Army Service Forces, to assist in the clinical testing of new antimalarial drugs as part of the antimalarial program which the Army and Navy regarded as of primary importance for the prosecution of the war.

*Human Subjects for Experiments.* In several contracts it became essential to determine the effectiveness upon human subjects of procedures which had been evolved in the laboratory, before they could be recommended to the Services. The Army was properly unwilling to allow CMR investigators the use of military personnel for these purposes except in special fields: measures for combating fatigue were studied with soldiers at Fort Sheridan, Illinois, Fort Knox, Kentucky, and Camp Young, California, in 1942–1943, and extensive studies of water requirements and the effects of water deprivation were conducted with desert troops in southern California in 1943 and 1944.

This by no means satisfied the needs of the program. After some exploration, volunteers were obtained from groups of prisoners and conscientious objectors who agreed to serve as subjects in experiments which were always attended by discomfort and sometimes by danger. The prisoners received certificates of merit from CMR and most of them received honoraria of from $25 to $100 for their participation in the experiments; the conscientious objectors received certificates of service but no compensation. The details and hazards of each experiment were, of course, fully explained to the volunteers before its initiation, and their understanding of the circumstances acknowledged in writing.

Prisoners were first used in the CMR program in the summer of 1942 at the Massachusetts State Prison Colony in Norfolk, Massachusetts, when 65 volunteers were injected with bovine albumin. From the Federal Penitentiary at Terre Haute, Indiana, 247 subjects became available for an investigation into the prophylaxis of gonorrhea conducted for CMR by the United States Public Health Service and the Bureau of Prisons, Department of Justice. The largest and most important use of prisoners was made in connection with the testing of new antimalarial drugs. Over 1350 volunteers were concerned in these projects, carried on under supervision of the Board for Co-ordination of Malarial Studies, at the United States Penitentiary in Atlanta, Georgia, the Stateville Prison, Joliet, Illinois, the New Jersey State Reformatory, Rahway, New Jersey, and the United States Army Disciplinary Barracks, Green Haven, New York.

When the services of conscientious objectors were desired, application was made by CMR to the Camp Operations Division of National Selective Service System Headquarters. If its approval were obtained, and if no objection were made to the purpose of the experiment by representatives of
the religious groups who maintained the camps (American Friends, Mennonites, Brethren), the responsible investigators interviewed the occupants of a conveniently located camp and asked for volunteers. Two hundred forty-one subjects were obtained in this fashion for experiments on problems of nutrition, malaria, aviation medicine and acclimatization that involved, among other things, subsisting for long periods on starvation diets.

Hospital patients who were to be infected with malaria as a form of treatment for their disease were logical candidates for participation in the program. Through co-operation of the appropriate State and City Departments facilities of the following hospitals were placed at the disposal of CMR investigators: Goldwater Memorial Hospital, Bellevue Psychopathic Hospital, and Manhattan State Hospital, all in New York City; Massachusetts General Hospital and Boston Psychopathic Hospital, both in Boston; Manteno State Hospital, Manteno, Illinois; and Gaston Psychopathic Hospital, Memphis, Tennessee.

Results of Contracts. The scientific accomplishments of the research program are summarized in the two volumes of the OSRD history entitled *Advances in Military Medicine*. Only their quantity will be mentioned here.

A considerable proportion of the civilian medical research conducted in the United States during the years 1942-1945 was performed under contract with OSRD. As of May 9, 1946, 1,129 papers describing this work had appeared in scientific journals and 869 additional manuscripts had been approved for publication. An unpredictable but large number will continue to appear over a period of several years as security regulations are still further removed. In addition to these journal publications, a number of monographs and fasciculi have been and will be prepared. A three-volume "confidential" fasciculus totaling 1,500 pages describes the background and advances in various aspects of chemical warfare and contains a complete bibliography of the subject. In the field of malaria, a three-volume monograph, entitled *A Survey of Antimalarial Drugs: 1941-1945*, was published at the end of 1946. It relates the effectiveness and toxicity of over 12,000 drugs that were examined for their antimalarial action and describes the methods for synthesis of these compounds. An equally comprehensive monograph on the *Chemistry of Penicillin*, which is in course of publication, describes the results of the concerted efforts of American and British investigators to synthesize penicillin.

Organization of CMR and Supervision of Research Program

Washington Office. The four civilian members of CMR had important responsibilities in their normal capacities, of which it was impossible to divest themselves entirely. They all attended the weekly or biweekly meetings of the Committee in Washington. They all spent approximately one
half of each week in Washington concerned with its affairs. Until the
reorganization of the Committee in June 1944, its full-time staff was ex-
ceedingly small.

In September 1941 Dr. A. M. Walker was appointed Assistant to the
Chairman. Technical Aides were provided for the two most active fields
in December 1941. In June 1942, when Walker entered the Army he was
succeeded by Dr. E. Cowles Andrus as Assistant to the Chairman, respon-
sible for administration of CMR affairs.

Initially, the Committee had felt the unwisdom of organizing itself into
divisions and sections as the NDRC had done. Committees on the very
subjects which such divisions and sections would embrace already existed
within NRC and there seemed danger in erecting an overlapping and, in
a sense, a competing organization.

On these several counts the Committee was content for over two years
to maintain but a small staff. Its purely administrative functions, designed
to facilitate the work of the investigator, were handled adequately in the
Washington office by the one or two Technical Aides. Such tasks as clear-
ance and deferment of personnel, priorities for material, circulation of
reports, inquiries of a thousand sorts, were handled in this fashion. For
its more important supervisory function, the Committee depended during
these years upon its own members, upon the NRC committees and upon
special consultants. A variety of means were employed toward this end.

Although the Chairman and Vice-Chairman were confined to Wash-
ington by their respective duties with CMR and NRC, the other two
civilian members made occasional trips to survey the progress of contracts.
In February 1942, the Chairman of CMR directed a letter to the Chair-
man of the Division of Medical Sciences of NRC, asking that the NRC
committees undertake to supervise and correlate the projects which they
had recommended to CMR and which were already under way. He sug-
gested that meetings of investigators would be a useful means of effecting
co-operation. In the fall of 1942, again utilizing the services of the NRC
committee chairmen, CMR asked for a critical evaluation of its OSRD
contracts with the purpose of identifying those which should be prosecuted
with vigor and those which should be terminated or not recommended for
renewal. Seventeen chairmen made these surveys in their fields of special
interest and reported their conclusions in meetings with CMR during
December of that year.

Utilizing another method, CMR appointed Special Advisers and Con-
sultants to inspect and report upon certain aspects of the research program.
A further attempt to establish co-ordination was made through the medium
of the progress reports which each investigator was required to submit
to CMR. These reports were duplicated in the Washington office and
distributed to responsible investigators in the same field, to members of
the NRC committees which had recommended the project, to the Offices of the Surgeons General and fifteen copies to the London office of CMR for distribution in England.

Reorganization. These attempts at supervision and co-ordination were all useful but the majority of them lacked continuity. The request that NRC committees undertake supervision of research entailed heavy responsibilities. In some fields the committees achieved effective integration; in other instances little was accomplished. There was no permanent responsible echelon interposed between CMR and the investigators which could insure the proper execution of contracts. Too much was being attempted by too few. An increasing realization of this fact led to a replacement of the original and simple organization of the Committee on Medical Research by a more elaborate structure in June 1944.

A Medical Administrative Officer, Dr. Chester S. Keefer, was appointed, and to him was delegated the general responsibility of supervising and administering the scientific performance of all OSRD contracts in the field of medical research. The following divisions and sections were established:

**Division 1 (Medicine)**

E. Cowles Andrus, Chief (Internal Medicine, Johns Hopkins University)  
Section 1 (Preventive Medicine)  
  Colin M. MacLeod, Chief (Bacteriology, New York University)  
Section 2 (Venereal Diseases)  
  J. Earle Moore, Chief (Internal Medicine, Johns Hopkins University)  
Section 3 (Tropical Diseases and Mycotic Infections)  
  Emmet B. Bay, Chief (Medicine, University of Chicago)

**Division 2 (Surgery)**

John S. Lockwood, Chief (Surgery, Yale University)  
Section 1 (Wounds and Burns)  
Section 2 (Neurosurgery)  
  Cobb Pilcher, Chief (Surgery, Vanderbilt University)  
Section 3 (Surgical Specialities)

**Division 3 (Aviation Medicine)**

Detlev W. Bronk, Chief (Physiology, University of Pennsylvania)

**Division 4 (Physiology)**

Joseph T. Wearn, Chief (Internal Medicine, Western Reserve University)  
C. N. H. Long, Deputy Chief (Physiology and Biochemistry, Yale University)  
Section 1 (Blood Substitutes)  
Section 2 (Shock)  
  Dickinson W. Richards, Jr., Chief (Medicine, Columbia University)  
Section 3 (Nutrition and Clinical Investigation)
Division 5 (Chemistry)
  Milton C. Winternitz, Chief (Pathology, Yale University)
  C. Chester Stock, Deputy Chief (Biochemistry, Memorial Hospital, New York City)
Division 6 (Malaria)
  George A. Carden, Jr., Chief (Internal Medicine, Columbia University)

Records Section
  Kenneth B. Turner, Chief (Internal Medicine, Columbia University)

Each contract in effect at the time of the reorganization or thereafter adopted was assigned to the Medical Administrative Officer or to one of the divisions. The Division Chief became responsible to the Medical Administrative Officer, and through him to CMR, for the contracts within his field. This was a continuing responsibility. The Chief was in a position to accept it because the field of his division was of practicable proportions and because he was given the assistance of Technical Aides and Consultants. He co-ordinated the work of the several investigators in each subject area and kept the CMR informed of the progress of individual investigations and of the general state of advancement of the subjects within his division. In the case of new projects he maintained close liaison with the NRC committees and advised CMR on proposals which had been recommended by them. He was free, at his own discretion, to stimulate the submission of contract proposals.

The Records Section established a central office which effected a greater degree of order in the acquisition and filing of progress, interim and final reports of contract investigators than had previously been the case. It distributed progress reports more widely, though to the same general groups. It created a roster of contracts, listing under each the number and substance of the reports which had been received. In April 1944, the section inaugurated a weekly bulletin containing a summary of reports which had been received by CMR from open and restricted projects. The reports were abstracted by their authors or by the section staff and arranged by subjects in a useful and readable fashion. These bulletins were given a much wider distribution than the original reports, and by July 1945 the edition had increased from 1000 to 3100 copies, 400 going to England, 350 to the European Theater of Operations and 200 to the Pacific.

The reorganization of CMR provided a more effective supervision of the execution of contracts, relieved the members of a mass of detail which had pressed upon them, and gave them more time for the broader aspects of the CMR program. It might well have been effected sooner.

West Coast Consultant Panel. The administrative activities of CMR and NRC were necessarily conducted in Washington. There were no representatives from the West Coast upon CMR and, initially, only eight upon
the NRC committees. Unavoidable as this lack of representation was because of geographical considerations, it had the unfortunate effect of making investigators in that area feel that they were uninformed and inadequately utilized in the research program. This feeling was crystallized in September 1942, when thirty investigators from San Francisco directed a letter to CMR stating that their usefulness was handicapped by ignorance of the work in progress and of the relative urgency of problems in the field of military medicine. In point of fact, at the time the letter was written 8.3 per cent of the active contracts (21 of 254) were in the hands of three California universities. The percentage of proposals for contracts from the West Coast which had been rejected by NRC committees and CMR (42 per cent) was somewhat lower than that (47 per cent) from the country as a whole.

No special effort, however, had been made to keep the West Coast informed of CMR activities. The Committee invited two representatives of the group to visit Washington. After familiarizing themselves with the situation in Washington, the representatives consulted with their group in San Francisco and in May 1943 made a report in which they recommended the appointment of official advisory commissions in natural geographical areas and of additional assistants for the NRC committees. Pursuant to the first of these suggestions a consultant panel to CMR with a membership drawn from residents of California was appointed on July 1, 1943. Its function was to insure that the investigative resources of the West Coast were fully utilized by organizing research projects and by analyzing proposals for contract prior to their submission to CMR. The arrangement was a reasonable and profitable one.

Board for the Co-ordination of Malarial Studies. When problems arose which required a peculiar degree of co-ordination or which did not fall in the purview of any pre-existing group, special boards or committees were created to handle them. The best example of this mechanism was provided in the field of malaria.

The search for antimalarial drugs which might prove superior to atabrine in potency and preventive effectiveness constituted a particularly difficult and laborious study. Each of the 14,000 compounds examined had to be prepared or synthesized, and most of them had to be tested for both suppressive and preventive action on several types of avian malaria and in more than one host. The more promising compounds had then to be examined for toxicity in animals and man, and their clinical effectiveness determined in civilian patients and volunteers. Finally, selected compounds of particular promise were tested on soldiers in this country and in foreign theaters.

Such studies involved the close and continuing co-operation of many groups of investigators in different institutions and in different parts of the country. An Office for the Survey of Antimalarial Drugs was established in July 1942 by Johns Hopkins University under contract with OSRD. Its pur-
pose was to collect and codify the mass of chemical, pharmacological and clinical data which was to be developed in the succeeding years and to make this information available to investigators in this country and the British Empire within the limitations of military security and the commitments which had to be made to commercial firms. Initially, the studies of malaria were co-ordinated by a series of "conferences on malaria research" called by the Subcommittee on Tropical Medicine of the NRC. In January 1943, a more formal integration was accomplished by appointment of a Subcommittee on Co-ordination of Malarial Studies within the National Research Council. Dr. Frederick M. Hanes was Chairman of this subcommittee which at first had three subsidiary panels dealing with the biochemistry, clinical testing, and pharmacology and antimalarials under the chairmanship, respectively, of Drs. W. M. Clark, J. A. Shannon, and E. K. Marshall, Jr. Later, a fourth panel, concerned with the synthesis of antimalarials, was instituted; Dr. Clark was its first Chairman, being succeeded by Dr. C. S. Marvel. As the work was pushed with greater vigor and assumed greater importance, as the magnitude of the malaria problem was more fully realized, and as the need for closer co-operation with the malarial studies of the Services became apparent, the Chairman of the NRC Division of Medical Sciences suggested that an independent Board for the Co-ordination of Malarial Studies be established. Such a board was appointed and held its first meeting in November 1943. It received its financial support from OSRD funds. As finally constituted under the chairmanship of Dr. R. F. Loeb, it included seven representatives of the three Surgeons General, the chairmen of the four NRC antimalarial panels, Dr. A. R. Dochez, member of CMR, and Dr. G. A. Carden, Jr., Chief of the CMR Division of Malaria.

The Board supervised and directed the malaria program with distinguished success and provided a model of effective co-operation between civilian and military groups. The representatives of Army, Navy, and Public Health Service were not general Liaison Officers present to ask or receive advice from a committee, but were voting members of the Board. They were investigators and specialists in malaria in their own right, who were in a position within their Services to effectuate measures which the Board might recommend. They brought to the attention of the civilian members exigent military problems with which the latter were unfamiliar and arranged for prompt and adequate field trials of procedures developed in the course of civilian investigation.

**Liaison with Allied Governments**

At the meeting on November 19, 1941, Dr. Kenneth B. Turner of New York was selected to head the medical section of the OSRD London Mission. After familiarizing himself with the plans and procedures of the NRC committees on military medicine and visiting a number of OSRD
research projects, Dr. Turner reached London in February 1942. He re-
mained there until June 1943 and was succeeded by Dr. Joseph W. Ferre-
bee. In December 1943, Dr. Ferrebee was in turn replaced by Dr. Hamilton
Southworth, who was in England representing the Office of Civilian Defense
and who remained in charge of the CMR section of the London Mission
until it was closed in June 1945. On one occasion when he returned to this
country, his place was filled by Dr. L. L. Waters, a CMR Technical Aide
who had been sent to England with two CMR investigators to work in the
Porton chemical warfare laboratories.

The primary purpose of establishing the liaison was to keep CMR in-
formed of British research in military medicine at a time when security
classification and delay in mails grossly impeded the usual interchange of
information. The NRC had already arranged for an exchange of the
minutes of its committee meetings with those of the British Medical Re-
search Council, but the exchange was not prompt, and minutes are rarely
an adequate summary of transactions. The successive Liaison Officers estab-
lished relations with the Medical Research Council and attended meetings
of its numerous committees and those of appropriate groups within the
Royal Army Medical Corps, Royal Navy, Royal Air Force, Emergency
Medical Service and Ministries of Production, Food, and Home Defense.
Towards the end of the war their most important contact was with the
U. S. Army. They visited laboratories where important research was in
progress.

Throughout their stay they sent weekly news letters to CMR and special
reports of investigations for distribution to the committees and investigators
who were concerned with similar matters in this country. In return they
distributed to British investigators copies of the progress reports of CMR
projects and of the bulletin which was issued by the CMR Records Section
after April 10, 1944. Another function of the Liaison Officers was to arrange
and facilitate the visits to England which were periodically made by CMR
investigators. The activities of the London office were profitable to both
countries and, if the evidence of formal correspondence be accepted, meas-
urably increased friendly relations between British and American workers.

A British counterpart of the CMR section of the OSRD London Mission
was established in Washington in 1942, and in 1944 Medical Liaison Officers
in Washington were appointed by Australia, South Africa and Belgium.

Useful as the London office was it could not, of course, achieve the degree
of liaison which is obtainable only by direct personal contact between in-
vestigators. The desirability of sending American investigators to England
and receiving British investigators in the United States was therefore early
envisaged by CMR and, both upon its initiative and that of British agencies,
visits were arranged and carried on throughout the war. All American
representatives were either OSRD Consultants or were appointed such for
the purposes of the visit. The missions served important functions. They established many cordial personal relationships and provided an understanding of the problems faced by the two countries. They frequently succeeded in co-ordinating research programs. They always resulted in a gain of information; and if, towards the end of the war, the British profited rather more than the United States by this exchange, the reverse was true at the war's beginning.

The British initiated a combined British-American-Canadian surgical mission to the Soviet Union which reached Moscow on July 2, 1943, and returned to England, its point of departure, on July 30, 1943. Lieutenant Colonel Loyal Davis, USAMC, was appointed to represent CMR and NRC on this mission. The meetings permitted an exchange of information concerning the medical and research organization of the two countries. The members visited front line and base hospitals and reported on the methods of evacuation and surgical techniques employed by the Russians.

A second mission to the U.S.S.R., sponsored by CMR, was made by Dr. A. Baird Hastings, CMR member, and Dr. Michael B. Shimkin of the United States Public Health Service, in response to a suggestion by the Soviet Government. Drs. Howard W. Florey and A. G. Sanders represented Great Britain and Canada on this mission, which reached Moscow on January 14, 1944, and left on February 11. Manuscripts that had been prepared by American workers and reviewed by British and Canadian scientists were delivered to the Soviet authorities by Hastings. The reports described the status of investigations on ten subjects in which there had been active research developments; these subjects were discussed with leading Russian investigators at a series of conferences. The mission also visited twelve research and teaching institutes in the Moscow area. A very free and profitable interchange of information occurred, and it was hoped that the visit had established the basis for an enduring relationship. Plans to send another mission to the Soviet Union were interrupted by the termination of hostilities, but some contact was maintained by an exchange of literature.

Liaison with the Services

The reason for the existence of CMR was to aid the Army and Navy in saving lives in order better to fight the war. To accomplish this purpose, effective liaison was essential. CMR needed to be informed accurately and fully of the needs and interests of the Services. Conversely and for equally obvious reasons, the Services had to be promptly informed of the results gained by research. The formal liaison arrangements appeared adequate for these ends. Sitting with the NRC committees, and therefore in a position to advise them in the initiation of research projects, were designated representatives of the Surgeons General. Sitting as voting members of CMR, and
therefore participating in the formulation of its program and apprised of its results, were medical officers of policy-making rank: the Chief of the Division of Preventive Medicine, Office of the Surgeon General of the Army, and the Chief of the Research Division, Bureau of Medicine and Surgery of the Navy.

If the criterion of success is to be results, the liaison must be adjudged successful. Many of the advances in military medicine made during the war were the consequences of CMR research. Some of these advances were promptly transferred to the field. But it would be fatuous to say that the arrangements for such transfer were perfect.

The most effective co-operation was secured when something beyond the formal net of liaison was created. Two of several such examples occurred in the fields of malaria and aviation medicine. That in malaria has already been recited. Representatives of the Surgeons General, who were experienced field investigators in the subject, functioned as voting members of the Board for the Co-ordination of Malarial Studies. In aviation medicine, the Chairman of the NRC committee continued his association with its activities after entering the Navy, and the Division Chief for CMR was Coordinator of Research in the Office of the Air Surgeon, Army Air Forces. In both fields the committees were accurately informed of the needs of the Services. In both fields their research findings were promptly transferred into practice.

The converse is equally true. In other fields of medicine and surgery, in which the contacts of NRC committees and CMR with the Services were less intimate and personal, the effectiveness of the work was correspondingly less. This is evidenced by the value, universally felt, of the information brought back by those CMR missions who had contact with troops in the field or by medical officers who had served in foreign theaters and, returning for some other purpose, talked informally to CMR and NRC committees. The opinion of CMR that numerous and frequent missions to the fighting fronts to orient investigators as to conditions actually confronted there were to be desired was overruled by the Surgeon General of the Army on the basis of his more intimate knowledge of combat situations.

Several successful examples of civilian and military co-operation occurred at Army General Hospitals and at civilian laboratories. Such investigations were carried on in the field of tuberculosis and psychiatry at Fitzsimons Hospital, in the penicillin study at Bushnell and Halloran, and in the studies on convalescence at Gardiner. The permission extended by the Surgeon General for civilian investigators to use troops for research upon fatigue and water deprivation has already been mentioned.

Liaison is a two-way road. The difficulties of getting information from the field to investigators in the States have been mentioned. The corresponding difficulty of getting information from the States into the field
was a frequent subject of comment by returning medical officers and CMR missions from all theaters. Even in the life of portable surgical hospitals there are lulls in activity when news of the progress of medical research is of interest and value. It is always of interest in more stable installations. The earlier publication and wider distribution of the CMR weekly bulletin would have gone some distance towards filling this vacuum. Co-operation from the Services would have been required but should have been forthcoming. The Navy asked and received permission to republish extracts from the bulletin in its admirable BuMed News Letter.

The formation and assignment of CMR was a novel experiment in American medicine. Planned and co-ordinated medical research had never been essayed on such a scale and, at its inception, there were the gravest doubts that it could be successfully executed. Fortunately, the experiment was a success; it was effective in meeting the needs posed by war.

This chapter has concerned itself with the mechanisms of CMR administration. As was the case throughout OSRD, the strength of the organization lay in the integrity and disinterestedness of the individuals who directed and participated in it. Such administrative difficulties as were encountered by CMR came upon it from without. For the most part they applied throughout the OSRD organization; they are discussed at considerable length in later chapters.
CHAPTER VIII

OTHER OSRD RESEARCH GROUPS

While most of the scientific research and development carried on under OSRD auspices was supervised either by NDRC or CMR, there were four activities which, at one time or another, were carried on without the interposition of either of those Committees. Two of the four were under NDRC auspices at one time and a third was under CMR for a short time. One of them functioned immediately under the Director, the other three were supervised by committees created especially for the purpose. They were quite disparate in scope and function. Their history is another illustration of one of the principal contributing factors to the success of OSRD—its flexibility. Bush might have set a pattern and forced all activities into it. Instead he wisely adapted the organization to the task confronting it. The organization chart was the servant, not the master, of the organization.

The most important of these special activities was that dealing with atomic energy. Of less importance relatively, although highly significant in its own right, was that dealing with proximity fuzes for shells. The other two—sensory devices and insect control—were the result of special situations which kept them from fitting into the conventional NDRC and CMR patterns. Each will be described briefly.

Atomic Energy

President Roosevelt's letter of June 15, 1940, appointing Bush to the National Defense Research Committee informed him of the recent appointment of a special committee under the chairmanship of Dr. Lyman J. Briggs of the Bureau of Standards "to study into the possible relationship to national defense of recent discoveries in the field of atomistics, notably the fission of uranium." The President stated that he would request the committee to report to Bush as the jurisdiction of the NDRC included atomic energy. On July 1, 1940, Briggs wrote Bush giving him a brief history of the activities of his committee and requesting funds for the continuance of one line of research. This program was considered by NDRC at its meeting the next day. The Committee on Uranium was constituted a special committee of the NDRC under the chairmanship of Briggs and with a slight change in membership. NDRC approved in principle the pro-
gram which had been outlined by Briggs and directed him to make definite proposals for consideration when funds had been allocated to the Committee.

The first funds for the support of the uranium program were voted by NDRC at its meeting on October 25, 1940; and each succeeding meeting of the Committee saw additional implementation of the program. Recognizing the potential importance of research on atomic energy, on April 19, 1941, pursuant to authorization of NDRC, Bush requested Jewett, as President of the National Academy of Sciences, to appoint a special committee to review the program of research in the field and to make recommendations for a future program. A committee of distinguished scientists was appointed and Jewett sent its report to Bush on May 23. When NDRC met on June 12, it felt the need for additional light on the engineering aspects of the program; and accordingly it requested the National Academy to have the report reviewed by a committee with a membership competent from that standpoint.

With the establishment of OSRD, the Committee on Uranium was continued as an NDRC activity but with its title changed to Section on Uranium for uniformity of nomenclature. Briggs appeared before the first meeting of the reconstituted Committee on July 18, 1941, to outline a research program. At the same time, the Chairman laid before the Committee the reports submitted by the special Academy committee on atomic fission. It had become apparent by this time that success in the preliminary research program would lead to a very expensive long-range program which would dwarf the other NDRC activities. The Committee accordingly requested Bush to consider anew the entire uranium program in its relation to the activities of the NDRC; he in turn called upon the National Academy of Sciences for a further report.

Upon receiving that report, he discussed the situation with NDRC at its meetings on November 28, 1941, and January 2, 1942. At the first of those meetings, it was agreed that arrangements should be made to handle the program outside the regular activities of NDRC. At the January meeting, Bush informed the Committee that he had completed the necessary arrangements. The problems were divided into those relating to physics and those relating to engineering. Three distinct programs were established in physics, and a Program Chief designated for each. In the case of the physics program, Bush acted upon recommendations made to him by a committee of three consisting of Conant as Chairman of NDRC, Briggs, as Chairman of Section S-1 of OSRD (the word “uranium” had been dropped for security reasons), and the appropriate Program Chief. Contracts on the developmental and engineering aspects of the program were entered into upon the recommendation of a Planning Board composed of outstanding engineers, with E. V. Murphree, Vice-President of Standard Oil Development Company, as Chief. In practice, orders for large quantities of materials for con-
tractors on the program were channeled through the Planning Board.

In June 1942 arrangements were made for a division of the work in the field of atomic energy between the OSRD and the War Department. The organization within OSRD was again modified. To handle the OSRD part of the program, the Director appointed an Executive Committee of S-1 charged with the duty of recommending contracts and supervising operations under those contracts. The members of the Executive Committee were Conant as Chairman, Briggs, E. O. Lawrence (physicist, University of California), A. H. Compton (physicist, University of Chicago), H. C. Urey (chemist, Columbia University) and Murphree. Compton, Lawrence and Urey had been Program Chiefs under Section S-1, and Murphree had been Chief of the Planning Board. Under the new arrangement the Planning Board ceased to exist, but its former members were available for consultation by the War Department. The division of functions between the OSRD and the War Department contemplated that for the immediate future OSRD would continue with experimentation while all large-scale aspects of the program would be placed directly under Army control.

The Executive Committee held its first meeting on June 25, 1942. In that and subsequent meetings it recommended contracts for research and development in the field of atomic energy; beginning on July 1, 1942, those contracts were financed by funds transferred to OSRD from the War Department.

At its first meeting the Committee recommended the appointment of Stewart as its Secretary and the appointment was approved by the Director so that the administrative aspects of the Committee’s operations could be meshed in with the other administrative operations of OSRD. Upon the Committee’s recommendation Section S-1 of OSRD was abolished and the members of that section (except for the members of the Executive Committee of S-1) and the Consultants to it were appointed a panel of Consultants to the Committee. Dr. Harry T. Wensel (physicist, National Bureau of Standards) was appointed as Assistant to the Chairman of the Committee and played a very useful role not only in that capacity but later with the Corps of Engineers when the entire project was transferred to the newly created Manhattan District of that Corps.

In order to insure co-ordination of the work of the Executive Committee with that being conducted by the Manhattan District, it was the practice of the Executive Committee to hold executive sessions for the discussion of its program and to follow them on the same day with other sessions with officers of the Manhattan District. During these sessions, the officers had ample opportunity to question the scientists and they in turn to present problems on which the Manhattan District could be useful. These meetings supplemented the close relations between Manhattan District officers and scientists working on specific projects.
The Executive Committee held meetings on June 25, July 9, July 30, August 26, September 13–14, September 26, October 23–24, November 14, December 9, and December 19, 1942, and on January 14, February 10–11, March 18, April 29, and September 10–11, 1943. By the time of the December 1942 meetings the atomic energy program had progressed to the point where it seemed advantageous to transfer the entire responsibility to the Manhattan District with research concentrated on those points which fitted closely into the Manhattan District program. Those OSRD contracts which did not fit into the production program were permitted to lapse while those (and they were the major ones) which did support the Army program were terminated as of an agreed date by OSRD (usually March 31, 1943) and picked up as Manhattan District contracts. At the request of the Manhattan District, OSRD later entered into a few contracts in the general field where the District desired to conceal its interest in a particular subject. Although OSRD as an organization stepped out of the atomic energy field, persons associated with it continued as key scientific advisers to the Manhattan District and to the President. Bush and Conant were members of the top-level, "policy" committee considering the uses of atomic energy, while Tolman spent most of his time over a long period as the key man on General Groves’s scientific staff.

The growth of the OSRD program in atomic energy is indicated by the following figures, showing the funds contracted or transferred for it:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDRC (of CND) June 27, 1940 — June 28, 1941</td>
<td>$468,000.00</td>
</tr>
<tr>
<td>NDRC (of OSRD) June 28, 1941 — December 1941</td>
<td>$452,650.00</td>
</tr>
<tr>
<td>Section S-1 of OSRD January — June 1942</td>
<td>$1,952,168.00</td>
</tr>
<tr>
<td>Planning Board of OSRD January — June 1942</td>
<td>$2,224,392.77</td>
</tr>
<tr>
<td>Executive Committee of S-1 (OSRD) June 1942 — September 1943</td>
<td>$13,041,037.57</td>
</tr>
</tbody>
</table>

Funds through June 30, 1942, were from those allocated or appropriated for NDRC or OSRD. All funds used on the program after that date were transferred to OSRD by the Army. The money spent on the atomic energy program by OSRD paved the way for Army expenditures of approximately two billion dollars. The best account of the results obtained appears in the volume *Atomic Energy for Military Purposes* by Henry De Wolf Smyth.

**Proximity Fuzes for Shells**

The primary field of activity of Section T was proximity fuzes for shells. Its success in that field was outstanding. Initially, Section T was one of the sections of Division A of NDRC of the Council of National Defense. It continued as one of the sections of Division A of the reconstituted NDRC until March 31, 1942, when it was transferred out of NDRC and brought immediately under the Director. At approximately the same time the cen-
entral laboratory of the section was moved from the Carnegie Institution of Washington to Johns Hopkins University. Work on fuzes for bombs and rockets which had been carried on under the former contract was transferred to the National Bureau of Standards under Section E of Division A.

The transfer of Section T was for reasons of administrative convenience, not of principle, for there was nothing in the nature of the problem or the magnitude of the program to require the shift. Dr. Merle A. Tuve continued as Chief of the section. Because of the initially predominant interest of the Navy in the subject matter, a naval officer was appointed as special assistant to the Director of OSRD to aid the Director in following the activities of the section.

The pattern of Section T activities was the same as that for other OSRD activities except that Section T operations were reviewed by the special assistant rather than by a committee and that Section T funds were largely provided by the Navy. In the later stages an increasingly large proportion of the section’s operations was devoted to matters more closely tied in with procurement than with research. Bush suggested that it would be desirable for the section to be taken over by the Navy. Upon the insistence of the Navy as expressed in a letter of November 22, 1943, that the section could function more effectively as a part of OSRD than it could as a part of the Navy, he did not press for immediate transfer. When OSRD prepared its demobilization plans nearly a year later, however, the Navy concluded that it would be desirable to take over the Section T activities as a unit. The first step was a Navy-Johns Hopkins University contract of December 1, 1944, which permitted the transfer of the Section T central laboratory staff and facilities. This was followed by a series of Navy contracts replacing OSRD contracts in the Section T field.

The OSRD method of contracting was followed by the Navy in connection with the transfer of the section. In fact the Navy vocabulary was enriched by the addition of the phrase, “Section T type contract,” to describe the relation which the Navy entered into to support the transferred activities. A total of approximately $26,400,000, most of it received by transfer from the Navy, was spent in support of the Section T program.

**Sensory Devices**

The problem of rehabilitation of wounded soldiers was on the threshold of OSRD jurisdiction. The unsatisfactory situation with respect to artificial limbs led OSRD upon recommendation of CMR to enter into a contract with the National Academy of Sciences under which a Committee on Prosthetic Devices was established to survey the field and work toward the improvement of devices. The problem of devising and developing instrumental aids for men with sight impaired in the war was one of much
greater difficulty, which involved techniques of both NDRC and CMR and yet clearly fell outside the fields of both.

After consulting NDRC and CMR, Bush in January 1944 established a Committee on Sensory Devices to operate in this area and to report directly to him. The Committee members were: George W. Corner, Chairman (anatomist, Carnegie Institution of Washington); Henry A. Barton (Director, American Institute of Physics); A. J. Carlson (physiologist, University of Chicago); Wallace O. Fenn (physiologist, University of Rochester); Stacy R. Guild (otologist, Johns Hopkins University); Karl S. Lashley (psychologist, Yerkes Laboratories).

The Committee immediately tackled the problem of developing a reading machine for the blind, i.e., a device for converting printed matter into some sort of sensory stimulation other than visual, and a guidance device for use by the blind somewhat as a flashlight is used by a sighted person walking in the dark. It was clear from the start that invention and engineering would not be the chief problem in these somewhat fantastic enterprises. The really critical question was how much the blind man could learn about the objects and scenes before him through instruments that stimulated his hearing or his sense of touch. How far could a buzz in his ears or a tingle on his skin be made to give him knowledge of a printed word or of an obstacle in his path? The machines must speak in codes that could be learned and that could be made to convey images of useful quality.

It was evident that much of the work in design and construction would be of such novel character that the Committee would require facilities for working out preliminary developments before going to outside industrial and academic laboratories for more exact apparatus. Haskins Laboratories was placed under contract for this purpose, and other contracts were placed in proper relationship to the central laboratory contract.

In addition to its program of aid to the blind, the Committee had a related program for the development of devices to aid persons of low visual acuity.

As a part of its general demobilization program, OSRD on November 1, 1945, entered into a contract with the National Academy of Sciences for work in the field of sensory devices. Under this contract the Academy combined the work on prosthetic devices with that on sensory devices under a single Board for Prosthetic and Sensory Devices. The OSRD Committee on Sensory Devices was dissolved and the same persons became members of the Committee on Sensory Devices of the Academy Board. The half-dozen OSRD contracts in the field were terminated and the contractors entered into subcontracts under the prime contract between OSRD and the Academy. The final step in the transfer of the program came when OSRD transferred the prime contract to the Surgeon General of the Army. The principal effect of the transfer was to give the Army a well-organized,
effective program of research in the fields of prosthetic and sensory devices. Approximately $272,500 was committed to the work on sensory devices under OSRD auspices.

Insect Control

The OSRD Insect Control Committee was created on September 20, 1944, pursuant to a recommendation of the CMR to co-ordinate the activities within the OSRD relating to insect and rodent control. These activities were in turn but a part of the total governmental program which involved several departments and included such matters as the mass production of DDT, its chemical characteristics, formulations and methods of dispersal for its efficient use, its potential danger to insects of economic importance and to other desirable forms of life including plants and birds, and its influence upon food and food sources. The Committee's function of co-ordination was described as follows:

It will be the task of this Committee to review all research projects having to do with insecticides and insect repellents now under way by the OSRD, to recommend to the Divisions of the CMR and NDRC and to the OFS, which have the responsibility for their supervision, the appropriate conduct of these projects in order to fit them adequately into the over-all picture; to initiate by recommendations to the appropriate Divisions of the NDRC and CMR, and to the OFS new projects whenever the Committee finds that such are needed to round out the work of the OSRD in the field of insect repellents and insecticides; and to further the knowledge of insect control in the military theaters of operation.

The members of the Committee were: M. C. Winternitz, Chairman, Chief of Division 5, CMR; A. B. Hastings, member, CMR; J. T. Wearn, Chief of Division 4, CMR; Roger Adams, member, NDRC; W. R. Kirner, Chief of Division 9, NDRC; W. A. Noyes, Jr., Chief of Division 10, NDRC; A. T. Waterman, Deputy Chief, OFS.

In order to facilitate the work of the Committee, subcommittees were appointed in the fields of biology, chemistry, rodent control, entomology, dispersal, and improvement of repellent preparations for skin application.

The Committee and its subcommittees had appropriate liaison with the Army (Technical Division of Chemical Warfare Service, Medical Division of Chemical Warfare Service, Army Committee for Insect and Rodent Control, U. S. Typhus Commission, Office of the Quartermaster General, Office of the Surgeon General, Office of the Chief of Engineers); with the Navy (Bureau of Medicine and Surgery, National Medical Research Institute); with the United States Public Health Service (Typhus Control Division, Malaria Control in War Areas Division, National Institute of Health); with the Department of Agriculture (Bureau of Entomology and Plant Quarantine); and with the Department of the Interior (Fish and Wildlife Service).
One of the principal activities of the Committee was to maintain a Coordination Center for the purpose of assembling information on insect and rodent control and making it available to qualified personnel.

Upon the recommendation of, and under contract with OSRD, the National Academy of Sciences formed an Insect Control Committee in February 1945, composed of representatives of most of the Government agencies working in the field, in order that they might consider broader aspects of insect control and the relationship to it of their respective programs. As OSRD demobilized, the Academy Committee took over those functions of the OSRD Committee of a continuing interest. Then on July 1, 1946, it became the Chemical-Biological Co-ordination Center of the National Research Council.

Within the framework of the organizations heretofore discussed—NDRC, CMR, and the groups described in the present chapter—there was carried on the work for which OSRD was created. The next chapter describes steps taken to obtain the best combat results from the products of their endeavor; and most of the remainder of the volume is devoted to the supporting activities whose objective was to make possible the effective functioning of the groups primarily responsible for results in the fields of military research.
CHAPTER IX

OFFICE OF FIELD SERVICE

Establishment of the Office of Field Service

NDRC early found that the most effective use of the equipment it developed required close and continuing collaboration with the using service. British branches of the M.I.T. radar laboratory and of the Harvard radar countermeasures laboratory were established in the fall of 1943, in order that scientists could closely follow the use of the laboratory-developed equipment by the Eighth Air Force and could adapt that equipment to meet tactical situations without delay. NDRC contracts with Columbia University and with the University of California brought similar close relations in the United States between the NDRC group working on anti-submarine warfare and Navy activities.

As more and more NDRC-developed equipment appeared in production quantities, an expansion of these field activities was clearly indicated. The Army and Navy training programs could not turn out enough technicians familiar with the equipment and then keep them abreast of the latest models. Military dissatisfaction with the performance of new weapons in combat, although it might result from improper use in the hands of personnel without technical knowledge, could delay an entire program of research and development. It was a matter of greatest importance that OSRD transfer a substantial segment of its scientific brainpower to improving the effective use of new weapons already developed.

In response to urgent calls from the armed forces themselves, some steps in this direction had already been taken. Increasingly, OSRD contractors were asked to send representatives from their laboratories to military stations at home and abroad to help with the introduction, installation and maintenance of the equipment they had developed or to aid in training the troops in its proper use. Such detailing of personnel to field activity was commonly within the subject work of contracts or was added in order to make such service available. As the number of men thus dispatched overseas increased, the need for co-ordination of their efforts became evident.

In addition to the expert help required for introducing new weapons and teaching people to operate and maintain them, there was a growing need for aid in the broader problem of finding out how they could best be employed in actual military or naval operations. This is a part of what is called
"operational research," or "operational analysis." Generally operational research included studies of the performance of equipment under operating conditions and of the performance of personnel in the operation of the equipment, with a view to improved training and doctrine, analysis and evaluation of one's own tactics or of the enemy's tactics. Some aspects of this work were a normal part of the functions of military personnel; but as the techniques were perfected, there was greater need for men trained in science and especially in mathematics and statistics.

Accordingly, after discussing the matter with the Advisory Council, Bush announced the creation of the Office of Field Service (OFS) on October 15, 1943; and on November 8, 1943, he issued Administrative Order No. 4 which established it as a principal subdivision of OSRD. This new unit which was to be headed by a Chief to be appointed by him had its functions defined as follows:

Under the general supervision and direction of the Director, the Office of Field Service shall direct, supervise and coordinate the rendering by the Office of Scientific Research and Development or its contractors to the Armed Services of the United States and its Allies of certain field services designed to (i) make the most effective possible use of developments by the United States or its Allies on mechanisms or devices of warfare or in military medicine, and (ii) minimize the effectiveness of any such developments made by the enemy, especially those in combat use. Principal among such services shall be operational research, field engineering, the organization and operation of laboratories established in military fields of operation, the work of ad hoc committees or missions for special study of field problems, the analysis of information contained in reports or derived from consultations concerning scientific problems arising in connection with military combat operations, and, subject to the policies fixed by the Scientific Personnel Office, the employment and training of personnel needed for such activities.

Karl T. Compton, President of M.I.T. and a member of NDRC, was named Chief of OFS and Alan T. Waterman, Deputy Chief (physicist, Yale University). The principal officers of OFS were the following:

Chief: Karl T. Compton (October 11, 1943 — July 30, 1945)
       Alan T. Waterman (July 31, 1945 — December 31, 1946)

Deputy
Chief: Alan T. Waterman (October 11, 1943 — July 30, 1945)
       John E. Burchard (August 1, 1945 — June 30, 1946)

Assistant
Chiefs: John E. Burchard (August 1, 1944 — August 1, 1945)
       George R. Harrison (February 24, 1944 — January 31, 1946)
       Paul E. Klopsteg (April 2, 1945 — January 31, 1946)
       Philip M. Morse (February 20, 1945 — January 31, 1946)
       John T. Tate (December 3, 1943 — January 31, 1946)
One policy which OFS followed consistently was that it would function only on direct request from a branch of the armed forces or from another Government agency, and that personnel made available would be loaned for an initial period not to exceed six months. It was understood, of course, that should the extension of such loans be desired by all parties concerned, including the individual himself, this would be effected. The title "Field Service Consultant" was given to all OFS field service representatives to disguise their specific functions and to provide latitude in the performance of their duties.

Major Categories of OFS Activity

By the time of the surrender of Japan OFS activities had extended to every theater of the war and had included every type of assistance foreseen in its charter. It had dispatched nearly 300 scientists and technical men on missions overseas, two thirds of them to the Pacific; had assigned 200 to project activities in the United States; had interviewed several thousand technical men; and had devoted considerable energy to answering questions, giving advice and looking up personnel in response to a host of assorted requests from the armed forces.

The technical accomplishments and personal adventures of the scientists who represented OFS are dealt with in a separate volume, called Combat Scientists. These men came from all the divisions of NDRC and from the special committees and panels of OSRD. Most of them had some previous affiliation with OSRD or its contractors, for OFS learned that the greatest need was for the specialist, highly skilled, fully acquainted with the intricacies and limitations of his equipment, able to command the respect of technically trained officers and facile in teaching the GI how best to employ the bewildering gadgets placed in his hands.

The varied functions of OFS fell into the following major categories: (1) procurement and processing of civilian specialists in science and technology for loan to war activities, predominantly for temporary duty overseas in theaters of military operations; (2) indoctrination of personnel procured for field service in developments of NDRC, in military procedures, or in the application of certain scientific techniques to problems of warfare; (3) establishment, staffing and supervision of "projects" on direct request from the armed forces, both at home and abroad; these covered a broad range both geographically and in fields of special scientific knowledge; (4) informal assistance from both the central office of OFS and from its field men to the Army, the Navy, units of OSRD, or other war activities in matters of procuring scientific personnel, exchanging technical information or setting up and manning activities that had scientific or technical aspects; (5) informal assistance in the placement of officers, enlisted personnel, or
draftees with technical background; (6) informal assistance to NDRC divisions in promoting field missions.

The services rendered by OFS field men included many kinds of consultation: analysis and outlining of problems in which civilian aid could prove helpful; analysis of military and naval operations, resulting in recommendations for revision of tactics; assistance with installation and maintenance of equipment or with training of military personnel in its proper use; analysis of the performance of new weapons and devices under field combat conditions, which might result in modifications back at the laboratories; assistance in promoting the flow of technical information between laboratories and production plants and the field users; assistance in the procurement of scientific intelligence; counsel on improving the utilization of personnel within the armed forces.

**Nature of Requests**

A “project” of OFS was essentially a job for which it procured and assigned personnel. The request might be for a single man or a group of men to be sent out for a few weeks to survey scientific aspects of a military problem in order to advise specific directions in which further help might be needed. On the other hand, it might involve the formation of a more or less permanent group at field headquarters, either for operational analysis or for consistent and continuous attack on problems that developed from day to day. Or it might be for the loan of an operations analyst or an equipment specialist to a group of civilians already established in one of the Services, such as an Operational Research Section of the Air Forces.

Ordinarily requests for OFS assistance began with informal negotiations. When OFS had determined that a request lay within its province and that there was some hope for securing the personnel necessary, the originating office initiated a formal request. Usually this was merely a paper confirmation of a request for services that had already been arranged. In this sense, OFS operated to a great extent “on the cuff,” because its fundamental philosophy was to get the requisite manpower on the job at the earliest possible moment.

**Promotion of Field Missions for NDRC Divisions**

Divisions of NDRC found themselves repeatedly blocked in efforts to get their representatives into combat areas in order to improve their own technical liaison with the using forces. They commonly felt that if their representatives could only demonstrate new devices to the officers in the combat areas where the need for them was most acute, this would result in pressure from the theaters upon the planning groups in this country and might
accelerate acceptance and procurement. Although the military in Washing-
ton were commonly sympathetic and willing to help in arranging such missions, they could not insist on sending civilian visitors to an operating command in the field. Here the theater commander was the supreme authority. He could refuse such missions if his staff were not convinced of their desirability; yet the real need was for an opportunity to convince the staff of the utility of the equipment. The divisions often urged that OFS use its good offices in the close contacts with high levels of Army and Navy which it was establishing both at home and in the field to bring about an invitation from a theater commander for a division representative to visit the areas under his control.

Facilitating Exchange of Scientific Information

The presence in OFS of men who could be emissaries not only for the OSRD development program but also for the technical services was welcomed by all to whom a free flow of technical information was important and who had suffered from the inability to communicate freely with the ultimate users of newly developed equipment. OFS therefore established with NDRC and with the Service laboratories procedures that would lead to rapid procurement of technical information, agreeing in turn to supply them with firsthand information that came back through military channels from the field service representatives.

Groups of OFS consultants maintaining more or less stationary headquarters in the field developed libraries for the whole command, containing not only the material procured through the OFS central office but also technical reports from Service branches on the mainland and operational reports originating in the theaters. Correspondence and technical reports which soon began to flow back from OFS men in the theaters commonly contained requests for information, for equipment, or for personnel. Over two hundred requests were received from the Middle Pacific. Approximately half of them were requests for information concerning the production status, availability, shipping dates or operating characteristics of radar equipment of all kinds. Some of them led to development work by NDRC or by the Services. Forty requests for equipment were received, a substantial number of them for radar spare parts, preproduction models, or test equipment. Seventy-one requests for reports involved nearly 400 separate documents published by NDRC, CMR, the Services and other agencies. Films, photographs and drawings were sent out to the theaters in large quantity.

About 150 requests were received from the OFS headquarters in the Southwest Pacific. Approximately one third of these were for equipment, generally for the development of new equipment to meet problems unique to that area.
Something over one half of the OFS personnel was engaged in the four principal lines of activity specifically mentioned in the following pages, namely ASWORG, ALSOS, the Operational Research Section in Hawaii and the Research Section in the Southwest Pacific. The remainder had highly varied and interesting assignments, but from an administrative standpoint they operated directly with OFS headquarters in Washington rather than through one of the four major activities.

The Antisubmarine Warfare Operational Research Group

The Antisubmarine Warfare Operational Research Group (ASWORG) had been established under a contract with Columbia University supervised by Division 6 of NDRC. Shortly after the creation of OFS, it was made a direct activity of that Office and it became the largest single project activity of OFS both in terms of number of men involved and in geographic distribution of their assignments. More than seventy specialists became members of the group, about half of them added after the transfer to OFS jurisdiction. Representatives of the project were located in North Africa and London, in Trinidad, Brazil and Newfoundland, in Hawaii and the Philippines, at Boston, New York, Quonset, Langley Field, Miami, and Fort Lauderdale.

The contribution of operational research toward solving the antisubmarine problems established the ASWORG organization and its methods so firmly that the Navy extended the scope of its responsibilities to activities of American submarines in the Pacific, to naval air operations and then finally to all types of naval operations. Whereas the group had concentrated in the early days on such relatively simple matters as the operation of a single aircraft on convoy patrol or submarine search, it was later dealing with the complicated operations of whole task forces. The group was renamed the Operations Research Group (ORG) in October 1944, and transferred to jurisdiction of the Readiness Division in COMINCH.* At the end of the war it was taken over from OSRD, with somewhat reduced manpower, to become a permanent part of the Navy organization.

A fundamental concept that characterized this project throughout its history was that a large section of the group’s membership should remain as a central group working with the general staff in Washington, carrying on the more theoretical tasks of statistically analyzing operational reports, devising and interpreting tactics and assisting in the preparation of tactical doctrine. Other members were assigned for temporary duty to the field where they would work with the users of new weapons, could apply ideas for new tactics in practice, and could recognize new problems to be transmitted to the central body for further work. Free interchange of informa-

* Commander-in-Chief, U. S. Fleet.
tion and personnel between the field units and the home office was essential. A rotation of assignments permitted field men to renew their acquaintance with laboratory developments and provided an opportunity for training members of the group in field work through practical experience. Success in early operations led to the establishment of several subgroups to deal with submarine operations, air operations, amphibious operations and naval gunfire support, antiaircraft fire, and special problems, including suicide attacks by Japanese airplanes against American vessels.

**OFS Activities in Europe**

In the European Theater of Operations (ETO) NDRC already had effective mechanisms for supplying technical consultation to both high and low echelons through the OSRD London Mission and the work of the British branches of the M.I.T. Radiation Laboratory and the Harvard Radio Research Laboratory. These agencies were functioning effectively and there was no need for OFS to exercise jurisdiction over them. It was decided rather that OFS should use them when expedient for attachment of new missions which it might be asked to sponsor in the European theater.

Thus, unless the military orders specifically prevented, every OFS man going eastward was advised to stop in at the London (or later, Paris) Office with a copy of his instructions from OFS. There he was given guidance on his mission and help with his fiscal affairs. He was also familiarized with a channel for sending reports and requests to OFS which commonly proved faster and more direct than the military channels normally available for communications of a technical nature. The use of this channel was always with the approval of the military and copies of the communications were usually sent concurrently through military channels.

Perhaps the single most important and certainly the most colorful OFS project in the European theater was the ALSOS Mission. This was a joint Army-Navy-OSRD activity that involved sending a group of outstanding physicists, chemists, metallurgists, engineers and other scientists into the territory recently won and close on the heels of or even along with the advancing armies. Its primary object was to secure an immediate over-all picture of German scientific research in the war effort and especially to find out with the greatest possible speed what progress German scientists had made in the critical field of atomic energy.

From the days when American troops made a successful landing in Italy until the end of the war, OSRD sent some sixty scientists into enemy-occupied and finally into enemy territory. They were engaged in assembling accurate information regarding the personnel, laboratories, institutions and industrial firms engaged in scientific war research for the enemy; prompt apprehension and questioning of the scientists and technical men and the
capture and securing of documents, equipment and facilities; intelligent investigation of files, laboratories and workers; translation and evaluation of a mass of correspondence and records; and finally an orderly reporting to the authorities in America.

**Initiation of OFS Aid in the Pacific**

In contrast to the situation in the Atlantic, when OFS began functioning there was no precedent for the widespread acceptance in the Pacific area of civilian scientists from OSRD. It was difficult in the early days of the war for theater commanders in that area to secure adequate transportation, supplies and weapons. They were reluctant to permit civilian “super-salesmen” to come out and increase their problems of housekeeping and transportation, only to whet their appetites for equipment which might not reach them for many months. Moreover, the officers for the most part were not familiar with benefits which were being derived on the other side of the world from close co-operation between scientists and military men. It was therefore decided at the beginning that OFS would take the primary responsibility for missions to Pacific areas and that one of its first obligations would be to establish appropriate liaison with the operational commands, a major undertaking in itself.

In order to explore the possibilities of OFS activities in Pacific operations, Compton undertook a series of conferences with the Commanders in Chief and other high officers of both Services in the Central, South and Southwest Pacific beginning in December 1943. He returned from this tour of the Pacific with what he described as “a pocketful of requests” for help from OSRD and from the Services. Many of them would involve field service activities. Some were for development work by NDRC; some were merely for the latest information on equipment. The stage was now set for extensive activity in the Pacific and the greater part of OFS attention during the next fifteen months was devoted to filling these requests and the numerous others which developed out of them as the personnel dispatched to the theater became active. Two major branch offices of OFS were to be set up, one in Oahu and the other in Australia. These would logically become foci of OFS in the respective theaters and their first functioning would relate to these requests. The OFS group in Hawaii retained its base of operations at Oahu to the end of hostilities and functioned as a closely knit, coherent unit. The OFS office in the Southwest Pacific, on the other hand, moved from Brisbane, Australia, to Hollandia, New Guinea, then on to Leyte and finally to Manila. Men sent through that office were detailed to duty which often took them thousands of miles from the OFS headquarters for many months. They were widely dispersed through the theater and had to operate almost independently.
Establishment and Growth of the Operational Research Section in Hawaii

Dr. Paul E. Klopsteg, Director of Research at the Technological Institute of Northwestern University and Chief of Division 17 of NDRC, was named an Assistant Chief of OFS and left for Oahu in March 1944. After a month of intensive consultation with officers of the Army headquarters staff and in the technical services he returned with a program of work and a suggested plan of organization. This called for the establishment of a “balanced team” consisting of specialists who would be constituted as a special group working at GHQ and reporting directly to the Army Chief of Staff. Dr. Lauriston C. Marshall, formerly director of the British branch of the Radiation Laboratory, was selected as the leader of this balanced team and departed for the theater in May. On the basis of his contacts with the officers and a priority listing of problems for the theater, Marshall soon recommended that his team consist of a permanent staff of twenty-three which would include experts in various named fields. This recommendation was approved by the Commanding General of the Central Pacific Area.

As the personnel of the group increased, the team was informally divided into groups of experts in the following four fields, each headed by a senior man who became a leader and took responsibility for supervision of the projects undertaken by his group: weapons and analysis; radar, communications and countermeasures; amphibious operations, transportation and cargo handling; and work simplification (until December 1944). Coordination was provided through weekly conferences of all members of the team who were not out in forward areas. When additional personnel were brought to the theater on short missions, it was the policy to attach them to Marshall’s team for administrative purposes and for coordination.

Soon after the balanced team was formally established in the theater it was designated as the Operational Research Section (ORS) and was assigned for administrative purposes to G-3 (operations), which placed it immediately under the supervision of the Assistant Chief of Staff, G-3, as a subsection. Although the Section functioned as a part of the Army organization, it worked with both Army and Navy. Throughout 1944 and the early months of 1945 the total personnel of the group increased steadily. By the end of hostilities nearly fifty men had been attached to it, including those assigned for short special missions. The Japanese surrender obviated the need for ORS and its activities were officially terminated on August 17.

Although ORS was technically a creation of the Army, Lieutenant General Robert C. Richardson adopted a generous and farsighted policy in authorizing the use of ORS men on work for the Army Air Forces and the Navy. Policy considerations of these branches dictated that requests for such
aid normally be made on an informal basis. Always with the approval of the Army Commander, ORS devoted approximately half of its manpower resources to problems of interest to these other agencies. At one time shortly before the Japanese surrender, more than a third of the personnel attached to ORS were in forward areas on temporary duty assigned to the Air Forces. Most of the work accomplished with units of the Navy could not receive official recognition and remains unreported. In several cases material prepared by ORS members was written into Navy doctrine as operational procedure.

**Development of OFS Headquarters in the Southwest Pacific**

At the end of March, 1944, Dr. George R. Harrison, Dean of Science at M.I.T. and Chief of Division 16 of NDRC, was appointed an Assistant Chief of OFS and departed for Brisbane, Australia, as the first head of what was to be in effect a branch office of OFS in the Southwest Pacific, operating within the military framework rather than as an independent agency like the London Mission. The task of this OFS unit was to provide necessary liaison with British military and civilian agencies centered in Australia; to serve as an administrative center for travel and fiscal details and communications of OFS personnel sent to the Southwest Pacific; to maintain continuing liaison with the troops in forward areas and discover new problems in which OSRD scientists might help; to co-ordinate and supervise all OFS missions to that theater; and to improve the flow of technical information.

Harrison succeeded in stimulating considerable interest in OSRD assistance among the officers, and requests additional to those brought back by Compton began to come in to Washington. In July 1944, Klopsteg succeeded Harrison. He remained until October at which time Dr. H. K. Stephenson, a Technical Aide in the Office, took over as Acting Chief, a position he retained until the unit was deactivated at the end of hostilities.

Activities of OFS Consultants who were processed through the Research Section of the Southwest Pacific Area (General MacArthur’s command) were even more varied than were those of the Operational Research Section at Oahu (Central Pacific Area, General Richardson’s command). They included a survey of the destructive action of marine borers; investigation of insect infestation of Army food stores; a study of transportation bottlenecks and equipment failures; work simplification to expedite handling of communications traffic; research on immunization and treatment of malaria; investigation of fungus infections of the skin; studies of wave propagation in jungle and mountainous terrain; establishment of a group of radar specialists to co-operate with the Australians in constructing radar equipment for ground control; a study of combat experience with smoke munitions,
flame throwers and mortars; work on radar countermeasures; demonstrations to introduce weapons developed for jungle warfare by NDRC; and a prolonged study of rockets for the support of operations.

A continual stream of information covering a wide variety of topics flowed back to the United States through the Research Section, including the field use of insecticides and DDT; tropical deterioration; fungus corrosion of optical instruments; Japanese fire control equipment; Japanese radar, rockets, land mines and booby traps; nonmetallic Japanese land mines; and many others.

Whereas the ORS in Hawaii was in daily touch with the staff officers to whom it had to report, the Research Section in the Southwest Pacific was often separated by 2000 miles of water from the high command, water dotted with Japanese-held islands over which scientists were not permitted to fly. Personnel sent to Marshall's team could discuss their problems regularly with each other, could get immediate action on the travel and fiscal details that might plague them, could get forward to operational areas readily and return frequently to their field base at Fort Shafter. Men sent to the Research Section, on the other hand, had to go out into the jungles, depend on local resources in a poorly supplied region, send their communications through devious and unreliable channels, fight their way back to headquarters with the most meager transportation. Headquarters moved repeatedly and the office personnel were constantly changing. In view of all these difficulties the substantial accomplishments of the Field Service Consultants who went to SWPA are a tribute to their persistence, imagination, patience and courage.

By late April 1945, the tempo of the war in the Pacific had greatly accelerated. Waterman went out, therefore, to confer with the commanders about a broad program for increasing OSRD aid in the whole Pacific area, for bringing about a more effective set-up of the civilian missions and for improving the co-ordination of all OSRD efforts through OFS and its military liaison agencies. He obtained the approval of General MacArthur for an all-out scientific effort through the establishment of a Pacific Branch of OSRD with headquarters at Manila.

Liaison with the Armed Services in Washington

The Office of the Co-ordinator of Research and Development was designated by the Secretary of the Navy as the single channel through which arrangements with the Office of Field Service were to be made. Except for the expansion of the Antisubmarine Warfare Operations Research Group there were so few field service projects undertaken at the formal request of the Navy that liaison relations were comparatively simple.
While OFS was of considerable assistance to the Navy, particularly in Hawaii, it commonly had to work informally. Officially the Navy attitude discouraged the presence of civilians in forward areas.

Initially the Operations Division was designated as the Army Ground Forces liaison office with OFS. In a short time, however, the War Department shifted the responsibility for liaison with OFS to the New Developments Division (NDD) which then remained the major Army channel for field service activities throughout the war. This division was a special staff section composed of officers of the General Staff Corps. Its Director at that time was Major General Stephen G. Henry, an able officer of wide acquaintance in the Army whose enthusiasm for the introduction and effective utilization of new weapons and devices was matched by his readiness to take maximum advantage of the skills of scientists either in or out of uniform. General Henry was ardent in his support of OSRD and keenly interested in the concept of transferring scientific talent through OFS from research to field use. His personal backing did a great deal to smooth the way for OFS in the difficult first days of its dealings with the Army.

In August 1944 General Henry was succeeded as Director of NDD by Brigadier General William A. Borden, who was also keenly interested in the possibilities for assisting the field forces by sending scientific talent to the front and was thoroughly co-operative. Unfortunately the New Developments Division was never sufficiently staffed to do its job completely. As it grew, it took on increased responsibilities in connection with other aspects of its directive and the officers assigned to take care of OFS matters were able to devote only part of their time to OFS projects. Field service operations would have progressed more effectively if the Service liaison office for the OFS type of activity had been authorized to develop a staff of officers and secretaries whose only responsibility was the handling of OFS matters and whose function included the military processing of all personnel loaned to that Service.

Initially OFS had no single channel with the Army Air Forces. Requests originating in different units came through various offices. This created difficulties and led to arrangements in the summer of 1945, when plans for channeling all OSRD field groups through OFS were being formulated, to set up a single office in the Air Forces that would function in parallel with NDD for processing OFS men and handling OFS communications on AAF matters. Brigadier General J. F. Phillips's division in the office of the Assistant Chief of Air Staff for Matériel and Services was designated, and Colonel W. G. Brown, who had been AAF Liaison Officer with NDRC, was assigned to supervise the processing. The office began to function late in July 1945.
Liaison in the Theaters

Although the basic liaison with the Services at home was generally excellent, there remained the problem of establishing good relations with the theater commanders. In the European areas the matter was already well taken care of by the OSRD Liaison Office.

In the Central Pacific the problems of OFS organization and liaison were relatively minor. The Operational Research Section had a clear staff position as a subsection of G-3. This made it possible for all branches of the Army to request assistance easily. Effective working relations with Air Forces and Navy were developed so that the section could serve all elements of the command. Members of the "balanced team" could collaborate, could travel about in the theater without too much difficulty. In spite of minor disadvantages in its situation, the organizational pattern of this ORS became a model for effective placement of civilian scientists in an operational command in the Pacific.

At first all communications except strictly personal letters had to pass through the hands of NDD and OFS for appropriate distribution. The resultant delays in handling the papers for clearance up through the chain of command in the theater were incompatible with the urgency of the matters discussed. The theater command recognized that this would impair the efficiency of ORS. Accordingly, ORS was finally permitted to transmit, without the usual staff consideration, "technical" letters directly to any civilian agency in the theater or on the mainland provided they contained the statement, "This letter does not necessarily reflect the views of the Commanding General," and that copies were sent concurrently for information to OFS and NDD. This procedure was eventually approved also by the command in the Southwest Pacific.

In the Southwest Pacific the situation was vastly different. Greater distance from home bases, wider dispersal of forces and of the scientists aiding them, longer and slower lines of communications, periodic remoteness of GHQ from the operating fronts, smaller supply of weapons and of transportation, disagreeable climate and uncomfortable working conditions, repeated shifting of headquarters—these were the difficulties under which MacArthur's forces and the scientists sent to help them had to labor for many months. It is not surprising that it took more than a year of experimenting before the most effective way of setting up an OFS group in the command was evolved.

In July 1944 General MacArthur issued a clarifying directive which established the OFS unit as the Research Section, General Headquarters, Southwest Pacific Area, and broadened its responsibilities. It specified that the section would serve as a liaison office for the ground, air and naval
forces with the civilian research agencies in the United States, Australia and elsewhere, and as a clearing house and channel for all work requiring the use of civilian scientific personnel in that theater. It was likewise specified that all communications concerning OSRD activities would be co-ordinated with the Research Section. Subsequently the Research Section was transferred from GHQ to be under the direction of the President of the USAFFE* Board, Colonel William Alexander. A new directive was then issued establishing the unit as the Research Section, USAFFE Board, and permitting it to remain an entity within the Board. This setup interposed one more link in the chain of command because the President of the Board reported to the Deputy Chief of Staff, USAFFE, Major General Richard J. Marshall. Nevertheless, because the members of the USAFFE Board had great freedom to work on their projects in all parts of the theater, OFS was able to operate more effectively.

Establishment of the Pacific Branch, OSRD

Even before the fall of Germany the need for a more effective focusing of the scientific effort against Japan had become apparent. Bush instructed that OFS should be the channel for all field operations of OSRD and its contractors in the Pacific. Waterman left for Honolulu and Manila in April 1945, to work out plans for more effective co-operation with field headquarters.

Conferences with Generals MacArthur, Akin, Marquat, Krueger and Kenney disclosed that the command felt the need for a highly qualified group of men to act as a consulting staff on such pressing problems as suicide attacks, disposal of devastating enemy mortar fire, and tactical uses of radar, which could not be solved by standard military methods. The consultants should be men of such standing in OSRD that they could get immediate assistance in men and equipment or information when they asked for it.

Waterman returned in June with a request from General MacArthur for the establishment of a Pacific Branch of OSRD (PBOSRD) dependent upon the theater for facilities and having the greatest possible freedom for work that could be granted by the Commander-in-Chief. It would include three types of service: (1) a consulting staff of outstanding senior scientists, medical men and engineers; (2) a pool of scientific specialists closer to the operating units and already processed for assignments on temporary duty to the fighting fronts; and (3) a headquarters administrative office and laboratory facilities for emergency work.

The theater wished to exercise operational control in the military sense,

* U. S. Army Forces in the Far East.
that is, to have the unit report directly to the command and follow the customary regulations of military control over personnel, equipment and communications. It was proposed the PBOSRD should be an operating unit with its Director reporting directly to the Chief of Staff so that in effect it would be a Special Staff Section of GHQ; in addition, it was to be free to communicate directly with OSRD at home on purely technical matters.

Lieutenant General R. K. Sutherland, Chief of Staff for General MacArthur, also decided that General MacArthur should have a senior advisory specialist as his own consultant on technical matters. He would be appointed Special Staff Officer on scientific and technical affairs and would report to the Chief of Staff independently of the Director of PBOSRD. Obviously the two would have to work in close co-operation. Eventually E. L. Moreland, Executive Officer of NDRC, was selected for this important post. Bush accepted the recommendation for the establishment of a Pacific Branch of OSRD and appointed Compton as its Director with the responsibility of supervising the entire OSRD program in the Pacific.

Since the Army had approved a plan that would give the technical men direct access to the topmost levels of the Pacific command, it was clear that OSRD units need feel no further hesitancy to release their most competent personnel for aid in delivering the knockout blows at Japan. Bush and Conant addressed letters to all divisions of NDRC and CMR asking that they back the powerful team of Compton and Moreland to the fullest extent possible. Those divisions which would be primarily concerned with problems of the theater gave Compton recommendations of key personnel who would be made available on call for the staff of senior consultants. These men were then alerted by OFS, began their processing and stood by for the theater request.

It had been agreed that OFS was to assume primary responsibility for attention to the needs of this new unit so that the Director of PBOSRD could look to a single office in Washington for administrative assistance in procurement of personnel, handling of communications and requests for information. A contract was proposed with the National Academy of Sciences for the establishment and operation of a laboratory at Manila and at such other places as might be indicated, together with the supporting services which a contractor might appropriately provide. The Director of PBOSRD was to be Scientific Officer under the contract.

Although Compton arrived in the theater only a few days before the capitulation of Japan, the Pacific Branch was more than a paper organization. There was already in the theater a sizeable group of first-line men sent out from various OSRD Divisions to the Research Section and Far Eastern Air Force. They would have constituted Compton’s initial staff. The central OFS office in Washington had approximately seventy more
in process for assignment. The formal requests that would have authorized dispatch of a large contingent were received in Washington in the midst of the victory celebration.

**Procurement of Scientific Personnel**

By the close of the war nearly 500 persons had been engaged in the work of OFS. During the two years of its active recruiting scientists were dispatched to a foreign mission at the rate of one every two days. On V-J Day seventy men were in various stages of preparation for departure.

When OFS began its operations, scientific manpower had been stretched almost beyond its elastic limit. The senior staff of OFS had to turn to its scientific associates for the names of promising men who might function effectively in field service. The alumni placement bureaus of M.I.T., Yale and Princeton were consulted. The staffs of many educational institutions produced the names of a large number of scientists who might eventually be available for OFS work. But, for the most part, the personal contacts of the OFS staff in their own specialties and in NDRC were the most prolific sources of information. As the calls were increasingly for men who knew NDRC equipment, acquaintance with the OSRD divisions became even more significant to successful recruiting in OFS. The Scientific Personnel Office of OSRD, which had extensive records of NDRC contractors' employees, became at times a source of much information.

There were calls for men from almost every scientific discipline. The importance of new devices is nevertheless strongly reflected in the distribution of OFS personnel according to their fields of special competence. Thirty-seven per cent of them were trained as physicists, electrical engineers and communications men. Twelve per cent came from chemistry or chemical engineering backgrounds and an equivalent group from mathematics. The medical and biological fields contributed 10 per cent. Civil engineers, architects and mechanical engineers, constituting 11 per cent of the total, were utilized because of their suitability for work on bomb damage assessment. Five per cent came from training in industrial engineering to aid in the expanding work simplification program of the Army which OFS supported. Geophysics, seismology and geology were represented by 3 per cent of the field service and administrative personnel. The balance of 10 per cent included such diverse training as economics, law, fire protection engineering, camouflage, naval architecture and library science.

Ordinarily the special training of an individual was used directly in his OFS assignment, but the versatility and adaptability of scientists from the various disciplines was rather cogently demonstrated. Many used their collateral training rather than the specialties in which they may have made
their prewar records. Biologists studied the behavior of submarines, convoys and patrolling aircraft. Geologists became administrative officers, went out to counsel on countermeasures to enemy land mines, or helped Army officers in developing a guide manual for jungle warfare. Although generally the field service scientist had to know more about his special subject than any officer with whom he might be associated in the theater, breadth of training was quite as likely to win him respect and cooperation as was intensity. Even more important was the practicality of his outlook.

More than half of the Field Service Consultants had had graduate training in science. Forty-two per cent held Doctor of Philosophy or Science, Doctor of Medicine, or equivalent degrees. Yet 32 per cent had not gone beyond undergraduate college training. This figure may be misleading because most of these men either had years of practical experience fully as significant as and often more pertinent than the more advanced education, or they had received an intensive indoctrination through work with OSRD which would be fully equivalent to graduate study in its intellectual challenge.

**Length of Affiliation with OFS**

A high percentage of the OFS assignments were renewed at the end of the initial six months maximum that was a standard specification. The average length of affiliation of the Field Service Consultants was eight and one half months. Many assignments were, of course, much shorter, a few as brief as a single month, while in the Operational Research Group, which had a stable program, the average tenure was eighteen months. Experience showed that the usefulness of scientific consultants to a theater headquarters was greatly impaired by shifting personnel through replacement of men sent for short periods. Consequently, without committing the man to the military in writing for more than six months at a time, OFS began the practice of having a verbal understanding with him and with his employer that he would remain in the combat area beyond the initial interval if he were still needed.

**Methods of Obtaining Personnel**

OSRD obtained statutory authority to hire technical and professional personnel for OFS under personal-services contract without regard to Civil Service regulations; the rate of compensation provided was not to exceed $25 per day. On a forty-eight hour week this meant that the maximum salary payable under such contracts was $700 per month or $8400 per year.
Two types of personal-services contracts were utilized by OFS. One involved the full-time services of the individual; 208 people were hired on this basis. The other provided for the services of the individual on a periodic or WAE (when actually employed) basis. In most cases this was used to make available the services of people who had critical commitments elsewhere and could give only a portion of their total working time to OFS. Twenty-five people were procured on this basis. Salaries under personal-services contracts were arrived at on a basis of negotiation which, in general, followed the principle of "no-profit-no-loss" which OSRD had adopted; salary arrangements were reviewed by the Scientific Personnel Office from this standpoint.

The delays and complications inherent in switching employment for short intervals kept the personal-services contract plan from becoming as effective as had been anticipated. A considerable number of OFS consultants who were in the employ of OSRD contractors were merely borrowed from their employers on the basis of a detail. As the pressure increased and the OSRD contractors became the primary sources of field men, the proportion of men loaned to the Services through detail to OFS likewise increased. The total number of personnel procured on detail constituted a little over one fourth of the OFS roster. Several OFS Consultants were obtained by detail from other Government agencies.

In some instances employers not under contract with OSRD were unwilling to release their personnel to Government payrolls. They were willing, however, to make them available provided the Government found some mechanism for reimbursing salary, transportation, per diem and incidental expenses, but leaving the individual legally on the payroll of the original employer. This was particularly desirable if a change in employer would mean a sacrifice in pension status or seniority schedule. It was also desirable where there was some fear that the temporary separation arranged for service with OFS might encourage a more permanent one afterwards. Accordingly, in April 1944, Bush authorized the execution of contracts between OSRD on behalf of OFS and industrial firms or educational institutions on a basis comparable to that which had proved successful in the operations of NDRC. The contracts were essentially similar to the standard NDRC research and development contracts. Altogether, OFS recommended fourteen such contracts covering a total of nineteen technical men.

INDOCTRINATION

The first responsibility of OFS, after arranging for the services of an individual, was to ascertain that his orientation in OSRD was sufficient to permit his being sent as one of its representatives. Unfortunately the
time available between establishment of contact with the individual and his departure for an assignment was so variable that no systematic program of orientation could be devised. Under the guidance of the OFS central staff each man had to acquire as much information as the time schedule and his preoccupation with the many other details of preparing for assignment would permit. Fortunately, as the tempo of the war increased, the number of field service consultants who came to their assignments from a long background in OSRD increased, so that systematic orientation became less important.

OFS was not equipped to provide indoctrination in military protocol and etiquette. It had to depend for this on its liaison with the Services. Ordinarily, the Navy undertook its own indoctrination. The Army appeared to attach less importance to the subject and left it largely to the common sense of the individual to acquire what he could in his contacts while still undergoing processing or later while on his field assignment. Moreover, the time interval in which a man had to be fully prepared for departure was generally insufficient to permit more than a perfunctory attempt at formalized indoctrination. Fortunately, the majority of OFS men going out either had acquired a "know-how" in dealings with the military from earlier experience in OSRD, or they were being sent to report in the theater through one of the OFS offices there. Here they found colleagues, familiar with the procedures, who took appropriate steps to guide them.

**Processing for Assignment**

In addition to procedural formalities involved in his employment or appointment by the Government, each individual who accepted an affiliation with OFS for field service had to undergo an involved series of steps to prepare him for the assignment. These came to be known as "processing." For those who were going overseas this was doubly complicated because it involved procurement of military as well as civilian credentials and the purchase of uniforms.

Processing consisted of two major sequences. One involved the things which any civilian would need to do to go abroad in peacetime - immunizations, obtaining a passport, arranging for the handling of fiscal matters, and the preparation of civilian credentials. The other involved special steps necessary because of the war and because the individual was proceeding to a military combat area. These additional items included: security clearance for the handling of classified information; permission from the local Selective Service Board to leave the country (applicable only to men in certain age groups); a military permit to be attached to the passport and authorizing entrance to the war theater (issued by the Joint Chiefs of Staff in Washington only upon receipt of a request for the individual by name
from the theater commander); extra-hazardous insurance to provide broad coverage geographically and to include possible injuries or death resulting from war conditions; an official appointment to and identification with a branch of the armed forces; appropriate military or naval uniforms and equipment as prescribed by the sponsoring Service agency for the theater and season; official military travel orders; and arrangements for transportation to and within the theater. Altogether the processing unit of OFS listed nearly a hundred separate items on which some action would be necessary in the case of every Field Service Consultant who was to be sent overseas. It was exclusively a responsibility of OFS to act on many of these.

Always there was pressure for speed to accomplish the processing. When the military decided that an individual was wanted, he was usually wanted post haste. The relationship between some of the processing steps was so close that a delay in the handling of one might start a chain of cumulative delays. For example, a holdup on security investigation would not permit issuance of military credentials, which in turn would delay the time-consuming process of procuring a properly fitted uniform. In view of wartime travel restrictions it was highly important that the consecutive items in such a sequence be handled systematically and efficiently.

Even with the highest priority from the military and great pressure from top echelons in OSRD, it was rarely possible to prepare a man for assignment overseas and get him on a plane within less than a week. Commonly the interval that elapsed between the first contact with him in response to a theater request and his departure from the country was at least a month. This was a source of much distress to the military sponsors, to the central staff, to the NDRC divisions, and to the individual, although it did permit him a bit more time to arrange his personal affairs and acquire greater familiarity with military protocol and etiquette.

Field Service Consultants who were assigned for duty within the United States or in England could serve in civilian clothing. For duty in a combat theater it was necessary, however, to wear the uniform of the branch of the armed forces to which assignment was made. This was like the uniform of an officer, without special insignia of rank, but it did carry identifying shoulder patches. In order to procure the uniform an official appointment by the Army or Navy was necessary. This was made on recommendation from OFS and involved submission of a series of documents regarding the man’s security clearance, personal health, immunizations, police record, draft release and the nature of his proposed assignment with the military Service.

Men assigned to the Navy were issued a Certificate of Identification which authorized them to take passage on naval vessels and to visit naval establishments and were given appointments as U. S. Navy Technicians and a Letter of Credentials outlining their status and the purpose of their as-
signment. These credentials were provided by the Office of the Chief of Naval Operations on recommendation either from OSRD or from the sponsoring office within the Navy (Bureau, COMINCH, etc.). A Navy Technician wore a patch over the left breast pocket of his blouse. This depicted an eagle clutching mechanic’s tools. The insignia was given to all such civilian appointees regardless of their intended function. Consequently, there was no distinction to the observer between a Coca-Cola machine maintenance technician, a mechanic and a physicist or engineer from OSRD. Early in its history, OFS was unsuccessful in an attempt to persuade the Navy that some special designation should be devised for all civilian scientists of OFS loaned to the Navy which would give them greater prestige; but special insignia were authorized for the members of the Operations Research Group, largest of the OFS projects undertaken for the Navy.

In 1943 the Army could appoint a civilian as “Expert Consultant to the Secretary of War” or as “Technical Observer.” Technical Observer appointments were comparable with U. S. Navy Technician appointments in that there was no distinction made between technicians sent out from manufacturers to service field equipment and scientists who would operate at staff level. The New Developments Division, impressed with the disadvantages of this, managed to secure a revision of Army regulations and the authorization of two new types of appointments: “Scientific Consultant” and “Operations Analyst.” This occurred in the fall of 1944 and thereafter OFS personnel were sent out with one or the other of these designations. A new shoulder patch with the words “Scientific Consultant” or “Operations Analyst” embroidered across it was devised and issued by the Adjutant General’s Office. After this, the Navy, which had declined the OSRD proposal that such arrangements be made, became interested and asked Compton to propose a similar revision of its regulations. This happened so late in the war, however, that the revision was never accomplished.

Upon recommendation from the OFS transmitted via the New Developments Division, or from the sponsoring office in the case of Air Forces appointees, the official credentials were issued by the Adjutant General’s Office. These consisted of two AGO cards, one of which specified that the individual was a noncombatant civilian, to be given billeting and messing facilities of the type accorded to an officer, the other assigned him an “assimilated rank.” This was established arbitrarily on the basis of the salary he received, according to a schedule prepared by the War Department. The assimilated rank was intended to be used only in case of capture when, theoretically, the enemy would treat the individual as he would an officer of the same true rank under terms of the Geneva Convention. Actually, the assimilated rank was frequently and necessarily referred to in connection with billeting and other matters since the individual had to fit into Army arrangements, although such use was not intended.
There was considerable reluctance on the part of the War Department to issue appointments carrying assimilated ranks higher than Colonel. However, late in the war, when greater confidence was felt in the OSRD civilians, a few higher appointments were authorized. When Compton and Moreland went to the Southwest Pacific, just before V-J Day, each carried the assimilated rank of Major General.

In order to get a civilian scientist into an operating theater, priority for his travel had to be established by the theater. If a request from the theater for men to staff a particular project had been received in general terms, OFS went about the necessary recruiting and when it had secured appropriate candidates who would presumably be accepted by the theater, their processing started. A communication naming them was forwarded to the theater so that the official theater request and travel priority could be established. One of the aggravating delays in processing occurred frequently when a theater asked for an individual but failed to establish a travel priority. In the Pacific, where OFS had its advanced headquarters, the communications were channeled through the OFS scientists in the theater who took the responsibility for following up, initiating and expediting the necessary military action, so that such oversights were reduced.

**Status of the Field Service Consultant in the Theater**

One advantage of the OFS system for sending personnel out on missions was that they were sent as representatives of a high echelon office such as the New Developments Division to report to GHQ and to be attached at staff level to the command. They might be detailed to work directly with the officers and enlisted men of a lower echelon, but they had immediate access in the theater across channels to an authoritative body in the Service and through it to a high level in Washington. This meant that they were unlikely to get trapped in low priority work, that their communications could get through promptly and would carry appropriate weight and that they could move about more freely in the theater.

The scientist who went to any theater outside the United States was responsible during his stay only to the Commanding Officer, was subject to military discipline and etiquette and was entirely dependent on the cooperation of the Commanding Officer to provide billeting, transportation, communications facilities and permission to leave the theater. He was expected to conduct his correspondence as would an officer, censoring his own personal mail but honor bound to keep it personal, enjoying the privilege of freedom from postage. His official communications went through the appropriate office of the theater staff after review by the officer to whom he was directly responsible, thence through the theater AGO to the Service liaison office at home. This office forwarded his communications to OFS.
which in turn distributed any necessary information or requests to NDRC, CMR or other agencies. In the theater, the civilian was usually accorded membership in the officer’s club and liquor locker, received social invitations, and participated in the various ways of relieving the tedium of working under war conditions.

DEMOBILIZATION

Immediately after V-J Day, Bush formulated a demobilization policy for OFS. The field men overseas were to be recalled as soon as their missions could be completed. No new ones were to depart without specific individual approval of the Director, and this would be given only for problems in which OSRD could properly maintain a continuing responsibility. Projects that lost their significance when war ended were to be terminated; others which the Services wished to continue temporarily or to take over as more permanent peacetime undertakings of the military or naval arms, were to be carried by OFS only until suitable arrangements for transfer to the Services could be completed. None of this liquidation was to be accomplished with such haste that values of the scientific work would be destroyed, the amicable relations of OSRD with the Services jeopardized or the individual workers concerned left in awkward positions with regard to employment, but a spirit of positive action for demobilization was to prevail.

Although some delays were anticipated because of the probable scarcity of transportation, the overseas travelers managed to get plane transportation quickly. By the middle of October, 1945, all OFS men in Europe had returned; by November 1 only a handful were left in the Pacific. In January 1946, the personal-services contract employees could be counted on one’s fingers and the Washington staff had been reduced to a skeleton force engaged primarily in following up fiscal details, straightening out the records for the archives, disposing of classified documents and writing the OFS history. Despite its speed, this demobilization was entirely orderly, with most of the personnel returning to posts from which they had been on leave.

The Office of Field Service represented a concerted effort to obtain the closest possible relation between the civilian scientist and combat troops on terms which would enable the scientist to make his greatest contribution in a critical area. The detailed report contained in Combat Scientists shows that the effort produced highly significant results which lay the foundation for even more effective operations should the need unfortunately arise at some future date.
The National Defense Research Committee and, later, the Office of Scientific Research and Development were created to mobilize the scientific strength of the country for the purpose of assisting the Army and Navy. Close relationship with the Services, therefore, was imperative to define the needs of the forces and to assure that the final output should meet the need for which a project was initiated. It was needed to avoid duplication of facilities and of effort, and to speed the work from initiation toward the final stage of placing the equipment in the hands of the troops. Outstanding was the requirement that the relationship should be such as to provide for complete interchange of information. To meet such requirements meant that a system of teamwork — novel because of the full stature to which its military implications had brought science — had to be established; scientific men and military men had to learn to work as partners. That this novel problem was generally solved with full effectiveness is clear from the results which were achieved. There were defects at first, as was to be expected, for the problem was a new one and methods for working it out had to be developed. If in the recital of the history of that development places where defects lingered are cited, that is to indicate where a still better job could be done another time.

MECHANISM OF LIAISON

The mechanism of liaison with the Services included the Advisory Council of OSRD, already discussed. Liaison in the medical area and in field service operations was discussed in the chapters on the Committee on Medical Research and the Office of Field Service. The present chapter will be confined to liaison relations between NDRC and the Services in the field of weapon development.

WAR AND NAVY DEPARTMENT LIAISON OFFICERS

The most direct contacts between NDRC and the Services were through the Army and Navy members of the Committee and through the activities
of the Director of OSRD as Chairman of the Joint Committee on New Weapons and Equipment of the Joint Chiefs of Staff (see Chapter III). Supplementing these, the formal points of contact between OSRD and the Services were the War Department Liaison Officer for the NDRC in the case of the Army and the Co-ordinator of Research and Development in the case of the Navy. These two officers were the official spokesmen for the War and Navy Departments and through them cleared the formal expression of views of the Departments in their transactions with OSRD.

From June 27, 1940, when NDRC was formed until July 12, 1941, when the Office of the Co-ordinator of Research and Development was created by General Orders No. 150 of the Navy Department, liaison with NDRC was through the Director of the Naval Research Laboratory. Establishment of the Co-ordinator’s Office in the Office of the Secretary of the Navy provided a better mechanism for liaison. Rear Admiral Julius A. Furer, as Co-ordinator from December 13, 1941, until his retirement after V-E Day, made that mechanism function admirably, at times under extraordinary difficulties. He served also most effectively as a member of the Advisory Council. Captain Lybrand P. Smith joined the Co-ordinator’s Office August 1, 1941, as assistant to the Co-ordinator and at that time became the Navy member of NDRC, continuing as such until Admiral Furer took his place February 28, 1945, on Captain Smith’s retirement. OSRD-Navy relations benefited greatly from the continuity of service of these two naval officers and also from their special qualifications for their respective positions.

The numerous changes which occurred in Army representation necessarily acted as a handicap. The complexity of the Army organization also was a source of trouble. The Army was large. In the number of officers it expanded in about two years by a factor of fifty. It was subdivided into the Ground Forces, the Air Forces and the Service Forces, of which the first had the function of combat; the second, combat and procurement; and the third, mainly procurement. Above these was the War Department General Staff and the Special Staff of which the New Developments Division when formed in October 1943 was a part.

The Army Ground Forces contained a wealth of information as to combat needs of forces in the field, which was often difficult to obtain, largely because of the complexity of the Army organization, and the frequent interposition of the technical branches of the Army Service Forces between the Ground Forces and OSRD. A bright spot in the Ground Forces organization was provided by the boards maintained by each of the arms within the Ground Forces for testing proposed equipment to determine its suitability for field service. Thus there were the Armored Force Board, the Engineer Board, the Coast and Field Artillery Boards, the Antiaircraft and the Tank Destroyer Boards. The members of these Boards were usually competent and alert to the needs of the troops, with whom they were in close touch. In
the entire history of OSRD there was no more satisfactory or productive liaison than existed when scientific groups sat down with the Service boards to hear their problems at first hand and learn the characteristics of needed equipment. In such cases, scientists and military personnel tackled a problem together, and action was swift.

The Army Air Corps became increasingly autonomous during the war. Liaison with scientific organizations was in the main direct, though nominally and officially through the War Department Liaison Officer.

The Army Service Forces included a large headquarters besides the several procurement agencies of the War Department: for example, the Ordnance Department, the Signal Corps, the Corps of Engineers, the Chemical Warfare Service. In that headquarters was placed the War Department Liaison Officer for NDRC. So placed, his office operated under handicaps, some of which might have been avoided had it been placed under the Secretary of War or the General Staff.

A succession of changes in organization within the War Department affected liaison with NDRC. Frequent changes of personnel further tended to weaken the effectiveness of liaison. When NDRC was created, the War Department detailed Colonel Gladeon M. Barnes of the Ordnance Department as War Department Liaison Officer. Before the office had become active he was relieved on July 30, 1940, by Brigadier General Richard H. Somers, also of the Ordnance Department. General Somers served in this capacity until August 5, 1941, when Colonel (then Brigadier General) Barnes was re-detailed. He served until the reorganization of the War Department in March 1942.

Thereafter, the functions of development had been a responsibility of the G-4 (supply) Division of the War Department General Staff, of which Major General Brehon B. Somervell was chief. In the reorganization these functions were transferred with General Somervell to the newly created Army Service Forces (for a period called the Services of Supply). In the headquarters organization of the Service Forces, the War Department Liaison Officer for NDRC was attached to the Development Branch (later designated the Research and Development Division). On April 3, 1942, Major General C. C. Williams, who had been Chief of Ordnance from 1918 until 1930, was appointed War Department Liaison Officer and also became the War Department member of NDRC. General Williams brought broad vision and prestige in the Army to the Office of the War Department Liaison Officer, with an understanding of the increased potentialities of highly technical equipment in military operations and an appreciation of the reliance which must be placed on scientific personnel as a consequence. For personal reasons it was necessary for General Williams to retire; he was relieved on July 7, 1943.

General Williams was succeeded by Brigadier General W. A. Wood, Jr.,
Director of the Requirements Division of the Army Service Forces. His assistant as War Department Liaison Officer was Colonel Ralph M. Osborne of the Field Artillery. General Wood continued as Liaison Officer for a few months only, when he in turn was succeeded by Colonel Osborne on January 4, 1944. On May 15, 1944, Colonel Osborne also became Director of the Research and Development Division. After Colonel Osborne’s departure for overseas duty, Colonel Philip R. Faymonville was designated War Department Liaison Officer on February 10, 1945, but soon after was relieved from duty in Washington and on June 28, 1945, Brigadier General Eugene A. Regnier, who had become Director of the Research and Development Division, was designated War Department Liaison Officer for NDRC. He continued as such to the end of hostilities.

In the five years and two months from the creation of NDRC to V-J Day, seven officers served as War Department Liaison Officer. One of these served twice. Three officers only, General Williams, General Somers and Colonel Osborne, served as long as one year. In contrast, Rear Admiral Furer, Navy Co-ordinator of Research and Development, served three years and five months, from a week after Pearl Harbor until after V-E Day.

**Project Liaison Officers**

Those means of liaison with the Services which have been mentioned were at the higher levels only, involving few persons and having little day-by-day contact with the scientific work that was being done by thousands of scientists in hundreds of laboratories throughout the United States. The nineteen divisions and several panels and committees of NDRC were working each in a different field, and each one was directing work on a number of contracts, most of which were on different projects. These activities were multifarious. Day-by-day contact between the Army and Navy and the activities of OSRD was provided by means of Project Liaison Officers.

Project Liaison Officers usually were named by the technical branches of the War Department or bureaus of the Navy Department, and sometimes by the combat arms or by the command. It was their responsibility to provide to the scientific group the point of view of the using arm. One Liaison Officer ordinarily served as such for a number of projects, usually in the same general field. Officers of good quality were required. Sufficient background of technical training was needed to enable them to perceive the elements of the particular problem, although it was no part of their duty to suggest to the scientists how the problem was to be solved. Enough experience in the military or naval service was necessary to enable them to reflect the point of view of the users. Some Project Liaison Officers were of little value because they lacked both technical background and Service experience.
Project Liaison Officers provided a means for the quick exchange of information. Through them arrangements were made for tests. In the late stages of a development, they were the intermediaries in the necessary prompt selection of a commercial organization for engineering and production. These later stages were facilitated by the Engineering and Transition Office of OSRD, which itself was a useful liaison agency with the procurement branches of the Army and Navy. Project Liaison Officers existed to speed the project from initiation to the final stage of large-scale Service procurement.

Lack of continuity in Liaison Officers on projects caused frequent comment throughout the war from Chiefs of NDRC divisions. A new Liaison Officer lacked knowledge of the work in hand. This situation was about equally serious in the Army and Navy. At the Radiation Laboratory both Services maintained reasonably large staffs, as did the Navy with the Division 3 rocket work at the California Institute of Technology, so that there was always someone present at these places who knew the work; but this was not the case with NDRC as a whole.

As the Liaison Officers most often were designated by the technical branches of the armed services, they reflected the attitudes and were subject to the prejudices and opinions of their military superiors in those branches. Officers who had worked hard with limited resources felt a justified pride in their establishments and resented in some cases the intrusion of a civilian group which might possibly supersede their organizations. Some few older officers of the technical branches of both Services had an attitude of proprietary interest in the development of military equipment. They had the feeling, perhaps, that they were the professionals in a field which was their own and where civilian scientists were intruders. Coupled with this in a few cases was an overzealous branch loyalty tending to lead, without deliberate intention, to identifying loyalty to the branch with the broader interests of the Service as a whole or of the country. Such mistaken branch loyalty seriously handicapped in some cases the relations of OSRD to the Services.

One sometimes troublesome pitfall was oversecurity. The Services at times were reluctant to divulge confidential data, though this was essential if successful designs were to be undertaken. The Navy in the earlier years was particularly security-minded; officers did not want to give information to civilians for fear it would be given to others. The assembling of all existent information was a first step in undertaking a problem. Actual and not synthetic data were needed; it was not sufficient to furnish interpreted information in the form of supposably similar cases. Civilian scientists at times were inhibited from attacking a problem because they were not given the background information. The situation improved very greatly during the war, as officers of the Army and Navy came to know the civilian scientists.
Performance of Equipment

One phase of liaison between NDRC and the Services was related to the transmission of operational information from the Army and Navy to the divisions, where the information was concerned with the performance of instruments or weapons developed by an NDRC organization. The lack of an adequate supply of such information points to a chief defect in the liaison organization. Operational research groups (or operational analysis groups) of scientific personnel working with the armed forces as described in the preceding chapter, provided a sound remedy for this defect where such groups existed, but they were formed gradually and covered only a fraction of the field. Setting up advanced laboratories in England in 1943 by the radar and the countermeasures divisions of NDRC solved the problem for those two divisions in the European theater.

It is almost axiomatic that a development engineer must have full knowledge of the operational setting in which the instrument or weapon under development will find itself, and of the performance of the first models of the device which go into Service use. Through improving liaison during the war years, the Services came to enable the divisions of NDRC to approach this requirement more and more closely. Information as to how items already in use were performing was at the outset very difficult to obtain, for two principal reasons. The overcoming of these causes took time, because the situation was inherently a new one for all concerned.

The first cause was that the reports from which such information could be obtained usually were regarded by the Services with such secrecy that they were reluctant to make them available to a civilian organization. General operational information of a really significant sort was likely to be held very closely. In the second place the Services did not in general have a systematic method of collecting and analyzing operational experience in terms of the technical performance of equipment. The paucity of information was not unique with NDRC but was apparent within the Army and Navy whose own technical branches did not receive timely information. Adequate machinery for obtaining data on performance simply did not exist, although the arrangements for “Group A” (described in the next section) mitigated the situation somewhat.

What OSRD did not know it could not correct. In the Army the difficulty lay in the lack of adequate reporting by the using troops to the technical branches of the Army Service Forces, and the lack of an adequate follow-up inspection system operated by these branches. It is possible that exchange of information could have been expedited by the assignment of
Liaison Officers to the NDRC divisions concerned, from the using arms in addition to those from the technical services. Three cases of lack of information will be cited as illustrations of the problem. The campaign in North Africa began in November 1942, and electronic antiaircraft directors developed under an NDRC division were in use during that campaign; but in August of 1943 that division was informed by Ordnance Department representatives that no data on operation in the field of this new and important instrument had yet been received. Another division delivered a device to Wright Field for test in April of 1943; in August, no report had been received and attempts to secure a report through the War Department Liaison Officer had been fruitless. In a third instance, tests of countermeasures equipment developed by NDRC were conducted at the Naval Research Laboratory. An NDRC observer was present, but was excluded on the ground of secrecy from the most important part of the tests and therefore he learned little for the developing agency. Yet this observer was actually the man who had done the laboratory work on the instrument under test.

The work of OSRD as a research and development agency was facilitated as this lack of a rapid flow of accurate information was overcome. As progress was made toward swifter and more detailed reporting, users and suppliers were brought together more efficiently on matters that were in embryo. The ideal, of course, in assuring a satisfactory flow of data from the theater of operations is to have persons there whose first interest lies in research and development and who take part in operations for the purpose of making observations pertinent to those subjects. Intimate back-and-forth discussions on the spot are the best way of keeping up with the requirements of the troops and of quickly adapting new equipment to the problem at hand. Such an ideal, under the conditions of war, can never be fully accomplished. In the later stages of the war an approach was made toward it through the establishment of the Office of Field Service.

**Group A of Liaison Office**

Liaison with the Army and Navy during the first two years of OSRD operations worked to overcome the practical impossibility of obtaining the views of the combat forces on particular weapons and to surmount the lack of reports on conditions in the theaters of operations, which was handicapping investigation and development of new weapons. Urgent need existed, however, as late as 1943 in nearly every division for information as to what the using Services needed and how it should be developed. The Services, by that time, were willing to entrust to OSRD military information of the highest classification where it was available and might have a bearing on
the development of weapons. Accordingly, agreements were reached under which operational information, particularly that which would show the effectiveness of weapons, could be distributed to groups working on similar weapons in this country.

Since the Liaison Office staff had knowledge of all the work going on in the NDRC and CMR, it was given the task of obtaining operational information in the form of reports from the U.S. Army and Navy for OSRD. A special group, designated as Group A, was established within the Liaison Office for this purpose in February 1943. Because of the stringent controls required, the group was segregated within the Liaison Office and operated as a separate unit. In the case of the more highly classified documents, the recipient was required to sign a statement that he had received and read the document, and each individual whom he permitted access to the documents was likewise required to record the fact that he had obtained the information contained in the report.

During most of the operation of Group A, a staff member paid daily visits to the Military Intelligence Reports Center. There he was permitted to look over documents being marked for circulation and to note what documents he wished for the OSRD. These were duplicated and forwarded to the Liaison Office. Each report was scrutinized in Group A and then routed to the Division Chief or other individual having a direct need for the report. In addition to the intelligence reports, Group A distributed to the interested divisions of NDRC such reports of an operational character as were sent to the Administrative Office by the Services.

A very important activity which grew out of Group A was the participation of OSRD in the formation and operation of the Joint Electronics Intelligence Agency (JEIA). This was a joint undertaking participated in by the Army, the Navy, and OSRD. Each group furnished to JEIA operational and technical reports on electronics which it had received through its own channels. Each day the reports which had been received the previous day were scrutinized by representatives of each of the Services participating in the plan. The material was then duplicated and distributed in accordance with requests. As a result of this plan, all British reports dealing with electronics or closely allied subjects were distributed directly and promptly to the working groups in Army, Navy, and OSRD regardless of the channel by which they had been received. The average time required for this distribution was cut from two months to two days.

Even with the strict security standard which Group A maintained, in its period of greatest activity it received 1200 reports a month and distributed 3000, including duplicates of reports which required relatively wide distribution. With the close of the war with Japan, OSRD had little need for further operational information, and so most of the reports distribution was dropped and termination of the Group A activity was inaugurated,
LIAISON WITH THE ARMED SERVICES

LIAISON BY COMMITTEES

After the first year of the war and perhaps in growing recognition of the value of OSRD, there came into existence occasional committees composed of both officers and scientists, which were organized to meet special problems. This was an important development in the relations of OSRD with the Services. Thus there were formed in 1943 two committees under the Chairmanship of Dr. J. A. Stratton of the Office of the Secretary of War, to survey developments and to recommend Army policy in the use of radar for aerial gunnery and blind bombing. Professor Samuel H. Caldwell, Chief of Section 7.2, Airborne Fire Control, sat on both committees; and the survey was carried out by a group consisting of him, Dr. Harold L. Hazen, Chief of Division 7, and A. L. Ruiz, a member of that Division of NDRC.

Some rather general confusion in the field of aerial gunnery came to a climax in early 1944, and at the request of the Army Air Forces NDRC set up a committee to survey the problem. Under the terms of the request NDRC furnished the Chairman, Dr. John B. Russell, of the Airborne Fire Control Committee and the Vice-Chairman, Dr. Saunders McLane of the Mathematics Panel. Because of the pressing importance of the subject and the competence of the personnel this Committee attracted strong interest and soon became a joint Army and Navy project. Its membership included representatives of Wright Field, Eglin Field, the AAF Training Command and the Navy. The Committee set out to co-ordinate developments in gunnery devices, and to establish effective test and evaluation procedures. It had no authorization to impose its conclusions on the using Services; but the interest in its work was so strong and its prestige was such that the Committee became the highest authority and a most important factor in resolving problems in the field of airborne fire control.

At the request of the Bureaus of Ordnance and Aeronautics, NDRC entered into a co-operative undertaking with the Navy at the Patuxent River Naval Air Station in the autumn of 1943 with the objective of improved quantitative understanding of aerial gunnery. An NDRC group at Northwestern University worked on the design of computing mechanisms and measurement equipment. An elaborate synchronized camera system was devised with radio links to tie in the cameras in the fighter and in the bomber. Another group worked with the Navy at the Air Station. There eventually resulted at Patuxent a complete air measurement system and a ground computation system. This undertaking was highly co-operative. The Navy participation gradually increased until in early 1945 a Naval officer took over Chairmanship of the directing committee, as originally had been planned.

There were many such committees formed during the war, having mem-
bership comprising scientists and officers of the Army and Navy. Also, members of NDRC divisions sat as members of committees of the Joint Communications Board of the Joint Chiefs of Staff. These committees were very valuable in securing close working relations between the scientists and the Services.

**NDRC Division Meetings**

As a means of liaison with the Services, meetings were held from time to time by the divisions and sometimes by their component sections to which were invited representatives of the Army and Navy as well as of the British. These meetings served a useful purpose in keeping the Services informed of the progress of technical developments on which the divisions were engaged; and they served at times to acquaint the division with the views of officers with valuable firsthand experience or knowledge.

**Examples of Liaison**

The Ordnance Department of the Army was confronted with a particularly heavy procurement program. In its initiation, assistance was given by the Ordnance Association, a nationwide organization of industrial executives whose companies furnish supplies, materials and services to the Ordnance Department. The first and principal request made by this association as mobilization began was that the Government in placing orders, refrain thereafter from changing specifications. In meeting the large demands for munitions, the Ordnance Department doubtless was influenced by this consideration of quantity procurement, to the extent of avoiding as long as possible any disturbance of the assembly line. In such a situation officers were not responsive to change. The period of time elapsing between the appearance of a need by the troops, as for a better tank, to acceptance of the idea by the technical service and delivery of the hardware to the theater, should have been the shortest humanly possible. A balance was needed between the assembly line technique and the urgent necessity for improved weapons.

On the part of the Services the situation called for a broad vision, imagination, and an appreciation of the existence in the country of a vast store of highly specialized scientific knowledge. Though there were some exceptions, the vision, imagination, and understanding were in general ample to meet the need. On the part of science, the situation demanded honest effort to master new sets of principles and constant alertness to discern ways in which knowledge hitherto applied to far different uses could be made of value for military purposes. Again though these were exceptions, the effort was in general made, and the alertness in general continued keen. A few examples on both sides of the ledger are worth noting.
Frangible Bullet

Interest in the possibility of using frangible bullets for air gunnery training, so that live targets might be fired upon, was aroused in the spring of 1942. After repeated setbacks, which are recounted in Chapter 5 of the history * of Division 2, NDRC, the device was finally perfected. By V-J Day, frangible bullet training was in use in seven gunnery schools in this country and some 11,000 bomber missions had been flown by student gunners in which about thirteen million rounds of frangible bullet ammunition had been fired. The Training Command had directed that all air firing in gunnery training should be with frangible bullets.

In the early stages of this project, Ordnance opposition to it, based on its departure from experience in ballistics and on its involving a training situation of potential high hazard, had raised barriers which conventional Army and NDRC liaison procedures seemed ill-equipped to surmount. In the light of subsequent developments, it appears probable that had more effective procedures been available, the frangible bullet for training could have been in use at least a year earlier.

Hypervelocity Guns and Improved Machine Gun Barrels

The beginning of work by NDRC on hypervelocity guns was delayed because of the doubts expressed by the Services as to its value. Some objection to NDRC entering at all into this field was expressed by several old-time, influential officers, who felt that this was a subject most likely to be advanced by those of long practical acquaintance with ordnance. The attitude was not universal; thus Colonel Glenn F. Jenks, of the Ordnance Technical Staff, prepared a long memorandum on the status of knowledge about gun erosion, which he recognized as a limiting factor to increasing the velocity of guns. He emphasized the desirability of scientific aid, pointing out that no investigation had been made up to that time nor was one in progress which would give an understanding of the mechanism of gun erosion or a practical solution of the problem.

NDRC's interest in hypervelocity had been heightened by a plea from the British early in the spring of 1941 that this be one of the broad research programs on which American scientists should embark. In particular, the British authorities suggested that research be directed toward an antiaircraft gun that would send a shell to a height of 10,000 feet in three seconds. Considering the drop in velocity with range, this meant a gun with a muzzle velocity of at least 5000 feet per second, whereas the Army's new 90-mm antiaircraft gun, then recently adopted, had a muzzle velocity of only 2800 feet per second.

* In the volume entitled Rockets, Guns and Targets.
Later that spring NDRC launched its hypervelocity program independently of the Services by setting up a new unit in Division A, known as Section A, which later became Division 1. Its first task was to tackle the problem of gun erosion. Although the Ordnance Department opposed the participation of NDRC in an investigation of the general subject of hypervelocity, it did give some support to the erosion studies, especially by making available its files of information on this subject. Also it sponsored a conference on erosion, held at Watertown Arsenal on October 15, 1941, for the purpose of obtaining the comment of Army and Navy representatives on the section's proposed program.

It was not until the next year, however, that even acquiescence in NDRC's work on hypervelocity guns could be obtained. Although relations were cordial with individuals in the Ordnance Department, that branch of the Service did not officially support this work with enthusiasm until almost the close of the war.

Even the application of Division 1's findings in the field of gun erosion was retarded by an attitude of indifference on the part of some individuals in the Ordnance Department. In this case the fault was in a lack of realization of how much abuse our .50-caliber machine-gun barrels would receive in combat. The division's representatives were told repeatedly for about two years by persons in a position to know that there was no need to improve this barrel. The steel barrels then in use, it was said, were so inexpensive that it was not worth spending effort on trying to increase their life by some small amount, such as 25 per cent. This attitude eventually changed when reports from the Army Air Forces and the Navy Bureau of Aeronautics showed that the barrels could not always last a long bombing mission or a ground strafing operation.

By the time the need for improvement of this barrel was realized, the division's general erosion program was sufficiently far advanced so that it was able to offer two means of increasing severalfold the life of this barrel when used under the most severe conditions. The improved barrels were flown to the Pacific, where they proved outstandingly useful. The division's hypervelocity program also paid dividends, for by the end of hostilities it had developed several different methods of increasing muzzle velocity to the point where they were taken over by the Services for final application to new weapons. It is plain to see from the record, however, that this stage would have been reached earlier with some of them had Service support been wholehearted from the beginning.

**Electronic Antiaircraft Director**

One of the successes of OSRD was its sponsorship and active participation in the development of the electronic antiaircraft director called the M9.
The project was an outgrowth of direct liaison with the Coast Artillery Board, representing the using troops.

In June 1940, before the creation of NDRC, Bell Telephone Laboratories presented to the Ordnance Department the idea of developing an electrical director if the War Department were interested. They were not encouraged and no action was taken.

On October 3, 1940, the Fire Control Section first visited the Coast Artillery Board and were told that the most urgent need was for a satisfactory antiaircraft director. Rapid action was taken. The highly competent group at Bell Laboratories were told that NDRC would support the project and they began work at once. This director, in combination with radar and the proximity fuze, formed by far the most effective antiaircraft fire control system of the Allied or enemy forces, and contributed largely to defeat of the V-1 attacks on London.

Radar

Relationship with the Services took a different form in the case of the large divisions of NDRC, such as Division 14. In 1941 the Navy established a liaison office at the Radiation Laboratory at M.I.T. which grew to have a permanent staff of about thirty officers, with additional Project Liaison Officers temporarily attached. Soon afterward the Army Signal Corps established a similar liaison office and later, when the Air Corps was given responsibility for procurement of its own radio and radar, it also set up an office. These liaison offices were a tremendous help to both organizations. They handled all the more formal relations and aided in arranging for visits and for tests. Close collaboration existed. Division 14 did not await formal Service requests for undertaking projects and never hesitated to propose new ideas for projects to Army and Navy representatives. On the other hand, the Service representatives discussed their problems informally with division and Laboratory personnel. General agreements usually were reached before formal requests for projects were processed. An indication of the extensive contacts with the Army and Navy is the fact that in early 1945 an average of fifty officers came to the Radiation Laboratory each day for discussions and conferences.

A point which was stressed in Division 14 relations with the Services was that the Army and Navy should not come to the Laboratory with technical problems for the design of a piece of equipment of specified dimensions and power requirements, but rather they should bring full information of the conditions of employment in which radar might aid, and provide full access by Laboratory personnel to information on the success or failure of various methods which had been tried. After acquiring an understanding of the military problem it was then the job of the technical people in the
Laboratory to evolve suggestions and ideas for the best solution which they could visualize. The Laboratory then would come up with a proposal for the technical design of equipment, accompanied possibly by proposals for new methods of employment. After full analysis and discussion a final approach would be agreed on. From that time on the design of the equipment was left to the men in the Laboratory.

This governing principle came to be accepted by all concerned. It emphasized the partnership between the civilian scientists and the Services and got away from any suggestion that the scientists were working for or under direction of the Army or Navy. Many of the most spectacular achievements of OSRD resulted directly from this conception of partnership.

Relations with the Chemical Warfare Service

From the summer of 1940 until the summer of 1942, the relationship first of Division B and later of Divisions 9 and 10 to the Chemical Warfare Service (CWS) followed customary channels. These contacts proved, in many ways, to be inadequate to insure co-ordination between the CWS and the NDRC programs and to guarantee the absence of friction. Accordingly, an arrangement was adopted during the first week of August 1942, under which a representative of NDRC was placed in the office of the Chief of the Technical Division of CWS in a liaison capacity.

This “Technical Aide for Co-operation with the Chemical Warfare Service” was given a course of instruction in Army procedure and in the projects of the Technical Division, CWS. He visited various CWS laboratories and proving grounds. He was treated in every way as a member of the staff of the Chief, Technical Division, made recommendations on either OSRD or CWS projects, and attended staff meetings.

Several very difficult problems had arisen concerning items developed by the OSRD, so the Chief, Chemical Warfare Service, appointed a committee consisting of two Army officers and three representatives of NDRC, with an Army officer as Secretary. This committee began meeting late in August 1942, and continued to meet at more or less regular intervals for about two years. It succeeded in disentangling several very complicated situations under the broad powers given to it in the order under which it operated.

In November 1942, the Office of the Chief, Technical Division, moved from Washington to Edgewood Arsenal, and the staff was reorganized simultaneously. Under a program worked out by the CWS-NDRC Technical Committee as an experiment, the Technical Aide for Co-operation with the CWS was put on the staff of the Chief, Technical Division, with power to co-ordinate in his name in the Chemical Warfare Service the same subjects over which he had jurisdiction in his capacity as Chief of Division.
Liaison Office. This co-operative venture insured avoidance of duplication of
10, NDRC. This co-operative venture insured avoidance of duplication of
effort. The Office at Edgewood Arsenal and the Technical Aides in Wash-
ington co-operated in directing the program; and personnel began to be
interchanged on projects between the Service installations and NDRC con-
tractors. Under the arrangement approximately fifty men from Division 10
worked on Army posts at one time or another for periods of a few weeks
to more than two years.

During the spring of 1943, this system of unified control was extended
by placing the Chief of Division 9 on the staff of the Chief, Technical
Division, so that a large fraction of the NDRC projects pertaining to che-
mmical warfare formed part of one program with that of Technical Divi-
sion, CWS.

During the spring of 1944, the British Mission to the United States sug-
ggested that the large amount of field experimentation being conducted in
the United Kingdom, in Canada, in the United States, in Panama, in
Australia, and in India should be co-ordinated. Diverse conclusions had been
drawn concerning the behavior of chemical warfare matériel, and no effort
had been made to fill in gaps in existing knowledge consistently. As a result
of this suggestion, the Project Co-ordination Staff with representation from
NDRC Divisions 9 and 10, the CWS, the United Kingdom, Canada and
Australia was started at Edgewood Arsenal in April 1944. This Staff pub-
lished a series of reports, the last one of which was a comprehensive survey
of the effectiveness of chemical warfare matériel. It made recommendations
through proper channels concerning experiments to be conducted at the
various field stations throughout the British Commonwealth of Nations
and in the United States. Finally, it was instrumental in establishing a Far
Eastern Technical Unit attached to General MacArthur’s Headquarters;
this unit contained both Army officers and OSRD personnel.

This arrangement in the field of chemical warfare illustrates probably
the closest co-operation between civilian scientists and a technical service in
the course of OSRD operations, although it is paralleled by the close rela-
tions between Division 6 and the Tenth Fleet which was mentioned in
Chapter IX in connection with the Office of Field Service.

Relations with the Army Air Forces

Co-operation between OSRD and the Army Air Forces was effective
though uneven, ranging from the full collaboration which held in the work
on radar to breaks in continuity resulting in large measure from the anom-
alous situation of some Air Force agencies which had long been expected
both to engage in development work of their own and to evaluate develop-
ments performed by others. This was the situation of Wright Field, for
example, which the Liaison Officer between Wright Field and NDRC
contributed greatly to overcoming by devoting untiring effort to furthering co-operation between the Armament Laboratory and the scientists. The large amount of work which OSRD performed for Navy aviation was done without the handicap of this contradictory double responsibility; the Army Air Forces were the beneficiaries of some of the work undertaken at Navy request.

In the development of radar, as previously related, the Air Forces maintained a liaison office with a staff of officers at the Radiation Laboratory. Relations between this Laboratory of Division 14 and the Air Forces were truly co-operative. Division 14 had a group in England (later on the Continent also) and this British branch was closely in touch with air operations. Thus, in June 1943, the Eighth Air Force cabled Washington asking for equipment to permit bombing through overcast. Within six weeks sets were developed by the Radiation Laboratory to meet this need and within eight weeks bombers were practicing in New England, each step taken being a co-operative effort of the scientists and the Air Forces personnel. In September, sets were installed in England and on November 3, 1943, Wilhelms-haven was bombed through overcast.

There was also real teamwork between OSRD and the Flying Training Command. The Central Instructors' School of that command, located for a time at Fort Myers, Florida, and later at Laredo, Texas, engaged in many joint activities with the Airborne Fire Control section of NDRC's Division 7. By way of illustration, a need was recognized by the middle of 1942 for means of measuring, on the ground, the performance of various gunsights and computers. Out of that need and with the interested support of the Central Instructors' School as well as of the Navy, the University of Texas testing machine for aerial gunnery systems was developed, the support including sending groups of enlisted men to work with the Fire Control Section at Franklin Institute, Philadelphia, and at the University of Texas.

Whatever conclusions may be drawn from the record of Service relations with OSRD during the somewhat more than five years of war and preparation for war are of interest only as they point lessons for the future. Since it appears probable that the most effective organization in a future emergency will be one in which the country's scientists are assembled and directed by scientists and since most research in Service laboratories is of an applied nature, liaison must be geared to this conception. If in a future national crisis, new weapons of warfare (such as in this war were microwave radar, rockets, the electronic director, proximity fuzes and the atomic bomb) are to be produced rather than old weapons improved, an organization is needed that will know its way in the complex ramifications of the scientific world. It is very important for the future that responsible officers of
the Army and Navy keep open minds and perceive the limitations as well as the proper functions of Service laboratories.

In the situations in which the liaison between OSRD and the armed services was best during the war, there resulted a joint effort which brought new weapons to bear on the enemy in a remarkably short time. In these cases information on military needs was promptly forthcoming; analysis was quickly made; the best scientific and engineering talent of the country was applied at once to the problem; preliminary and field tests were carried through in days or weeks rather than months. It is unfortunate that such co-operation was not always forthcoming; and it is to be hoped that in any future emergency the Services will not be hampered in even a few cases by men in key positions who have a blind spot where co-operation with civilian scientists in a civilian organization is concerned.
CHAPTER XI

LIAISON WITH ALLIED GOVERNMENTS

The exchange of research information dealing with war weapons was initiated by the British after the fall of France and at the height of the German night raids on Britain. The first step was a visit to Washington in September 1940 of a British Technical Mission headed by Sir Henry Tizard, and including representatives of the British Ministries, which came empowered to disclose secret weapons on which the British were working for the defense of their island. The British had already concluded exchange arrangements with Canada, and had sent Professor R. H. Fowler to the National Defense Council of Canada to serve as Liaison Officer between England and Canada.

Early discussions indicated the value to the American weapons program of a full exchange of information and arrangements for future collaboration in research. With Army and Navy approval, a number of conferences between the personnel of NDRC and the British mission were held during September. At the NDRC meeting on September 27, 1940, Sir Henry proposed a continuing exchange of information regarding research on and plans for weapon development, and also a procedure under which reports and information would be passed between NDRC and Professor Fowler serving as British Liaison Officer for both Canada and the United States. The desirability of this arrangement was confirmed by an exchange of letters between Bush and the Secretaries of War and Navy. This decision to pool research information, supplemented by a later decision to divide research effort, was the starting point for Allied supremacy in new weapons, notably radar and subsurface warfare devices.

Establishment of the London Mission

Later in 1940, after preliminary discussions with members of the British Technical Mission, NDRC decided to send a Mission to Great Britain to investigate the scope of military research being carried on in that country and to report the fields which appeared most promising as well as most necessary to successful defense. An invitation was forthcoming from the British Government, and President Roosevelt designated Conant to head the Mission. F. L. Hovde, Assistant to the President of the University of Rochester, was selected as Resident Secretary of the Mission. Carroll L. Wilson, then serving as Assistant to Bush, was appointed Liaison Officer;
he accompanied Conant, because it was felt that he could better facilitate
the task of the permanent group in England if he were conversant with
the problems confronting it. The group reached London in March 1941,
and Conant and Wilson returned to the United States in April.

The agreements reached by the Conant Mission set the pattern for liaison
throughout the war. They provided that NDRC (and later OSRD) would
exchange war research information directly with the British Ministries and
without reservation as to commercial matters. Information obtained by
either Government from its commercial contractors was to be made avail-
able to the other for Government use only. In practice an informal policy
was developed that no information from a commercial contractor of one
Government would be divulged by the other Government to one of its
contractors without first obtaining the permission of the originating source.
This policy was formalized in the Radar Exchange Plan described later,
and was adhered to in all matters which fell outside the scope of that plan.
As a corollary, it was decided that individuals who held appointments
within the OSRD or within the British Government, and, at the same time,
were connected with commercial firms, would be regarded as dual per-
sonalities. Information was given to them in their capacities as Government
appointees with the understanding that it was not available to them in
their capacities as employees of commercial firms. Another principle on
which agreement was reached by the Conant Mission was that British
research should concern itself principally with immediate objectives con-
nected with the defense of Britain, and that long-range development should
in general be undertaken in the United States.

While Conant was primarily concerned with general arrangements and
high policy, succeeding visitors rapidly shifted the emphasis of the London
Mission, which he had left under the direction of Hovde, to specific prob-
lems. By June 1941, the Mission had been firmly established and it was
evident that its function would be a continuing one. Staff members were
added to it from time to time.

The London Mission originally operated with a small, permanent staff
supplemented by a large number of visitors who were sent to England by
the divisions and sections on specific missions or on visits of a comparatively
short duration. The scope and volume of OSRD activities increased enor-
mously after American entry into the war; and with many research prob-
lems being studied both in England and the United States, it was highly
desirable that the research groups in each country be kept as fully informed
as possible of progress in the other. In some fields, particularly in the field
of radar, co-ordinated research was planned between the groups. Experience
showed that the interchange of reports was not sufficient to cover a specific
field. Many research workers in England and America were too busy work-
ing on their problems to write adequate reports. Reports were slow in
arriving at their proper destination, and in many cases the individuals interested did not receive the reports of the corresponding British or American group. A number of the divisions sent visitors to England, who returned with a greatly increased fund of knowledge and with up-to-date information on research in their particular fields. Detailed information on many problems, however, was lacking, and it was not possible for the small permanent staff in London to obtain these details, especially in some of the more complex fields. As the first step to expansion Hovde returned to the United States as Assistant to Conant in accordance with the agreement under which the former had originally gone to London, and Bennett Archambault replaced him as permanent head of the Mission. After Archambault's arrival in London in April 1942, the staff was augmented to provide permanent representation in all the important research fields.

Arrangements which had been set up at the time of Conant's visit to England provided that the OSRD reports of interest to the British would be forwarded to the London Mission for distribution to the Ministries. At the same time, it was agreed that the reports from the various Ministries would be sent to the Mission for transmittal by pouch to the United States. With the establishment of the Central Scientific Office, later the British Central Scientific Office (BCSO), in Washington early in 1941, under Dr. Charles G. (now Sir Charles) Darwin and with the able assistance of Dr. W. L. Webster, however, there was set up a second channel which was available during the war for the transmission of information in both directions. Every OSRD report which was sent to England was also sent to the BCSO, and in a few instances multiple copies were sent to the latter office in order that some individual within it might forward a copy to the group in England which he represented.

The BCSO was of great help when the Liaison Office was establishing its procedures in 1941, particularly by centralizing the requests of various British agencies in Washington. The staff of the BCSO was also of considerable assistance in the guidance of prospective travelers to England by furnishing details of British research organizations.

Development of the Liaison Office under OSRD

Executive Order No. 8807 of June 28, 1941, establishing OSRD directed that organization in Article 2(g) to

Initiate and support such scientific and medical research as may be requested by the government of any country whose defense the President deems vital to the defense of the United States under the terms of the Act of March 11, 1941, entitled "An Act to Promote the Defense of the United States"; and serve as the central liaison office for the conduct of such scientific and medical research for such countries.
Administrative Order No. 1 of August 20, 1941, created the Liaison Office as one of the principal subdivisions of OSRD, designated its head as Senior Liaison Officer and charged it with "the conduct of scientific liaison" with the countries defined in Article 2(g) of the Executive Order (the so-called "lend-lease" countries). Carroll L. Wilson was named as Senior Liaison Officer, with Caryl P. Haskins and Franklin S. Cooper (both physicists and, respectively, Director and Assistant Director of Research, Haskins Laboratories) as Assistant Liaison Officers. Wilson continued as Senior Liaison Officer until October 30, 1942, when he resigned to spend his full time as Executive Assistant to Bush. Haskins was then made Senior Liaison Officer, and when he resigned to become Deputy Executive Officer of NDRC on September 15, 1943, Cooper succeeded him. William W. Eaton served as Assistant Liaison Officer between January 20, 1944, and March 1, 1945, and Eugene W. Scott received a similar appointment on February 26, 1945.

The duties of the Liaison Office from the beginning included direction of the London Mission, exchange of reports, arrangement for travel to England, handling of cables between Great Britain and the United States, and the clearance of visits of foreign scientists to OSRD projects. Proper distribution of British reports required the Liaison Office to be conversant with the details of all research being sponsored by the OSRD. The problem of keeping the Liaison Office fully acquainted with the nature and status of the problems being studied within the various divisions of the NDRC and CMR was one which proved quite difficult of solution. To meet it, the Office maintained a current file of contracts and endeavored to arrange for the attendance of its personnel at division and section meetings, although some divisions objected to the presence of Liaison Office personnel, particularly at executive meetings.

While some information could be obtained from reading the monthly or bimonthly reports of divisions, these reports were often quite general in nature, failed to give sufficient details as to progress, and frequently were several months late in publication. Dependence upon reports meant that work might have been in progress on a problem for several months before information of its existence reached the Liaison Office. In such cases British reports dealing with similar problems might not be forwarded immediately to the individuals most concerned. The difficulty was resolved late in 1943 and early in 1944 by adding a number of Technical Aides to the staff of the Liaison Office and assigning to them particular areas of research. While the manpower situation was such that there were a number of serious delays and it was not possible to add a Technical Aide for each division, it became apparent that those divisions which were served by a Technical Aide in the Liaison Office and who had similar representatives
in London obtained, by far, the best and most up-to-date information on their research problems.

In order better to service those NDRC divisions having offices in New York, the Liaison Office established a branch in New York City in February 1944 under Mrs. Louise Paddock, who had been in the Washington office from its inception.

With the rapid increase in the scale of operations and in the number of functions, it became necessary to formalize the organization of the Office along functional lines. The arrangements for travel of OSRD personnel to England, the handling of requests for British subjects to visit OSRD projects and meetings, and the dispatch, receipt, and distribution of cables between Washington and London were brought into a single unit late in 1942 which became known as the Overseas Service Division. The first head of this unit was Miss Barbara E. Caldon who was succeeded on December 18, 1944, by Mrs. Frances F. Giggal. By December 31, 1945, 1820 persons had engaged in foreign travel under OSRD auspices and the Overseas Service Division had carried for them the burden of wartime travel arrangements, including such items as passports, visas, travel priorities, immunizations, releases by Selective Service Boards, military permits, special clearances and a host of others. At its peak the division was handling 250 travelers per quarter. The total number of cables handled through December 31, 1945, was 7487, with the number running at approximately 700 per quarter for some time.

The volume of British reports increased month by month to the point where it became desirable to organize the working group associated in the receipt and distribution of this material into a unit, later called the British Reports Section. A total of 59,135 separate reports, letters and samples from the United Kingdom and Canada was handled through December 31, 1945, with the peak reached in the second quarter of 1945 when approximately 6000 were received. The British Reports Section was supervised by Harold A. Traver until late in 1943, when Dr. Dorothy W. Weeks was placed in charge. In September 1945, Dr. Weeks became a part time employee and Miss Mary L. Carll served as acting head during the periods when Dr. Weeks was not present.

The OSRD Reports Section was established somewhat later than the corresponding group for British reports as the flow of American reports in volume began later than the flow of British reports. By December 31, 1945, however, 82,153 items had been dispatched to the United Kingdom and Canada. The peak volume was in the first and second quarters of 1944, in each of which over 8000 items were handled. The section was formally organized on January 1, 1944, with William M. Olive in charge. When he left in August 1945, it was placed directly under the Assistant Liaison Officer.
As British reports were usually transmitted in a single copy, adequate distribution in the United States required duplication on a large scale; and the requirement of speed made photostating the preferred method of duplication. The total number of pages duplicated through December 31, 1945, reached approximately 1,835,000.

The lend-lease transactions were handled by Mrs. Dorothy D. Culpin until June 1944. Transportation was in charge of Mrs. Ruth F. Merker from August 1943 until June 1945. In June 1944, the two sections were combined under Mrs. Merker. The section was discontinued on July 1, 1945.

Group A, whose work has been described in the preceding chapter, should be mentioned here to round out the description of the administrative organization of the Liaison Office. It functioned under the direct supervision of Cooper until September 1943, when William Shurcliff was placed in charge. He was succeeded in November 1944 by David Z. Beckler.

The several Technical Aides in the Liaison Office were grouped into a Staff Section, operating under the Assistant Liaison Officer.

In addition to circulating British reports within OSRD, the Liaison Office was called upon to make available to the Services any British reports which they had not received through their own channels. This distribution was facilitated by the publication at varying intervals, usually semimonthly, of an accessions list known as the Services Index, between June 1941 and August 1945. The circulation of the Services Index increased the demand from the Services for copies of the reports which were listed. Requests for 21,000 reports were received and processed between March 1942 and December 1945.

OSRD reports for use outside the country were sent to three distributees, the OSRD London Mission, the British Central Scientific Office (later the British Commonwealth Scientific Office serving also Australia, New Zealand, and South Africa), and the National Research Council of Canada. Complete records were kept of all reports received and distributed. The types of reports which were distributed varied from monthly summary reports to progress reports on specific subjects. Almost every formal OSRD report was distributed to the British and Canadians. Other parts of the British Commonwealth, namely, Australia, New Zealand, and South Africa, which had been admitted to the exchange arrangements received copies of the OSRD reports directly related to their research activities.

The reports sent to the London Mission were distributed to the interested Ministries in England. The staff members of the London Mission worked out standard distribution schedules; and each report, upon its receipt in London, was placed on the proper schedule and distributed accordingly unless the staff member concerned made special arrangements. Usually a copy of each report was retained in the London Mission for reference purposes. As the size of the American armed forces in England increased,
American military establishments made frequent calls upon the Mission for copies of OSRD reports.

The exchange of visitors between the British and American groups gradually increased throughout the war, reaching its peak in the spring of 1945. It became increasingly evident that the best and most rapid method of coordinating research on specific problems in the two countries was by personal visits. This was, of course, a supplement to the exchange of reports. The permanent staff members of the London Mission and of the British Central Scientific Office were of great help in many cases on specific problems. In no case, however, was sufficient staff available to provide coverage for a field of activities.

Those NDRC divisions which solved their problems in particular instances by dispatching visitors to England were always ready to duplicate the procedure when the need arose. In many cases, however, the divisions placed the need for a key man in the United States above the value they might derive from his visit abroad. In these cases the divisions were dependent upon reports received from the British research group or from OSRD staff members in London. While the staff performed its own functions well, it was unable to substitute completely for specialists familiar with the latest developments in their fields. Both were desirable.

By the end of 1943 a satisfactory plan was developed for the exchange of information supplementing the visits of specialists. It involved an increase in the technical staff of the Liaison Office, particularly in Washington, and the exchange of Washington and London staff members at regular intervals. The Field Technical Aides (as the staff members responsible for following particular fields of activity came to be called) rapidly became acquainted with all the work of the NDRC divisions to which they were assigned. They had free access to British reports and soon acquired at least a reading knowledge of all the work going on in England in the specific fields in which they were interested. In most cases they established excellent relations with the divisions and attended their meetings and demonstrations. Many of them wrote special reports which were forwarded to staff members of the London Mission for their guidance and for distribution to the interested British groups. After acquainting themselves with the work being conducted under the NDRC, they visited England where they studied the organization of the specific fields of research which were being emphasized there. This knowledge of the organization and work being carried on in England and the particular problems of the staff members of the London Mission was invaluable to the members of the Washington staff and to NDRC in furthering the co-ordination of their work.

Because of its broad knowledge of OSRD operations the Liaison Office was assigned in the summer of 1942 a continuing function with respect to
patents. The Commissioner of Patents had been authorized by Congress to hold in secrecy patent applications the disclosure of which would endanger national security. Bush agreed that OSRD would advise the Commissioner on applications within its field; and the Liaison Office made the initial examination of applications which was followed by a more thorough review by NDRC specialists prior to advice to the Commissioner on the issuance of secrecy orders.

**Lend-Lease Activities**

By the middle of 1942 the Radiation Laboratory had developed a number of radar devices which the British wished to obtain and which the development groups wished to provide since the British were in a better position than the American forces to try out new weapons. To facilitate this, in July 1942, OSRD was designated as a procuring agency by the Lend-Lease Administration. This arrangement was continued until the cessation of lend-lease activities in September 1945. All the preliminary negotiations leading to a lend-lease requisition were handled between the Liaison Office and the NDRC divisions, and the final recommendation for approval of the requisitions was forwarded by the Liaison Office upon the advice of the divisions to the Foreign Economic Administration (FEA). Although the bulk of the lend-lease requisitions were on Division 14 or Division 15 contractors, almost every NDRC division had at least one device transferred to the British by this means.

There was also a small amount of reverse lend-lease; in this instance the materials were acquired in England by the London Mission or one of the branch laboratories and sent to the United States for the use of an OSRD contractor. The importance of the transfer of experimental equipment is but poorly indicated by the dollar value of materials transferred, approximately $6,600,000. Lend-lease facilities were also used to transfer some apparatus to Canada, but in these cases cash was paid by Canada. The OSRD in either case was reimbursed by FEA for the expenses incurred in making and supplying the device to the requisitioning agency.

**Special Facilities for Exchange of Radar Information**

Huge sums were spent both in England and the United States on the development of radar as a defensive and offensive weapon, and its use was an important factor in achieving victory. Proper liaison in this field was essential in order to insure the prompt exchange of information and the co-ordination of the research programs on radar in Great Britain and America.

With the entry of the United States into the war, research and develop-
ment in the field of radar were intensified and the increased activities of American companies placed a new emphasis on the benefits to be derived from a freer interchange between them and comparable British firms. At this time there was duplication in nearly all lines of radar research and development in the two countries. In February 1942, a memorandum was prepared by OSRD proposing an agreement among various British and American companies whereby information would flow promptly and automatically between companies certified to receive radar information. The two governments undertook to collect and disseminate radar reports for their respective companies, but assumed no responsibility for protecting commercial rights to the information beyond the maintenance of full records of distribution.

With the concurrence of the War and Navy Departments the proposed plan was presented to Bell Telephone Laboratories, General Electric Company, Westinghouse Electric and Manufacturing Company, Radio Corporation of America and later to other companies. Each company agreed upon the condition that a similar agreement be reached with the principal British firms. In August 1942, the Central Radio Bureau in England made a proposal along the lines of the American memorandum to appropriate British firms. Most of the British firms invited to join the interchange plan accepted and the plan was put in operation on September 1, 1942, between six American companies and eight British companies. Several others were added later. Certain specific devices and information were excluded from the exchange. The actual exchange of reports was carried out in the Liaison Office in Washington and the Central Radio Bureau in London. Complete records were kept of the reports put into the plan by each company and the distribution of the reports to firms in the opposite country. Frequently laboratory reports from the Radiation Laboratory were included in the exchange plan, and likewise the British put in many reports from their Government laboratories. Both the Central Radio Bureau and the Liaison Office made the reports available to the Services and to Government laboratories generally. In May 1945, the participating firms were solicited for their views concerning continuation of the exchange plan, and after several of them had expressed the view that the plan should be terminated following the cessation of hostilities with Germany, it was ended on July 1, 1945.

In the spring of 1943, the American program of research on radar was being expanded greatly under the auspices of the OSRD and the two Services. Development of radar apparatus also had been progressing favorably in Great Britain and a large research program was under way there. It was evident that more could be accomplished and technical manpower better utilized if the research programs of the two countries were co-ordinated. Accordingly, Karl T. Compton headed an American group which went to England in May 1943 to discuss methods of co-ordination. The group
made extensive visits to the various research establishments studying radar. They also reached agreement on the co-ordination of radar research programs with policy-making officials within the several Ministries. Besides the general policy decisions, another important development due to this visit was the establishment of British branches of American radar laboratories.

The members of the Compton Mission were convinced that research in the field of radar required that a research group be located close to the source of operational information, in this case the operating Air Force. The needs of the British offensive bombing groups and their defensive fighter squadrons were undergoing rapid and frequently unexpected changes. By having a close link between these operating groups and the scientists and technicians working on their problems, it would be possible to meet new changes in enemy tactics with greater speed, and changes in priority of research could be effected on short notice. Furthermore, the information concerning enemy jamming techniques and their effectiveness was held in extremely high security classification. This increased the difficulties in transmitting such information through a number of channels across the Atlantic to research facilities in America. In Great Britain, on the other hand, this information could be discussed between representatives of the operational groups and the scientific staffs, frequently before any written reports were prepared. The only practical method of effective co-ordination of the research programs on radar countermeasures as far as the OSRD was concerned was the establishment of an OSRD-sponsored group in Great Britain. By the spring of 1942, Great Britain had also become a base for American bombing forces, and the size of these forces was increasing constantly. These Air Forces needed a nearby technical group to which they could refer urgent problems.

It was decided that a laboratory on radar countermeasures could best be established in connection with the Division 15 countermeasures contract with Harvard University. A comparable branch was established for operations in the general field of radar under the OSRD contract with M.I.T. for the creation and operation of the Radiation Laboratory. The British made facilities available for both branch laboratories near the Telecommunications Research Establishment at Great Malvern. The American Air Forces used the facilities of the laboratories to capacity. The contribution which the laboratories made to the operations of the Air Forces in Europe and to the exchange of radar information with the British was tremendous.

**The Shift in London Mission Activities**

In the winter of 1943-1944, the load of the OSRD Mission in London reached its peak and the staff reached its maximum size. By spring, 1944,
many staff members were occupied almost entirely with duties which they had assumed with the United States Forces in Europe.

The successful invasion of the Continent and the swift freeing of the territory of France and Belgium which had been occupied by the Germans brought new duties to the staff of the OSRD London Mission. Many members served with intelligence teams which followed swiftly in the path of the armies. In addition the London office served as a base of operations for specialists supplied to the armed forces by the OSRD Office of Field Service. When the Combined Chiefs of Staff established the Combined Intelligence Objectives Subcommittee composed of representatives of the interested British Ministries, United States Forces in the European Theater, and United States war agencies represented in London, OSRD was included. Subgroups were organized by subjects, and OSRD had representatives on each subgroup which dealt with a subject of interest to the NDRC or CMR. By the time of the capitulation of Germany in May 1945, most of the activities of the London Mission had been shifted to the planning of intelligence investigations and to the carrying out of investigations in the field.

In the fall of 1944, it was obvious that London, while quite satisfactory as a base of operations for liaison with Great Britain, was not suitable for the work required of the field investigators, since it was too far to the rear of the actual fighting for proper use of facilities associated with the Air Forces. Therefore, in December 1944, quarters were obtained from the United States Embassy in Paris and a small branch office of the OSRD London Mission was established there under Dr. H. P. Robertson, who had been a member of the London staff. Dr. Wallace R. Brode of the Washington staff succeeded Robertson in March 1945, and remained in charge of the office until it was closed in June. In addition to this OSRD office, the two British branch laboratories established an advance service base near Paris with the American Air Forces. The Paris Office served as a useful facility for OSRD personnel who went to France as members of intelligence investigating teams.

By June 1945, the principal functions for which the London Mission had been established were nearly completed. The need for some liaison with research groups in England was still evident, however, and it was decided to maintain a London Liaison Office for this purpose. By the end of July, the reorganization had been accomplished and a small group under Dr. H. M. MacNeille remained in London to continue liaison activities. Before this change took place, however, arrangements were completed for a change in the procedures which had been followed in the transmittal of OSRD reports to England. Under the new arrangements, OSRD reports were delivered by the Liaison Office in Washington directly to the British Commonwealth Scientific Office, which was given complete information con-
cerning the distribution which had been established for each category of report. The reports were then forwarded to England through British mail channels and distributed by the Ministry of Production to the other Ministries.

The duties of the reorganized London Liaison Office were much more general in nature than those of its predecessor. Liaison consisting of personal contacts with research groups was of necessity largely discontinued for lack of staff. The general trend of British postwar research policies was carefully followed and the Office was supplied with similar information from this country for dissemination to interested British agencies. One problem which occupied a large part of the time of the staff members of the London Office was the question of declassification and publication of the scientific information which had been gathered in the two countries during the war. The London Office also continued to collect the reports of the British Ministries and to forward these to the Liaison Office in Washington, until the last of the OSRD London personnel were transferred to the Navy on March 1, 1946.

While the operations of the Washington Liaison Office and the London Mission serviced CMR as well as NDRC, the former were on a much smaller scale than the latter. It was in the medical field, however, that the only exchange of information with the U.S.S.R. was carried on by OSRD. Medical liaison is discussed in Chapter VII, which deals with CMR.

**The Liaison Office after V-E Day**

After V-E Day plans were immediately put in operation for the closing of the branch laboratories in England and the advance service base in France. The former activities were closed around the 15th of June and the Paris branch was closed on June 30, 1945. The London Mission was officially closed late in July 1945, although its liaison activities were maintained by the London Liaison Office until March 1, 1946. By the middle of the summer, 1945, travel activities in an eastern direction had nearly ceased, although travel to the Pacific had shown a slight increase. Most of the OSRD personnel stationed in Europe had been returned to the United States by the first of August. At that time the curtailment in the research activities and the number of contracts being maintained in an active condition by OSRD led to the decision to close the New York branch of the Liaison Office on September 1, 1945. Group A ceased its distribution activities and began to call in the reports it had distributed. At about the same time, the British Reports Section called for the return of British reports from contractors who had received them at the request of the divisions directing their work.

The lack of a subject index to British reports had not been particularly
serious during the active operations of the British reports group for each report, when received, had been routed to the appropriate persons in the NDRC and CMR. However, if this material were to be of any use as a reference library, it was absolutely essential that it be cross-indexed according to subject matter. In September 1945, therefore, Bush requested the Liaison Office to make plans to index the British material according to subject matter and to start the active indexing as soon as convenient.

An important part of the closing of OSRD activities was the determination of how the information obtained during the war could be utilized for postwar military and civilian research. Since the OSRD reports in the Liaison Office were a duplicate of those kept as official records, it was decided to use them as a nucleus for a complete document collection. The Director instructed the Liaison Office to complete its files of OSRD reports and to take in charge the important collections assembled by certain of the divisions. Associated with this problem was the delivery of declassified documents to a central agency in order that the results might become public knowledge.

The indexing of the British reports and the assembling of the document collection became the most important activities of the Liaison Office in 1946, although the recall of documents and declassification duties accounted for much of the time of the operating staff. By June 1946, the divisional document room collections had been nominally acquired and were in the temporary custody of the Navy Department. Later in the year, arrangements were completed to deliver the entire document center to the Joint Research and Development Board. This transfer was completed in order to have documents available to groups in both Services and to serve as a comprehensive source of technical information for the committees established by the Board.

Other remaining obligations of the Liaison Office were discharged by the middle of November, 1946, after which the Liaison Office ceased to be active, although the appointment of the Assistant Liaison Officer continued in force until the end of December.

There is ample evidence that the progress of the war was greatly speeded by the close working relationship established between American and British scientists. The exchange of information was valuable, but the best results came in those situations where specialists from one country were in direct, personal contact with those from the other. The success of this interchange on a broad basis between Allies commends it as a pattern should any need for it arise in the future.
Part Three: Supporting Operations

CHAPTER XII

THE ADMINISTRATIVE OFFICE

The primary function of the Administrative Office was to enable the scientists to function as efficiently as possible within the limits of Government regulations. NDRC and CMR were to look after the scientific aspects of the OSRD program; it was up to the Executive Secretary to provide the supporting mechanism. As the same individual served as Executive Secretary of OSRD, NDRC and CMR as well as Secretary of the Executive Committee of S-1, a single administrative office served for the OSRD and its constituent committees. The Executive Secretary was also Contracting Officer for OSRD.

From the inception of NDRC, OSRD and CMR until December 18, 1945, Irvin Stewart was Executive Secretary. From December 1940, Cleveland Norcross was his Chief Assistant; and after Stewart became Deputy Director of OSRD on December 19, 1945, Norcross first was made Acting Executive Secretary and later Executive Secretary.

The line between the scientific and administrative aspects of a research program is clear in theory but somewhat hazy in particular situations. Harmonious working relations between the Secretary's Office and the Chairmen of NDRC and CMR prevailed at all times, with the offices keeping in close touch with each other on all matters of common interest. The Administrative Office was established as a principal subdivision of OSRD in the following terms:

The Administrative Office, at the head of which shall be an Executive Secretary appointed by the Director. Under the general supervision and direction of the Director and subject to the provisions of Section 10 of Executive Order No. 8807, the Administrative Office shall have charge of the administrative affairs and records of the Office of Scientific Research and Development.

As further defined in Section 5 of Administrative Order No. 4, amended April 25, 1945, the principal duties of the Executive Secretary were the following:
Subject to all the limitations and restrictions applicable to the acts of the Director and under the general supervision and direction of the Director, the Executive Secretary is authorized (i) to negotiate and enter into contracts and supplements, amendments, modifications or extensions of contracts heretofore or hereafter made in connection with the functions of the Office of Scientific Research and Development and its officers, (ii) to approve or disapprove the form, terms, and/or conditions of subcontracts under prime contracts of the Office of Scientific Research and Development, (iii) to incur and release such obligations and to settle such contract claims as may be necessary to accomplish such functions,  

Provided, That settlement of all contract or subcontract termination claims in excess of $25,000 shall be subject to the approval of the Office of Scientific Research and Development Contract Settlement Review Board, (iv) to authorize Office of Scientific Research and Development contractors to settle with subcontractors termination claims not exceeding $10,000, without further review by the Government whenever the reliability of the contractor, the amount or nature of the claim, or other reasons appear to justify such action, (v) to issue such regulations as the Executive Secretary deems necessary to carry out the policies, principles, methods, procedures, and standards prescribed by the Contract Settlement Act of 1944 and the regulations issued thereunder by the Director of the Office of Contract Settlement, (vi) to review and approve or disapprove in accordance with the requirements of the General Accounting Office vouchers submitted under contracts and all other types of vouchers, (vii) to authorize or approve travel, use of extra-fare trains, superior Pullman accommodations, and seats in sleeping or parlor cars for trips of two hours duration or less, and certify long distance telephone calls in connection with such functions, (viii) acting as Contracting Officer of the Office of Scientific Research and Development to designate as his “authorized representatives” under contracts the appropriate officials, employees, or appointees of the Office of Scientific Research and Development or officials, employees or appointees of other Government agencies who have been detailed to the Office of Scientific Research and Development, (ix) to exercise the powers and duties vested in the Director and/or the Office of Scientific Research and Development by Appropriation Acts applicable to the Office of Scientific Research and Development, the Surplus Property Act of 1944, the Contract Settlement Act of 1944, Executive Order No. 9218, and all other applicable laws concerning acquisition, use and disposition of property, (x) to effect transfers and retransfers of funds, and (xi) to delegate any power or duty of the Executive Secretary to such assistant or other official of the Office of Scientific Research and Development as he may designate with the approval of the Director.

From July 26, 1945, until the creation of the post of Deputy Director on December 19, 1945, the order also provided that the Executive Secretary should become Acting Director of OSRD in the absence of the Director and of the Chairman of NDRC.

There were four major divisions of the Administrative Office, the heads of which reported to the Executive Secretary: administrative, patent, legal, and personnel operations and management. To a considerable extent the activities of these divisions, or of units within them, are part and parcel of the
operations reported upon in the next few chapters of the present volume, just as they are interwoven with the activities described in earlier chapters. Brief mention will be made here of some of those not reported elsewhere.

**Administrative Division**

*General Organization.* The Administrative Division was by far the largest unit in the Administrative Office; it operated directly under Norcross as Chief, with Miss Lee Anna Embrey as Administrative Officer. The division maintained offices in Boston and New York to service NDRC and CMR activities in those places, but the bulk of its work was in Washington. Eight sections were established to handle administrative services, central records, procedures, projects, contracts, fiscal affairs, priorities and property, and security, respectively. The last four of these are discussed in Chapters XIII, XIV, XVI, and XVII, respectively.

*Administrative Services.* The administrative services section handled those housekeeping activities which are at the same time essential and taken for granted. They included arrangements for space and communication facilities; maintenance of stocks, equipment and supplies; interbuilding mail pickup service; motorcycle messenger and chauffeur service; duplicating service; maintenance of equipment and stock inventory records; a service for the repair and maintenance of equipment, for the moving of offices, and the shipment of any kind of material. The geographical spread of OSRD activities, involving service to widely separated offices, and the immense amount of classified material to be handled made the task more difficult than the size of the organization would indicate. Under the capable direction of Mrs. Shirley Blackistone this group produced hard-to-get and "unavailable" items time after time, and in so doing gave much needed aid to the men whose efforts were closer to the end object of OSRD activities.

*Central Records.* The OSRD records problem was complicated by the multiplicity of offices. Central files were maintained at 1530 P Street. CMR files were kept at the CMR offices in the National Academy of Sciences. The chemical divisions of NDRC were in Dumbarton Oaks with their files. The limitations of space forced the Liaison Office, the patent division, the priorities section and others into different buildings in Washington with a consequent scattering of files. In addition each NDRC division maintained its own files, usually outside Washington; and in some cases there were section files separate from the division files because of the distance between section and division headquarters.

The central records section functioned at 1530 P Street, where the largest single group of files was housed. They were organized under the direction of Mrs. Louise Wahl, Miss Lucille Graveler and Miss Lola Jaques, who
served successively as Records Officers, and Miss Hope Cowles as Technical Assistant.

As OSRD was a temporary organization, it was apparent from the beginning that the files ultimately would be transferred to some other agency. In anticipation of that event OSRD obtained on detail a staff member from National Archives to aid in assuring that OSRD files would fit in with the planning of that agency. No attempt was made to prescribe the type of files or filing system to be followed by the divisions and sections. With the end of the war, however, the central records section made members of its staff available to review division files with a view to eliminating duplicate and unnecessary records. As each division office closed, its files were sent into the central office where they were treated as integral units with no attempt to incorporate them into the general files.

**Procedures.** The need for co-ordinating the procedural material essential to obtain the necessary minimum of uniformity in compliance with overriding Government regulations led to the establishment of the procedures section. It performed a useful function in preparing and reviewing procedural releases to forestall the issuance of conflicting or unco-ordinated instructions, eliminating obsolete materials, classifying proposed releases in appropriate categories, seeing that basic materials reached the people who should have them, and indicating their relation to previous releases. Under its direction the various OSRD administrative circulars were grouped and cross-referenced in numerical series which gave a fair degree of assurance that all the material issued in that form on a particular subject was in a single place and easily accessible. In addition a small staff of analysts, under the direction of Miss Embrey assisted by Mrs. Esther Stern, from time to time surveyed the operation of various units in the Administrative Office with a view to improving and co-ordinating work procedures of such units in their relation to each other and to other units of NDRC and CMR.

**Project Control.** The fact that several branches of the Army and of the Navy requested assistance of NDRC early made it desirable to establish some convenient method of keeping track of the various requests. An arrangement was worked out under which requests were numbered in the order of their submission, with a separate series for each requesting technical service. Thus the first Signal Corps request received the designation SCr₁, and the first Army Air Corps request ACr₁. Navy requests were identified by the key letter N, followed by another letter indicating the originating Bureau and the proper number, NO for the Bureau of Ordnance, NA for Bureau of Aeronautics, etc. Project requests were required to be submitted formally through the officially designated Service liaison to NDRC, i.e., through the Co-ordinator of Research and Development of the Navy or through the War Department Liaison Officer for the
NDRC. They were addressed to the Executive Secretary; and the project control section had the task of following them through the OSRD organization.

Promptly after its receipt each project was referred for recommendation to the NDRC division indicated by the Chairman's Office as appropriate to receive it. The divisional replies were in turn referred to the Chairman's Office. Recommendations that projects be declined were brought before the next meeting of NDRC where the adverse recommendation was invariably supported. Recommendations of acceptance were approved without reference to the Committee until a few months before V-E Day, when NDRC began to review all recommendations for consistency with the termination program of OSRD.

In view of the size and complexity of the Army and Navy and of the autonomy of NDRC divisions, the attempt to channel projects so as to insure appropriate review was not uniformly successful. Requests at times were submitted directly to the Chairman's Office or to NDRC divisional offices by officers or bureaus, although Service regulations required that projects come through a central office in each Service. The Chairman's Office regularly returned them for proper handling; the divisions sometimes returned them but at other times acted upon the requests. No fixed rule was possible. Speed was essential and divisions would properly start work upon informal representations of officers of their acquaintance. In many cases the paper request would follow the initiation of research by days or weeks. In some cases, however, it developed that the requesting officer was expressing his own views which were not shared by his superiors and that the division was working upon a problem in which there was no official interest and no place to use the results.

The second function of the project control section was the recording and distribution of reports. The variety of reports has been mentioned in Chapter IV. The section had the task of correlating reports with projects and with contracts as far as practicable, and of distributing most of them. The magnitude of the task is shown by an approximation that the total number of separate reports fell between 30,000 and 35,000, and the number of copies of each ranged from 2 to 100 or more. The rapidity with which OSRD grew, the speed with which it worked, the harassment of inadequate personnel, the autonomy of divisions, the varying habits of contractors, the need for communicating results as rapidly as possible regardless of form, the high security classification of the contents of most reports—all these made for variety in reports and confusion in their handling. Several months after V-J Day the task of untangling reports was still under way. There was a reasonable chance, however, that a complete and usable file would be ready by the time a successor organization had been established.
Between January 1942 and its merger with the contract section in December 1945, the project control section was headed at various times by Mrs. Olga Walsh, Mrs. Virginia Corcoran, and Miss Frances Cathcart.

**Patent Division**

The patent policy of OSRD and its administration are the subject of Chapter XV. Division headquarters were in Washington with Captain R. A. Lavender, USN (Retired), as advisor on patent matters and Lieutenant Colonel P. P. Stoutenburgh as his first assistant. Attorneys, who for the most part were Army or Navy officers detailed to OSRD, were assigned to follow inventions in the various parts of OSRD. Excluding a much larger number working on the atomic energy program under War Department contracts as well as OSRD contracts, the patent division at its peak had twelve attorneys with appropriate supporting staffs. Offices were maintained in Washington, Boston, New York and Chicago.

**Legal Division**

Until December 9, 1940, NDRC relied upon Oscar Cox, Assistant General Counsel of the Treasury Department, for legal assistance in accordance with arrangements made by the Council of National Defense. On that date Beverly Thompson, Jr., joined the staff as Counsel, but Cox remained available for consultation and review until late in 1942. Thompson resigned in April 1942 to enter the Army. His successor as head attorney was Albert M. Herrmann, who left for the Navy in October 1942. John T. Connor, who had joined the legal staff in April 1942, succeeded Herrmann as head legal advisor; he became the first General Counsel of OSRD, which position he held until he joined the Marine Corps in June 1944. Connor was succeeded as General Counsel by Oscar M. Ruebhausen, who continued in the post until February 1, 1946. E. Tefft Barker, a member of the legal staff since 1943, succeeded Ruebhausen as General Counsel. He in turn was succeeded on June 11, 1946, by Charles F. Brown as Acting General Counsel.

OSRD was fortunate in the composition and attitude of its legal staff. As a new and temporary organization with a scientific staff made up largely of volunteers impressed with the urgency of their assignment but with a background of academic freedom, a minimum of administrative restraint, and an abhorrence of "red tape," OSRD was unusually susceptible to the influence of its legal staff. Fortunately, that staff was also impressed with the importance and urgency of the task to be done and concentrated upon finding ways to give scientists the necessary freedom. The contract which was the basis of OSRD operations may well prove
to be one of its principal contributions. That contract was largely the work of the legal division.

At its peak the personnel of the legal division consisted of seven attorneys with the usual supporting personnel. A large part of the legal work was necessarily devoted to the negotiation and interpretation of contracts; and a special unit was established for contract drafting when that function was taken over from the contract section in October 18, 1943. In addition, however, the General Counsel participated actively in such matters as the organization of the penicillin and malaria programs of CMR, the preparatory work behind the report Science—The Endless Frontier, the discussions leading to the adoption of the OSRD publication policy, and the lengthy negotiations on bills to establish a successor for OSRD and for the broader purpose of promotion of postwar research.

**Division of Personnel Operations and Management**

OSRD established its own personnel office in April 1943 upon the liquidation of Central Administrative Services (CAS) of the Office for Emergency Management. Prior to that date, CAS had performed most of the personnel functions in accordance with the provisions of the executive order creating OSRD. Glenn Wilbur was the first OSRD personnel officer and he returned to the post after a tour of duty in the Navy. Mrs. Jean B. May was head of the office while Wilbur was in the Navy.

The general procedure of appointment contemplated that (1) whenever a vacancy was to be filled, the facilities of the Civil Service Commission would be used. If a qualified person appeared on the register of the Commission, he would be selected. If a qualified person could not be produced by the Commission within a short period, a person without a Civil Service rating could be employed if the Commission regarded his qualifications as satisfactory. (2) For every person appointed from other than Civil Service rolls, a complete personal history record would be filed with the Civil Service Commission to establish the qualifications of the persons appointed. The appointment would not carry Civil Service status. (3) Salaries would be established in accordance with the Classification Act of 1923.

At the request of NDRC, the Civil Service Commission early established a series of OSRD technical positions in the professional series with the title "Technical Aide." The individuals proposed for appointment were to be outstanding specialists in such fields as chemistry, armor, ordnance, transportation, etc.

Exemption from the provisions of the Civil Service and Classification Acts would have saved OSRD much work, although eventually it obtained Commission approval for nearly everyone whom it wished to employ. The Commission had no specific standards to apply to Technical Aide posi-
tions and its decisions as to positions and as to the qualifications of technical personnel necessarily varied. Many appointments went through without question, while others were delayed for the length of time necessary for Commission personnel to become conversant with the intricacies of a unique job and the peculiar fitness for it of a particular individual. The tendency to judge the importance of a man’s job by the number of persons reporting to him had to be overcome also, as the essence of many OSRD positions was the ability of the incumbent to work, with little supervision or assistance, on terms of equality with scientists in the employ of OSRD contractors. At the top levels of the Civil Service Commission there was unfailing appreciation of both the importance and the unique character of OSRD; the occasional difficulty which arose was always with the lower echelons of the Commission which were inconsistent in rulings on technical qualifications and found it hard to avoid comparing OSRD positions with peacetime scientific positions in permanent Government agencies, with which, in fact, they had almost nothing in common.

In the matter of clerical and stenographic personnel, the Commission was operating under conditions of almost unprecedented difficulty, for the demands imposed by war for this kind of personnel in Washington were far in excess of the supply. The Commission nevertheless gave OSRD reliable clerical people qualified to handle highly confidential material, and, beyond that, exerted special care to guard against the engaging of any who could not be relied on. For a considerable period, OSRD was authorized to recruit its own personnel in these categories, as a way of countering the shortage to some degree. This was a help, but the organization was never adequately manned in these supporting ranks.

What the staff lacked in numbers, however, it made up in loyalty and effort. New recruits were impressed with the importance of the task undertaken by OSRD until they appreciated the fact that a slight delay in the handling of papers in Washington might mushroom into a very significant delay in getting new equipment into the hands of troops on the battlefield. This spirit was intensified after the United States went into the war by the large number of young married women on the staff whose husbands were with the fighting forces.

The existence within OSRD of two offices concerned with personnel—the Scientific Personnel Office and the division of personnel operations and management—was a source of some confusion. For the most part their functions were distinct; SPO dealt principally with the scientific personnel of contractors and with the War Manpower Commission while the division dealt with Government employees and relations with the Civil Service Commission. There was some overlap. Thus SPO had the responsibility for application of the “no-profit-no-loss” policy even in the case of salaries of scientists coming on the Government payroll, while the division was
responsible for Civil Service Commission approval of these same men in positions carrying salaries commensurate with their responsibilities as defined in the Classification Act and Regulations. The situation was one requiring close co-operation between the two offices.

The Administrative Office was the unit through which most of the formal controls (other than those of a scientific nature) were exercised. Its philosophy was that of giving the scientists the greatest amount of leeway possible, of working with the divisions and the contractors as members of a team whose main job was winning the war. Every effort was made to devise controls which would offer the least interference with progress and yet would protect the public interest. The scientists were co-operative, and with a spirit of good will on both sides, the "red tape" was kept to a minimum and was observed in good temper and with relatively few lapses.

The writer's intimate association with the Administrative Office makes it difficult for him to assess its performance. As a principal subdivision of OSRD it was on a parity with NDRC and CMR, but it recognized that its mission was to facilitate their operations, just as they in turn existed primarily to stimulate and direct the scientists in the laboratories of OSRD contractors. OSRD was a co-operative undertaking to an unusual extent; its success was built upon the way in which it made use of the unique abilities of many people of varying talents. The results are apparent just as the observation tower of a tall building stands out. In both cases a firm foundation is essential. For OSRD the Administrative Office was an important part of the foundation.

At its peak the full-time paid employees of OSRD numbered approximately 850; of these some 300 were in the Administrative Office. The organization of the Office was constantly shifting in the endeavor to give better service to the scientists, directly or indirectly, in an infinite number of ways. It might be in obtaining an electronic component in short supply, the absence of which was blocking a research program, or in working out a way to borrow a tank. It might be in arranging a half million dollar advance payment to keep a contractor going or in helping to recover a dollar disallowed by the General Accounting Office under circumstances which left the claimant sour on the whole idea of working with or for the Government. It might be in finding ways to help launch a new research program or in enabling a scientist to make an essential trip in spite of the fact that every mode of transport was completely sold out.

Successful operation of the Administrative Office involved assuring the Comptroller General that Government funds would be properly spent and contractors that they could work successfully within the necessary regulations without grave risk of loss of their funds. It meant convincing the military services that an adequate program had been established to protect their
highly classified information and convincing the scientists that they could function within the limits of military security. It meant devising means of insuring the protection of the public interest in the patentable aspects of new developments as well as stimulating reluctant contractors to action in various ways. It meant handling the administrative relations common to all Government agencies and also the governmental contacts involved in over 2500 contracts with several hundred contractors. It meant finding ways by which a group of outstanding individualists could be satisfied to work within the framework of decades of "red tape." It meant setting seemingly impossible schedules of performance in "paper work" and then meeting those schedules. It meant struggling against a growing work load with a staff increasingly inadequate in numbers. It meant working under the constant demand for speed in every operation because of the recognition of the cumulative effect of delays.

It meant these and a thousand other things, all directed toward speeding improved equipment to the battle front and all handled by a temporary staff, for the most part trained on the job in the things they had to do.

Flexibility was the keynote of the operations of the Administrative Office as it was of the whole of OSRD. There was little, if anything, unusual in the formal organization; there was much that was unusual in the spirit which dominated it. The same spirit, derived in part from the pressure of war, prevailed throughout OSRD and was one of the most important factors in its success.
CHAPTER XIII

THE CONTRACT

The decision that NDRC and OSRD would not operate laboratories directly made it imperative to find a form of contract which would permit the achievement of their objectives. That part of the program carried on in the laboratories of other Government agencies occasioned no difficulty on this score; for with the assistance of the Bureau of the Budget, a simple procedure was worked out for the transfer of OSRD funds to those agencies, and the supervision of expenditures was a function of the appropriate officers of the transferee agencies. The order of the Council of National Defense and later the executive order establishing OSRD clearly contemplated the use of contracts in all other cases.

A check of Army and Navy contract forms failed to disclose any which promised to be satisfactory. For the most part they were aimed at procurement or production rather than research; and through the years they had become encrusted with layers of requirements designed to establish standardized Army or Navy practices. It would have been impossible for most academic institutions to work satisfactorily under them, and it would have been difficult for NDRC to build up a staff to administer them if they were adopted. What was needed was a contract which would combine a maximum freedom for the exercise of scientific imagination on NDRC problems with those safeguards necessary for the expenditure of public funds. Stewart, as Secretary, was given the responsibility for recommending an appropriate contract form.

Contracts for Research and Development

The contract form adopted by NDRC at its meeting on August 29, 1940, was largely the work of Oscar S. Cox, Assistant to the General Counsel of the Treasury Department, who had been assigned to assist the Committee in legal matters. The performance clause was a relatively simple provision. The contractor agreed to conduct studies and experimental investigations in connection with a given problem and to make a final report of his findings and conclusions to the Committee by a specified date. This clause was deliberately made flexible in order that the contractor would not be hampered in the details of the work which he was to perform. The objective was stated in general terms; no attempt was made to dictate the method of handling the problem.
The reimbursement provisions were in the alternative, at the option of the contractor. One alternative provided for the payment to the contractor of a flat sum, payable in monthly installments with a provision that a certain percentage (administratively set at 10 per cent) would be held until the submission by the contractor of the final report. The other alternative provided for the reimbursement of the contractor's actual cost in performing the work called for in the performance clause. The contractor was to be reimbursed monthly upon the submission of public vouchers certified by the contractor and approved by an authorized representative of the Committee. It was further stipulated that it was the intention of the parties that the contractor would not receive any compensation whatever, other than reimbursement for actual costs.

Another clause provided for reimbursement for special materials, buildings, facilities and equipment within a maximum amount stated in the contract. Upon the termination of the contract, the contractor agreed to deliver or sell, at the direction of the Committee, any unexpended materials, facilities and equipment, the cost of which had been reimbursed under the contract. The contractor was granted the first opportunity and refusal to purchase, lease or otherwise use the unexpended property upon terms to be agreed upon by the Committee and contractor, or in the event of a public sale by paying to the Committee an amount equal to the highest outside bid at such sale without any deduction for the costs of the sale.

The contract further provided that, in any event, the contractor could purchase the property, within one month from the date of the final report, by paying the Committee an amount equal to the cost of reproduction, less depreciation. In the case of additional buildings, for the cost of which the contractor had been reimbursed under the contract, the contractor was required, at the option of the Committee, to purchase the buildings by paying the Committee a stipulated percentage of the original cost. During the life of the contract or any renewal thereof, the contractor held all property at his own risk and in the event of any loss, theft or destruction, replacements were to be made promptly by the contractor at his own expense, and the replacements were to be subject to the same terms and conditions as the original facilities and equipment.

With respect to patentable discoveries or inventions, the Committee reserved the sole power to determine whether or not a patent application should be filed and to determine the disposition of the title to and the rights under any application or patent that might result from the performance of the work called for in the contract. The contractor agreed (1) that the judgment of the Committee on such matters would be accepted as final, (2) that the inventor or inventors would execute all documents and do all things necessary or proper to carry out the judgment of
the Committee, and (3) that he would include the provisions of the patent clause in all contracts of employment with persons who did any part of the work called for by the contract.

As practically all the work contemplated by the Committee was to be of a classified nature, four articles relating to security were included in the contract. The contractor agreed (1) never to disclose any information concerning the contract or obtained as a result of the work under the contract to any person, except employees assigned to the work, without the written consent of the Committee or its authorized representative; (2) to submit immediately a confidential report to the Committee whenever, for any cause, he had reason to believe that an active danger of espionage or sabotage existed at the site of the work; (3) to report to the Committee the citizenship, country of birth, or alien status of any or all of his employees at the site of, or having access to, any of the work under the contract, whenever requested by the Committee or an authorized representative, and (4) to exclude from the site of the work and to discharge or transfer, and thereafter to exclude from the site of the work, any person or persons designated by the Committee or its authorized representative, for cause, as undesirable to have access to the work under the contract.

In a concluding paragraph the contractor agreed to permit representatives of the Committee to visit and inspect the work under the contract and to report the progress of the work from time to time as requested by the Committee or an authorized representative.

At its meeting on September 27, 1940, the Committee adopted a termination clause which provided that at any time the Committee decided the work under a contract could not profitably be carried to conclusion, it might terminate the contract upon thirty days' notice. In cases where the right to terminate was exercised, the Committee agreed to indemnify the contractor against loss upon outstanding commitments which he was unable to cancel.

Experience under the contract showed, as was to be expected, the need for new provisions and for revision of some of those originally adopted. In particular the fiscal provisions required expansion and articles had to be inserted to cover certain statutory requirements. By the time the NDRC as a part of OSRD recommended that the Director follow the NDRC contract, that document had considerably expanded over the simpler one of August 29, 1940. A careful study of the standard contract was made in 1942 under the direction of John T. Connor, the OSRD General Counsel, and in January 1943, a revised form was adopted. With only one major change that revision, known as Standard Form 1001, was used thereafter for new OSRD research contracts, and earlier contracts were changed to that form as occasion arose to amend them for other reasons. As it repre-
sents the judgment of OSRD as to the best type of research and development contract, Form 1001 is printed in full in the appendix.* The text as printed there should be consulted in connection with the comments which follow. The comments single out certain provisions of the contract for the mention of points not apparent from the reading of the text. Several articles form the burden of discussion in later chapters, and no attempt will be made here to anticipate that discussion.

The reference numbers in the upper right hand corner of the first page of the contract were for convenience. At the time contracts were recommended by NDRC or CMR, a separate symbol number was assigned by the contract section to each recommendation, which served to identify it until the contract was signed by both parties. After signature, contracts were numbered in accordance with instructions of the General Accounting Office. Contracts of the original NDRC were identified by the symbol NDCrc (National Defense Council, research committee) followed by a number representing the place of the particular contract in a numerical series beginning with 1. When OSRD was established as a part of the Office for Emergency Management, the symbol was changed. OSRD contracts recommended by the NDRC were placed in an OEMsr (Office for Emergency Management, scientific research) series and those recommended by the CMR in an OEMcmr series. Office of Field Service personal service contracts were assigned to an OEMfs series.

The Preamble. As OSRD contractors almost invariably started work under letters of intent which preceded the signing of contracts by weeks or months, the preamble recognized that the effective date of the contract (which determines the time before which reimbursement cannot be made) might be different from the date of signature. The preamble also lays the foundation for the “actual cost” provision of the contract, for the limited accountability of the contractor for supplies and equipment purchased under the contract, and (in the small number of cases where advance payments were authorized) for advance payments by making the finding which is required by statute before such payments can be made.

An innovation in the OSRD contracts was the provision for a Scientific Officer. The first NDRC contracts required the contractor to follow the instructions of the Contracting Officer or his authorized representative. This was logical as the Contracting Officer was the then Chairman of NDRC and acting in its name. The same language was continued under OSRD contracts although the factual situation was quite different. By delegation from the Director, the NDRC and the CMR had the responsibility for supervision of the respective scientific programs and the Executive Secretary had the general responsibility for administration, including

* See Appendix 2.
the business and fiscal aspects of contracts. The Executive Secretary was also OSRD Contracting Officer; the legal channel for instructions to contractors was through him. According to the contract, Division Chiefs and Technical Aides could address the contractor only as representatives of the Contracting Officer, i.e., the Executive Secretary, although their primary responsibility was to NDRC or CMR. In order to bring the legal situation into accord with the actual facts, a significant change was made in the contract form in the spring of 1944. Responsibility under the contract was divided in the contract itself. Scientific aspects of the work under the contract were entrusted to a Scientific Officer named in the contract; business and fiscal aspects remained with the Contracting Officer. Such was the flexibility, co-operation and unity of purpose within OSRD that the earlier system had worked without difficulty, but the adoption of the Scientific Officer principle undoubtedly put contract operations upon a sounder basis. The practice that was usually followed was to name as Scientific Officer the Chief of the NDRC or CMR division having jurisdiction over the contract.

Article 1. This article clearly established the authority of the Scientific Officer over the subject work. No attempt was made in the usual case to define closely in the contract itself the scientific limitations within which the contractor must work. Rather the usual practice was to define the objective in general terms. The Scientific Officer closely followed the progress of the work and issued appropriate instructions as the work developed. This permitted him to focus attention upon likely leads without the requirement of a contract amendment every time something new developed. The same flexibility was permitted with reference to reporting the progress of work; the normal practice was to require monthly reports, with special reports as needed.

The provision governing termination was unusual in the ease with which extensions of time could be arranged. The OSRD practice was to write contracts for relatively short periods, usually six months, with an informal understanding that they would be extended if the progress of the work warranted. Rate of expenditure under many contracts was irregular and it was frequently desirable to extend contracts in time without an increase in funds. Under the provisions of Article 1 this was accomplished simply by sending the contractor a letter in duplicate requesting the extension which he accepted by signing one copy of the letter and returning it to OSRD. The saving in time over the execution of formal contract amendments was substantial in view of the volume of OSRD contract operations.

The prohibition against cost-plus-a-percentage-of-cost subcontracts and the limitation of fixed fees were in line with policies established by Congress. Requirement of approval of subcontracts involving research and development of the kind contemplated by the prime contract was designed to as-
sure the Scientific Officer of control over the scientific work and to assure
the Contracting Officer that the contract obligations, such as the patent
clause, were not evaded through the device of subcontracts.

The requirement of the Contracting Officer’s approval of stipulated types
of expenditure was a limitation on the general principle that the contractor
should be free to purchase such equipment as he needed for the conduct of
the contract work. Flexibility was essential in the interest of speed; and
approval was required only of certain types of expenditure which were of
an unusual nature and might absorb too high a proportion of contract funds.

In the earlier forms of OSRD contract the Contracting Officer acted
through authorized representatives who were situated in different parts of
the country as required in the administration of the scientific program.
With the adoption of the Scientific Officer device the Contracting Officer
no longer acted through such representatives. His functions were such as
best could be handled through a central office. To avoid the creation of
bottlenecks, the OSRD Fiscal Officer was made an Acting Contracting Offi-
cer with authority over most fiscal matters and the head of the property
control section an Acting Contracting Officer on property matters. Matters
of policy were reserved for action by the Contracting Officer. The Scientific
Officer, on the other hand, acted through scientific assistants, who were the
Section Chiefs or Technical Aides designated to follow particular contracts
in detail. The system worked well in practice. The term “scientific assistant”
was ill-chosen in view of the caliber of men supervising scientific work for
OSRD; “scientific deputy” would have been better.

Article 2. In contrast with the first NDRC contract form, the later one was
quite specific as to the items which could be included as reimbursable costs.
Most of Chapter XIV on fiscal affairs is devoted to the provisions of Arti-
cle 2. One additional point which may be mentioned is the “cost escape”
clause. The subject work of OSRD contracts was stated in general terms,
but the maximum amount for which the Government was obligated was
definitely stated. By its very nature as an exploration of the unknown, there

Article 3. The provisions of this article constitute the basis for the discus-
sion of property matters in Chapter XVI.

Article 4. The several clauses of Article 4 are discussed in the chapter on
fiscal affairs (Chapter XIV).

Article 5. This article had two forms, the “long form” and the “short
form” patent clause; the reasons for the alternative provisions and the con-
ditions of their use are discussed in the chapter on patent policy (Chapter XV).

Article 6. Article 6 likewise had alternative forms. The form given in the appendix was that used in classified contracts. In contracts which were not classified, the article on security provisions consisted merely of those clauses which are designated (b), (d) and (e) in the article printed in the appendix. The security provisions are considered at some length in Chapter XVII.

Article 7. The insertion of the provisions of Article 7 was required by the statutes and executive orders under which OSRD operated.

Article 8. This was another article the insertion of which was required by law in all contracts involving production. It was not required or inserted in contracts of a purely research type not involving the employment of laborers and mechanics.

Contracts for Procurement

In the early days of NDRC its contracts were for research and the contract form devised for that purpose was adequate. As results began to flow from research, NDRC had need for another type of contract which would take into account the different type of facilities demanded. By July 1941, a simple purchase agreement form had been devised for the few cases requiring its use. The purchase was usually for a fixed price and the agreement included a description of the articles to be purchased, method and date of delivery, method of payment (usually installment), provision for purchase by OSRD from another source if the contractor defaulted, right of OSRD to make changes in drawings and specifications with provision for any necessary adjustment of price, assumption of risk by contractor until delivery, security provisions, and public policy provisions.

As more and more of the OSRD work passed from the research and development stage into that of limited procurement, OSRD contractors and prospective contractors began to question the applicability of the "no-profit-no-loss" policy. Recognition was given the situation by Bush in a memorandum of June 7, 1943, discussed in the chapter on fiscal affairs (Chapter XIV), which laid the basis for profit on research and development contracts having procurement aspects.

Standard Form 1002 was adopted to meet the situation discussed in the Bush memorandum. Many of its provisions were identical with those of Form 1001. The principal differences were the more exact description of the articles to be delivered and the establishment of a fixed price together with provisions for keeping it in line with the contractor's actual cost plus a reasonable profit.
CONTRACTS FOR PERSONAL SERVICES

The regular staff of OSRD was recruited through Civil Service as is the normal practice of Government agencies. Civil Service procedures were not adapted to the type of employment contemplated for the Office of Field Service, however, and the National War Agencies Appropriation Act, 1944, approved July 12, 1943, carried the following authority for OSRD:

Salaries and expenses: For all necessary expenses of the Office of Scientific Research and Development, including . . . the employment by contract or otherwise, without regard to civil service or classification laws, at not to exceed $25 per day, of engineers, scientists, civilian analysts, technicians, or other necessary professional personnel . . .

The contract form used under this authorization provided, in substance, as follows: (1) general description of the employee’s duties. The employee agreed to perform such duties or services as might be assigned to him in a specified field, under the supervision and control of the Contracting Officer or an authorized representative; (2) term of employment and payment for services, including allowances for travel; (3) patent clause embodying the substance of the OSRD short form clause; (4) security and public policy provisions; (5) provision that all disputes concerning questions of fact should be decided by the Contracting Officer, subject to appeal to the Director of OSRD.

CONTRACT DRAFTING

Following the Director’s approval of NDRC, CMR or other recommendations, the contract section of the Administrative Office prepared appropriate letters of intent to prospective contractors based upon information furnished by the originating division. The supporting papers were then forwarded to the legal division for the drafting of the contract. Drafting of standard form contracts was done by a drafting unit (originally in the contract section, later in the legal division) which concentrated upon those not involving difficult questions or negotiations. Contracts involving unusual questions were handled individually by other attorneys. The system kept the difficult contracts from delaying the simpler ones.

After the drafting was completed, the legal division endorsed its approval as to form on a “recommendation copy” and returned the file to the contract section. In the early days the contract was then sent to the General Counsel of OEM for his approval as to form, but this requirement was later dropped. The recommendation copy was next sent to the supervising technical division for its endorsement if the draft correctly incorporated the division’s
intention, or for modification if it did not. When both the legal and technical divisions had approved, the copy was routed by the contract section to the Executive Secretary, who endorsed the recommendation copy if it was within the scope of the Director's approval. The original and one carbon were then sent by the contract section to the contractor for his signature.

Upon return of the signed copies, the section checked them against the recommendation copy and sent them to the Contracting Officer for signature on behalf of OSRD. If the contractor declined to sign because the contract did not reflect his understanding of the agreement, the section would refer his comments to the legal, technical, or patent division depending upon the nature of the misunderstanding. In only a few cases was it impossible to agree upon a text satisfactory to both parties, although at times extensive negotiations were required before agreement was reached. After signature by the Contracting Officer, the contract section would conform all copies of the contract, assign a contract number, send the signed original to the General Accounting Office, return the signed carbon to the contractor, and distribute conformed copies to the supervising division, the fiscal section and the contract files.

The records of the section were so maintained that it was possible at a glance to determine the exact location of any contract or proposed contract at any moment. The Executive Secretary was given a report showing the status of each contract under negotiation as of the close of business on each Wednesday. While the volume varied, during the winter of 1943–1944, on the average 225 contracts were in the process of negotiation at all times, with new contracts or supplements coming along at the rate of about 45 per week. The contract section was organized by Cecil L. Covington. When he left for the Navy, Mrs. Pauline Eason and Miss Margaret Simms served successively as Chief of the section.

The research and development contract was the heart of OSRD operations. While unintelligent administration can make a good contract unworkable, even an enlightened administration will have hard going if the basic contract is not fitted to the purposes of research. Experience showed the OSRD contract to be well adapted to obtain good results. Its form, developed directly to meet an unusual situation, has been utilized by the Services in some of their research contracts, and the spirit in which it was administered, likewise engendered by the recognized need for co-operation, can be expected to carry over into the future with good results.
CHAPTER XIV

FISCAL AFFAIRS

ALTHOUGH it was a small, temporary organization, OSRD handled an amount of money which was quite large according to peacetime standards. The responsibility for the administration of funds was one of those delegated by the Director to the Executive Secretary; the implementation of that delegation was a function of the budget and finance office within the Administrative Division, headed by Carey G. Cruikshank as Fiscal Officer. Cruikshank, who had a wide background in Government fiscal operations, came to OSRD from the Department of the Interior. To him goes much of the credit for the smooth functioning of OSRD fiscal affairs.

Serving immediately under Cruikshank was George Sklar as Assistant Budget and Finance Officer. The principal divisions of the office were the cost accounting section, W. F. Edwards, Chief; audit and claims section, M. R. Deutsch, Chief; budget and accounting section, W. B. Roberts, Chief; payroll unit, Mrs. Lillian M. Greene, head, and the special services unit, Mrs. Mae R. Magee, head. Gordon V. Potter, who had served in the fiscal office before joining the Navy, succeeded Roberts as Chief of the budget and accounting section on March 8, 1946.

The magnitude of OSRD fiscal operations is indicated by the following tables:

**Table 1**

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Allocations</th>
<th>SOURCE OF FUNDS</th>
<th>Appropriations</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Transfers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1941</td>
<td>$ 6,430,000.00*</td>
<td></td>
<td></td>
<td>$ 6,430,000.00</td>
</tr>
<tr>
<td>1942</td>
<td>9,000,000.00*</td>
<td>$ 3,900,000.00</td>
<td>$ 29,160,649.00</td>
<td>42,060,649.00</td>
</tr>
<tr>
<td>1943</td>
<td>683,803.76†</td>
<td>70,098,492.00</td>
<td>73,000,000.00</td>
<td>143,782,995.76</td>
</tr>
<tr>
<td>1944</td>
<td>3,750,000.00†</td>
<td>30,333,398.00</td>
<td>135,982,500.00</td>
<td>170,665,898.00</td>
</tr>
<tr>
<td>1945</td>
<td>1,548,034.62</td>
<td>74,464,774.04</td>
<td>102,049,300.00</td>
<td>178,062,108.66</td>
</tr>
<tr>
<td>1946</td>
<td>——</td>
<td>6,589,084.99‡</td>
<td>11,518,208.00</td>
<td>18,107,292.99</td>
</tr>
<tr>
<td>Totals</td>
<td>$21,411,838.38</td>
<td>$185,385,749.03</td>
<td>$351,710,657.00</td>
<td>$558,508,244.41</td>
</tr>
</tbody>
</table>

* Received from the Emergency Fund of the President for the operation of the National Defense Research Committee and the Office of Scientific Research and Development.
† Received from the Foreign Economic Administration for equipment developed by OSRD contractors and transferred to foreign governments.
‡ Through June 30, 1946.
Table 2

Breakdown of

Funds Transferred from the Army and the Navy

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Army</th>
<th>Navy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1942</td>
<td>$1,500,000.00</td>
<td>$2,400,000.00</td>
<td>$3,900,000.00</td>
</tr>
<tr>
<td>1943</td>
<td>44,574,000.00</td>
<td>25,524,492.00</td>
<td>70,098,492.00</td>
</tr>
<tr>
<td>1944</td>
<td>3,042,147.00</td>
<td>26,391,251.00</td>
<td>30,333,398.00</td>
</tr>
<tr>
<td>1945</td>
<td>24,624,953.14</td>
<td>49,834,820.90</td>
<td>74,459,774.04</td>
</tr>
<tr>
<td>1946*</td>
<td>4,781,658.02</td>
<td>1,807,426.97</td>
<td>6,589,084.99</td>
</tr>
<tr>
<td>Totals</td>
<td>$79,422,758.16</td>
<td>$105,957,990.87</td>
<td>$185,380,749.03</td>
</tr>
</tbody>
</table>

* Through June 30, 1946.
† Transfer of $5,000 from CIAA in 1945 not included here.

Table 3

Funds Obligated

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Allocations</th>
<th>SOURCE OF FUNDS</th>
<th>Appropriations</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1941</td>
<td>$6,161,691.00</td>
<td>—</td>
<td>—</td>
<td>$6,161,691.00</td>
</tr>
<tr>
<td>1942</td>
<td>8,294,181.56</td>
<td>$3,537,788.79</td>
<td>$27,794,869.62</td>
<td>39,626,839.97</td>
</tr>
<tr>
<td>1943</td>
<td>592,287.76</td>
<td>69,842,819.49</td>
<td>72,019,315.10</td>
<td>142,454,422.35</td>
</tr>
<tr>
<td>1944</td>
<td>2,618,276.00</td>
<td>30,312,650.24</td>
<td>129,582,671.50</td>
<td>162,513,597.74</td>
</tr>
<tr>
<td>1945</td>
<td>2,783,359.70</td>
<td>66,129,786.14</td>
<td>98,559,955.25</td>
<td>176,457,101.09</td>
</tr>
<tr>
<td>1946*</td>
<td>—</td>
<td>6,585,084.99</td>
<td>11,269,230.34</td>
<td>17,854,315.33</td>
</tr>
<tr>
<td>Totals</td>
<td>$20,449,796.02</td>
<td>$176,408,129.65</td>
<td>$339,226,941.81</td>
<td>$536,083,967.48</td>
</tr>
</tbody>
</table>

* Through June 30, 1946.

Out of the funds shown in Table 1, $11,100,237.13 was used for administrative expenses during the fiscal years 1941–1946; this provided for the operations of the staff which supervised the use of the remainder of the funds.

Transfer of Funds

The transfers to OSRD from the Army and the Navy were in substantial amounts as shown in Table 2. Something over half of the transfers for the fiscal year 1943 was to supplement the OSRD research and development budget. Most of the remaining transferred funds were for "crash" procure-
ment, i.e., for the production under OSRD auspices of quantities of equipment developed by OSRD as described in an earlier chapter.

It will be recalled that OSRD was enjoined to use the facilities of existing Government agencies where they were suitable and available. The extent of this use is indicated by the following list showing Government agencies to which OSRD funds were transferred, together with the amounts of such transfers:

**DEPARTMENT OF AGRICULTURE**

<table>
<thead>
<tr>
<th>Bureau of Agricultural and Industrial Chemistry</th>
<th>1944</th>
<th>$46,483.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>$46,483.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bureau of Animal Industry</th>
<th>1942</th>
<th>$5,000.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>1943</td>
<td>2,250.00</td>
<td></td>
</tr>
<tr>
<td>1944</td>
<td>6,750.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$14,000.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bureau of Entomology and Plant Quarantine</th>
<th>1942</th>
<th>$68,100.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>1943</td>
<td>93,150.00</td>
<td></td>
</tr>
<tr>
<td>1944</td>
<td>224,480.84</td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td>515,386.00</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>141,000.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$1,042,116.84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bureau of Plant Industry</th>
<th>1941</th>
<th>$5,000.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>1942</td>
<td>7,400.00</td>
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</tr>
<tr>
<td>Total</td>
<td></td>
<td>$12,400.00</td>
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</table>

<table>
<thead>
<tr>
<th>Soil Conservation Service</th>
<th>1945</th>
<th>$1,535.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
<td>600.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$2,135.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bureau of Home Economics</th>
<th>1943</th>
<th>$15,500.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>1945</td>
<td>15,760.00</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>14,847.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$46,107.00</td>
</tr>
</tbody>
</table>

Department of Agriculture Total.................. $1,163,241.84
# FISCAL AFFAIRS

## FEDERAL SECURITY AGENCY

Food and Drug Administration

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1943</td>
<td>$18,968.00</td>
</tr>
<tr>
<td>1944</td>
<td>72,288.90</td>
</tr>
<tr>
<td>1945</td>
<td>10,000.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$101,256.90</strong></td>
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</tbody>
</table>

U. S. Public Health Service

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1942</td>
<td>$45,080.00</td>
</tr>
<tr>
<td>1943</td>
<td>73,585.00</td>
</tr>
<tr>
<td>1944</td>
<td>135,204.20</td>
</tr>
<tr>
<td>1945</td>
<td>47,575.52</td>
</tr>
<tr>
<td>1946</td>
<td>65,399.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$366,643.72</strong></td>
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</table>

Federal Security Agency Total $467,900.62

## DEPARTMENT OF INTERIOR

Fish and Wild Life Service

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1944</td>
<td>$16,200.00</td>
</tr>
<tr>
<td>1945</td>
<td>18,675.00</td>
</tr>
<tr>
<td>1946</td>
<td>6,048.34</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$40,923.34</strong></td>
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</table>

Bureau of Mines

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1941</td>
<td>$96,700.00</td>
</tr>
<tr>
<td>1942</td>
<td>275,000.00</td>
</tr>
<tr>
<td>1943</td>
<td>450,000.00</td>
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<tr>
<td>1944</td>
<td>450,000.00</td>
</tr>
<tr>
<td>1945</td>
<td>600,000.00</td>
</tr>
<tr>
<td>1946</td>
<td>270,000.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2,141,700.00</strong></td>
</tr>
</tbody>
</table>

Department of Interior Total $2,182,623.34

## DEPARTMENT OF COMMERCE

National Bureau of Standards

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1941</td>
<td>$140,900.00</td>
</tr>
<tr>
<td>1942</td>
<td>956,600.00</td>
</tr>
<tr>
<td>1943</td>
<td>2,000,554.00</td>
</tr>
<tr>
<td>1944</td>
<td>3,999,500.00</td>
</tr>
<tr>
<td>1945</td>
<td>1,392,500.00</td>
</tr>
<tr>
<td>1946</td>
<td>42,500.00</td>
</tr>
</tbody>
</table>

Department of Commerce Total $8,622,554.00
NAVY DEPARTMENT

Bureau of Ordnance
1941  $25,000.00
1942  25,000.00
1943  75,000.00
Navy Department Total .................................  $125,000.00

WAR DEPARTMENT

Quartermaster Corps
1941  $10,000.00

Army Medical Center
1942  $9,000.00

Ordnance Department
1943  $30,000.00
War Department Total .................................  $49,000.00

U. S. COAST GUARD

1945  $7,776.54
U. S. Coast Guard Total .................................  $7,776.54

TENNESSEE VALLEY AUTHORITY

1945  $9,252.14
Tennessee Valley Authority Total ........................  $9,252.14

Grand total of funds transferred by OSRD to other Federal Agencies for research and development $12,627,348.48.

Policy with Respect to Profit and Loss on Contracts

In a memorandum of June 7, 1943, to Stewart, Bush discussed the policies concerning profits under OSRD contracts. He reviewed the reasons for the original adoption of the "no-profit-no-loss" theory in OSRD research and development contracts and noted its general acceptance by OSRD contractors. He then continued that as OSRD projects moved into pilot plant production and experimental quantity production, prospective OSRD contractors were increasingly reluctant to accept OSRD cost-without-profit contracts, arguing that the facts did not warrant the extension to their cases of the "no-profit-no-loss" policy adopted for research and development contracts.
After having inquired into the facts of several such cases, he had concluded that the point was well taken. Thus, unlike contracts involving normal research or development work, an OSRD contract calling for a substantial amount of straight shop, manufacturing or construction work required the use of personnel and facilities upon which commercial organizations usually relied for their profits. Use of those facilities on OSRD contracts prevented their use on more profitable war orders already on their books. Furthermore, the shop work under some OSRD contracts was similar to the work then being done in the contractors’ shops for the armed services on a profit basis. In such cases, the necessities of the situation, the public interest in starting the work as quickly as possible and equitable treatment of the prospective OSRD contractor required that the contract be executed on a reasonable profit basis. The amount of profit was not to exceed 7 per cent of the estimated cost, exclusive of profit. Contract Standard Form 1002 (See Appendix 3) was adopted for use in the relatively few cases where a profit was to be allowed.

**General Considerations**

In the early days of NDRC all fiscal functions were performed by Central Administrative Services (CAS) of the Office for Emergency Management. For its routine operations it was necessary for NDRC to maintain some fiscal records duplicating those maintained by CAS. The need for speed which was inherent in NDRC and OSRD functions was incompatible with the maintenance of fiscal control by another agency overloaded with work of other offices and at a different location. Gradually, one function after another was transferred from CAS to OSRD, and by November 1, 1944, the last of the CAS fiscal functions relating to OSRD had been transferred to OSRD.

There were few precedents for the type of operation OSRD was conducting. The entire program was built around the central idea that certain research and development work was urgently needed; that the best results could be obtained by leaving the scientist as free as possible to conduct that research; and that some method of fiscal control must be found which would protect the public interest in the proper expenditure of funds without unduly infringing upon the primary objective of the research program. In establishing its fiscal procedures OSRD worked closely with the Bureau of the Budget and the General Accounting Office with the hope of establishing those procedures upon a solid foundation.

As will appear from the text printed in Appendix 2 the standard form contract contained a list of expenditures which were reimbursable as direct costs. One clause covered items specifically certified by the Contracting Officer as constituting a necessary part of the cost of the subject work. It
was included in order that OSRD might reimburse contractors for expenditures made under unusual circumstances and in good faith but which might not fall within any of the other cost categories. Occasionally such costs would be suspended by auditors or would be questioned in the fiscal offices of the contractors. It was possible under this contract provision for contractors to request special authorizations from the Contracting Officer on such items, and if satisfactory explanations and adequate justifications were furnished and the OSRD technical representative approved, they were given.

The OSRD fiscal policies and procedures were compiled by Cruikshank in a mimeographed volume entitled *Contract Manual (Fiscal)* which was distributed to OSRD contractors, OSRD personnel concerned, and interested Government agencies including the General Accounting Office, Bureau of the Budget, War Department, and the Navy Department. The *Manual* was kept current by the issuance of amendments which were sent to the recipients of the original volume. The subjects covered in the *Manual* are indicated in the Table of Contents:

<table>
<thead>
<tr>
<th>Foreword</th>
<th>Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSRD No-Loss-No-Gain Policy</td>
<td>Terminations</td>
</tr>
<tr>
<td>Preliminary Negotiations</td>
<td>Property Control</td>
</tr>
<tr>
<td>Letters of Intent</td>
<td>Reports and Other Special Requirements</td>
</tr>
<tr>
<td>Principles and Provisions of Contracts</td>
<td>Subcontracts</td>
</tr>
<tr>
<td>Direct Costs</td>
<td>Vouchering Instructions</td>
</tr>
<tr>
<td>Indirect Costs (Overhead)</td>
<td>Advance Payments</td>
</tr>
<tr>
<td>Tax Exemption</td>
<td>Approvals of Vouchers</td>
</tr>
<tr>
<td>Insurance</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>Salaries</td>
<td>Exhibits</td>
</tr>
<tr>
<td>Special Expenditures</td>
<td></td>
</tr>
</tbody>
</table>

**Vouchering**

OSRD research contractors working on a no-profit-no-loss basis soon began to complain about the normal requirements of the General Accounting Office with respect to detailed itemization and substantiation of vouchers submitted under their contracts. The experience of OSRD early indicated that the usual vouchering procedures indirectly impaired the efficiency of research through delays introduced in obtaining reimbursements for legitimate costs. Research projects which were relatively small in size involved large numbers of insignificant items of cost which made detailed itemization unduly irksome and expensive. OSRD found that most contractors capable of performing research work of the type it needed were of established reputation; and it suggested to the Comptroller General that instead of requiring the usual itemization and substantiation from research con-
tractors, there be accepted certifications covering vouchered amounts based upon accounts and records which the contractors would agree to keep until representatives of the General Accounting Office or the OSRD had an opportunity to examine them. It was pointed out to the Comptroller General that many academic organizations did not have accounting procedures under which normal Government vouchering requirements could be met. Attention was called also to the fact that certain contractors refused to execute contracts on a cost basis unless relaxation from the ordinary vouchering procedure could be secured. Finally the Comptroller General was informed that much of the research work was secret and that complete itemization and substantiation might result in unforeseen disclosures as to the nature of the work.

The Comptroller General agreed that on the basis of the facts presented vouchering relaxation was warranted and issued to the OSRD two decisions (B–30282 dated January 4, 1943, and B–30282 of May 19, 1943) which formed the basis for the revised vouchering and audit procedures followed by OSRD thereafter in the administration of its research contracts.

The revised vouchering procedure provided flexible control through partial itemization and substantiation as well as a series of certifications. Contractors accompanied each voucher with a certification that the amount claimed as reimbursement had been expended in performance of the contract and was properly chargeable thereto, that it was correct and that records pertaining thereto would be kept for the required period. The OSRD representative supervising the technical work certified, after examination of the voucher, that to the best of his knowledge the items for which reimbursement was being claimed were required by and used in the performance of the contract work. After administrative examination and audit the OSRD Contracting Officer certified that the items of cost were necessary and reasonable and that the usual itemization and substantiation should be dispensed with.

This vouchering plan proved satisfactory to OSRD technical representatives, generally acceptable to contractors, and adequate for the protection of the Government. It was later extended by the Comptroller General to the War and Navy Departments for use under research and development contracts.

**Advance Payments**

The First War Powers Act (Public Law 354, 77th Congress) and the implementing Executive Order No. 9001 (the provisions of which were extended to OSRD by Executive Order No. 9219) authorized advance payments whenever in the judgment of the agency concerned "the prosecution of the war is thereby facilitated." Executive Order No. 9001 further stated
that advance payments should be made only after careful scrutiny to determine that they would promote the national interest.

Normally OSRD contracts did not provide for advance payments but in unusual cases when the contractor could justify the need and after he had furnished an acceptable current balance sheet, provision for advance payment was made upon the favorable recommendation of the OSRD technical representative. In a number of instances academic contractors were unable to finance OSRD contract operations since their funds derived from foundations, grants, state appropriations, etc., were not available for such use, and in a few cases other nonprofit organizations were restricted by charter from using their funds to finance Government contract operations pending receipt of reimbursements.

Advance payments were restricted to a monthly basis. OSRD technical representatives were given an opportunity to make recommendations on all advance payment vouchers submitted by contractors. This gave them a chance to pass upon the necessity for and reasonableness of each month’s estimated expenditures and assisted generally in effecting a satisfactory control of the situation. Technical representatives were authorized to question any apparently unreasonable or unnecessary items included in advance payment requests and to recommend approval of lower amounts. Various administrative requirements designed to protect the integrity of advance payments were included in the Contract Manual (Fiscal), copies of which were furnished to contractors.

At the peak of operations advance payments were being made under fifty-six different contracts to twenty-one contractors and approximated $10,000,000 per month. The advances were later supported by vouchers showing the usually required detail. As fast as the detailed supporting vouchers were received, the outstanding unsupported balances of advances were liquidated.

**INDIRECT COSTS**

As pointed out in an earlier chapter, NDRC adopted as its guiding principle that research under its contracts should be conducted on a policy of "no-profit-no-loss," and further that full costs should be paid. The standard contract form listed a number of items as directly reimbursable, but it was recognized that there is a substantial indirect cost of a going concern which must be allocated as a part of the cost of a particular operation. NDRC sought to approximate this indirect cost by an allowance for "overhead," which initially was 50 per cent of labor costs in the case of nonprofit institutions and 100 per cent of labor in the case of profit establishments.

Desiring to find out how this rule of thumb was working in practice, Conant, in August 1941, appointed a committee of disinterested individuals
to look into it and a number of other items of NDRC fiscal policy. The committee consisted of Walter A. Jessup, President of the Carnegie Corporation of New York, Chairman; Alan Gregg of the Rockefeller Foundation, and Elihu Root, Jr., prominent New York attorney. The Committee report of December 1941, recommended that in the case of contracts for over $35,000 a separate determination be made of the proper overhead charge with reference to the conditions of particular contract and the department and institution concerned. It was suggested that the recommendation as to the proper overhead percentage might be made after consultations with university comptrollers such as R. B. Stewart of Purdue, Lloyd W. Morey of the University of Illinois, Robert M. Underhill of the University of California, or Horace S. Ford of M.I.T. For smaller contracts the committee recommended that the practice of fixing a flat overhead percentage be followed, but with a review and a redetermination of the proper overhead for contracts with any institution when the aggregate of its contracts reached $150,000. There was a further recommendation that the base for computation of overhead be broadened to include all direct costs and that the overhead percentage be lowered accordingly.

Following the receipt of this report Bush asked the persons named in it to visit various academic institutions having OSRD contracts to recommend overhead allowances for those having total contracts in excess of $150,000. In March 1942, after having visited the institutions and discussed overhead costs with their presidents and other officials, these gentlemen made specific recommendations for overhead percentages at the several institutions. They also submitted a proposed plan of allowance for overhead costs on OSRD contracts with educational institutions. The plan provided for the computation of overhead costs on a sliding scale starting with 50 per cent of salary costs on the first $250,000 of OSRD contracts with any one institution, 45 per cent on the next $250,000, 40 per cent on the next $500,000, 35 per cent on the next $1,000,000, and 30 per cent on all above $2,000,000. Special consideration would be given to any off-campus project or any single contract of $100,000 or more, and the exact percentage applicable to such contracts should be determined on the basis of the conditions involved.

This report was submitted for review to an expert accountant with no university connections. He suggested generally that it would be preferable for OSRD contracts with academic institutions to be written on a “provisional price” basis and renegotiated after the completion of the work. This plan was considered but not adopted. A modification of the overhead plan seemed preferable to the complications which might follow the adoption of a “provisional price” plan, especially in view of the opposition of contractors revealed in tentative discussions.

In the course of the discussions of overhead the suggestion was made that the Comptroller General might rule the OSRD contract to be invalid
as being analogous to the prohibited "cost plus a percentage of cost" type of contract. OSRD attorneys and the General Counsel for the Office for Emergency Management agreed that the OSRD contract was perfectly legal; and their position was later supported by an unpublished decision of the Comptroller General.

Since OSRD industrial contractors had acceptable cost accounting systems, it was undesirable to attempt to set up a schedule for the determination of their overhead costs under OSRD contracts. OSRD contract cost accountants normally followed the contractor's cost accounting system when it was in accordance with accepted accounting practices; and they normally allowed necessary and reasonable expense items charged thereunder as outlined in the pamphlet *Explanation of Principles for Determination of Costs under Government Contracts*, which was issued in April 1942 by the War and Navy Departments. This booklet (generally known as the "Green Book") was a summary of Treasury Decision 5000 which defined and listed admissible and inadmissible costs under Government contracts. However, since that decision was concerned with costs under profit contracts, the "Green Book" was not followed blindly in determining legitimate expenditures under contracts executed on a cost basis.

While it was impossible to establish any general rule for the apportionment of overhead costs to OSRD contracts, it was found that the apportionment could often be made equitably on the basis of the relation which the direct labor (hours or dollars) properly chargeable to the pertinent OSRD contract bore to the total direct labor involved in all the contractors' operations during the same period.

The expansion of OSRD work with the consequent increase in the scale of operations under OSRD contracts meant greatly expanded payrolls and increased overhead payments based on those rolls. The situation clearly called for a study of the accounts of the larger contractors. A small but effective staff was built up under W. F. Edwards, whose sole function was to check overhead expenses of OSRD contractors. No attempt was made to inspect the record of indirect costs of smaller contractors. The staff was too small to permit a check under every contract; the amount received under the overhead provision of smaller contracts was small; and the audits made of other contractors showed that the 50 per cent allowance had closely approximated actual costs during the period when the contract operations were small.

The problem of ascertaining the amount of indirect costs was one peculiarly of the nonprofit institutions. Academic institutions had not been under the necessity of handling their accounts in as much detail as the industrial concerns, and there was considerable variation among them. Likewise there was a substantial range of opinion among university fiscal officers as to what constituted a proper charge against an allowance for indirect expenses.
Cruikshank, Edwards and their staff proceeded slowly in an effort to work
the matter out with the contractors and in the end they were successful
in carrying the institutions with them in an agreement upon the proper
elements to be considered, which was no mean achievement.

A detailed schedule of allowable charges was adopted and inserted in the
OSRD Contract Manual (Fiscal), where it will be available for consulta-
tion by Government personnel administering research contracts for years
to come. Overhead costs were first divided among the following nine major
heads, which are listed merely to give an idea of the type of cost covered
by the overhead allowance:

A. Administrative and general expenses
B. Departmental expenses
C. Depreciation of building space used for performance of the subject work
D. Depreciation of equipment used for performance of the subject work
E. Interest on investment in buildings and equipment used for performance of
   the subject work
F. Cost of maintenance and operation of facilities
G. Interest on average outstanding receivables
H. Cost of the use of technical libraries
I. Other specific expenses.

The manual gives a detailed list of items under each of the major heads,
and suggests formulas for determining the proper allocations. This pro-
cedure for determination of overhead costs on OSRD academic contracts
proved to be adequate for the protection of the Government’s interests and
satisfactory to most OSRD contractors. In examining the overhead costs of
the largest academic and industrial contractors to November 30, 1945, OSRD
cost accountants found the following situation: (1) approximately 51 per
cent had received excess overhead payments largely because of the expansion
of operations under the contracts involved. Refunds to the Government or
recovery through reduced future payments were obtained; (2) approxi-
mately 40 per cent broke even; (3) approximately 9 per cent received over-
head allowances amounting to less than overhead costs, the deficits in most
cases being small; 6 per cent desired to absorb such losses and 3 per cent
asked for, and received, contract amendments to make them whole.

Control and adjustment of overhead payments were effected not only by
securing refunds when required and reducing overhead percentages when
necessary, but also in cases where contractors’ operations reached high levels
or were of a fluctuating nature, by execution of formal agreements placing
a ceiling upon the number of dollars which might be collected within a
given period under the overhead provision. These ceilings were changed
from year to year to allow the collection by contractors of their actual over-
head costs. Overhead computations were based upon the contractor’s total
OSRD business without attempting a further allocation as among different OSRD contracts.

Both academic and industrial contractors displayed a splendid spirit of co-operation in assisting OSRD cost accountants to make examinations and audits of their accounts and records. In most cases reductions of overhead percentages were willingly accepted, and many refunds were made on an entirely voluntary basis. In practice the overhead provision as administered seems to have served its purpose of leaving the institutions whole, neither richer nor poorer for having devoted a part of their facilities to this phase of the public interest in a period of great national peril.

One aspect of the overhead problem was potentially quite troublesome. Academic institutions operate without financial profit; there is thus no account to which they can charge losses under Government operations except as they draw upon funds for their normal educational activities. Expenditures under OSRD contracts were made for the purposes of the contract. The beneficiary of the expenditures was the Government. They would not have been made except at the request of the Government and in the reasonable expectation that they would be reimbursed by the Government.

Yet, conceivably an expenditure ordered under a contract in good faith and made by the institution in good faith under such direction might upon audit some months or years later be held by the Comptroller General to have been improperly made. In what position would such a ruling leave the institution? It received no benefit from the expenditure, but the ruling of impropriety might require the institution to dip into its educational funds to make restitution to the Government. In an extreme case, an institution supported by state funds might find itself legally unable to use its funds to meet the adverse ruling of the Comptroller General. Clearly such a situation has nothing in common with a profit-making establishment being required to return part of the profit earned under a Government contract.

To the extent of its ability OSRD tried to reassure its academic contractors that such a contingency was remote. OSRD endeavored to establish the legitimacy of expenditures its contractors were called upon to make. It aided contractors in adducing the facts which would assist the Comptroller General in reaching a favorable decision. But OSRD obviously could not take the final step and assure the contractors that there would be no disallowances. Further, as OSRD was but a temporary agency, there was the chance that it might not even be in existence to aid the contractor in preparing to meet a disallowance.

Some contractors contended that in holding the overhead allowance to a figure which would cover only actual costs, OSRD left the contractor in a position where in the end he might suffer a substantial loss. This contention
was recognized as a theoretical possibility, but it was not permitted to work a change in the calculations of overhead as any allowance would turn into a profit if there were no adverse rulings by the Comptroller General. It did have an important bearing on some cases, however. Overhead payments had been made prior to the examination of costs by OSRD accountants and in some cases these payments were found to have been excessive. While agreeing to scale down future payments, some contractors insisted upon retaining all or a part of the excess as a "reserve" against future disallowances. OSRD never recognized the validity of the "reserves" as such. When its request for their return was refused in some cases, it sought at least a partial refund together with a commitment to return the balance at a future date when the contractor's contingent liability was no longer hanging over his head. In every case, the requested commitment was given.

Insurance

Within a short time after the establishment of the agency, it became apparent that grave insurance problems were created by the unique nature of certain OSRD activities. Not only did such activities involve the normal dangers of all experimental work but additional hazards resulted from the military character of the projects and the urgency of their completion. As illustration there may be mentioned such diverse activities as the synthesis of poison gases, the development of new and more powerful explosives, and following the performance of new devices in combat areas.

One matter which early troubled some OSRD academic contractors working on new explosives was the possibility of a disaster of catastrophic proportions. The chemist's faith in the accuracy of his calculations was not always reflected in the university's business office confronted with the specter of a series of explosions resulting from improper handling of new explosive compounds. An explosion on a truck transporting a new explosive through the streets of a city might result in damage claims in an amount sufficient to wipe out an endowment.

OSRD explored the possibility of seeking Congressional authorization to establish a contingent fund out of which to indemnify contractors directly. However, the Bureau of the Budget in 1942 rejected the suggestion, pointing out that accurate calculation of the sum was impossible and concluding that it would be inadvisable to tie up a large sum of money without some factual basis for establishing its sufficiency.

With the permission of the Bureau of the Budget OSRD then sought legislative authorization to promise indemnity to the contractors out of funds to be appropriated later. The authorization was granted in the 1943 Appropriation Act (Public Law 678, 77th Congress) in the following language:
Notwithstanding the provisions of Section 3679 of the Revised Statutes (31 U.S.C. 665), the Office of Scientific Research and Development is authorized, in making contracts for the conduct of investigations or experiments, to agree on behalf of the United States to indemnify the contractor from such funds as may be hereafter appropriated for the purpose, against loss or damage to persons or property arising from such work.

Pursuant to this authority, OSRD on July 1, 1942, inserted the following provision in its standard form contract:

**Indemnity Clause.** The Government shall indemnify the Contractor, from such funds as may be hereafter appropriated by Congress for such purpose, against loss or damage to persons or property arising from performance of its undertakings hereunder (including settlements made with the written consent of the Contracting Officer) not compensated for by insurance or otherwise, in amounts found and certified by the Contracting Officer to be just and reasonable; *Provided,* That the Contractor shall give the Contracting Officer prompt notice of the institution of, and permit the Contracting Officer at his election to control the defense of, all law suits instituted against the Contractor with respect to any such alleged loss or damage.

OSRD appropriation acts for subsequent fiscal years contained the same language relating to indemnity and the above provision accordingly was continued in the standard contracts. The provision was so restrictive and indefinite (“from such funds as may be hereafter appropriated for the purpose”) that many OSRD contractors were unwilling to rely on it to the extent of completely omitting ordinary public liability insurance and similar normal business safeguards.

The problem of protecting contractors against the loss of equipment purchased under OSRD contracts and subjected to unique hazards was troublesome in 1941 and early 1942, when the standard OSRD contract placed on the contractor all risks of loss as to such property. To protect themselves against this contingent liability, contractors usually secured property insurance (fire, theft, windstorm, comprehensive, etc.), the cost of which was defrayed by the Government. Where operations were hazardous, such insurance was very costly, if obtainable at all.

To meet this situation, the new standard form contract adopted in January 1943, provided in Article 4 that the contractor should be responsible for loss of or damage to equipment purchased under the contract only so far as it was attributable to the willful misconduct or lack of good faith of an officer of the contractor or of a person having substantially complete charge of the establishment where the contract work was performed. Since the Government assumed almost complete risk of loss and thus acted in its traditional role of self-insurer, there was no necessity for insurance protection by outside carriers. The provision resulted in a very substantial saving to the Government.
The general principle underlying OSRD insurance practices was simply that OSRD approved a contractor's self-protection by reasonable insurance whenever the risks covered were attributable to OSRD work and the loss in the event of accident would fall on the contractor.

There remained the most serious difficulty of all—providing protection for scientific personnel voluntarily engaged in extra-hazardous work on behalf of OSRD. These fell into three broad categories: (1) salaried Government employees, (2) OSRD appointees serving without compensation (WOC), and (3) contractors' employees and others associated with the contractors in the performance of OSRD contracts.

As salaried Government employees were protected by certain statutory benefits, they presented no particular problem. To secure insurance protection for WOC (without compensation) personnel was difficult, since OSRD could neither directly purchase special insurance for them nor reimburse contractors for premium payments. This situation was temporarily alleviated at a critical time by a grant from Carnegie Corporation of New York to the National Academy of Sciences which permitted the Academy to pay insurance premiums in a limited number of cases. The matter was particularly pressing because the activities undertaken for OSRD might have operated to invalidate insurance regularly carried by the appointee; and a man willing to undertake certain risks on his own might well think twice before taking a step which, in the event of an accident, might leave his family unprotected by insurance.

Most pressing was the problem of contractors' employees. These men, who normally were engaged in teaching or some similar academic pursuit, were being asked without special compensation to undertake new activities involving risk of death or permanent disability. All their existing personal health or accident insurance, double indemnity benefits in life insurance, and much ordinary life insurance (preferred risks and rates) might be held to be voided by these new activities which fell within the usual policy exclusions of "deliberate self-exposure to great danger" and "risks of war."

Some of the individuals were technically qualified for State Workmen's Compensation benefits as "employees," but the hazardous nature of their work made it impossible to persuade underwriters to assume the risks. Since most of the activities were secret in nature, full disclosure of the risks could not be made to an insurer. Moreover, many of the men qualified for Workmen's Compensation would, in the event of accident, receive benefits grossly disproportionate to the value of their services, their financial and professional standing and the net amount of their losses (in insurance voidance and otherwise) by reason of their OSRD work. Further, the majority of those affected were not eligible for Workmen's Compensation either because they were employees of universities and other "charitable corporations" excluded by state laws, or because they were merely "associated with" con-
tractors in advisory or other capacities and hence were not qualified as "employees."

This situation resulted in a reluctance on the part of contractors to undertake OSRD work for fear both of loss of personnel and of possible future liability on the contractors' part. Staff crises were precipitated at several institutions with employees insisting that their families be accorded some measure of protection.

Several contractors individually attempted to obtain adequate insurance protection for their employees and themselves. This proved to be exceedingly difficult because insurance companies were reluctant to take a small number of very dangerous risks. The secrecy surrounding most of the work prevented disclosure to the insurer of precise information which would enable it to establish some actuarial basis for the premium, and most war risks then were incalculable. As a result, few institutions could obtain adequate coverage and those which did so found the rates to be almost prohibitive.

Contractors forced to pay large premiums demanded that OSRD reimburse them for the expenditures as necessary costs of performing the contract work. After careful investigation of the facts establishing the necessity for such insurance and after the General Counsel of OEM had approved the legality of the disbursement, such expenditures were approved by the Contracting Officer.

It was obvious that a situation in which the contractors affected were compelled to make individual deals with different insurers was haphazard and uneconomical. Yet, there was no practical way in which OSRD could "assume" such risks and act as self-insurer. The legislative permission to indemnify contractors was, of course, inapplicable to a situation in which the primary necessity was indemnification of personnel rather than contractors. Reimbursing an individual contractor for premiums caused little difficulty but a more economical method of handling the problem was desired.

The matter was the subject of several conferences between OSRD and its contractors, the latter requesting that OSRD undertake to unite their respective problems and interests so as to effect a coherent and economical plan. A number of the leading insurance syndicates in the United States declined to attempt a solution of the problem. Finally, however, an acceptable proposal was secured from a syndicate headed by the Fidelity and Casualty Company of New York. After obtaining an opinion from the General Counsel of OEM establishing the legality of his action, the Director of OSRD approved the acceptance of the proposal.

The main feature of this plan was the payment of a principal sum of $10,000 to any assured who died or suffered total and permanent disability "as a direct result of his OSRD activities." Certain other benefits concerning
maining, temporary disability, and hospitalization expenses were included. The policy did not provide twenty-four-hour coverage since it was intended to protect the assureds only against accidents occurring in the course of their OSRD work. The substance of the program was embodied in a Master Policy executed by the company and delivered to OSRD. Individual certificates of insurance were issued by the company to the assureds. The policy became effective October 19, 1942; and it was extended through May 30, 1945, at which time the business was transferred to the Indemnity Insurance Company of North America.

The Master Policy itself was simply a document of convenience incorporated by reference into each individual certificate of insurance. Each certificate was a contract between the company and the individual assured, with the Government and the contractor receiving certain rights (through readjustment clauses, etc.) as third party beneficiaries.

One of the more difficult specific problems was the determination of a premium which would be reasonably calculated to protect all parties to the transaction. The Government desired to obtain a low premium rate. The company’s primary concern at the outset was self-protection. The risks were incalculable on an actuarial basis; the general nature of the assureds’ activities was not revealed to the company for security reasons, but its representatives were informed that all assureds would be performing extra-hazardous work and many of them would be directly subject to enemy action in combat areas. The possibility of a catastrophe could not be ruled out.

The agreement fixed the premium at $150 per policy year, later reduced to $100. To protect the Government, a readjustment formula was provided, under which a recomputation would be made one year after the expiration of the Master Policy (to allow time for the disposition of all claims) and “excessive” premiums would be returned to the Government. The precise formula was stated in the Master Policy. To protect the Company, provision was made that when its losses reached a certain figure, it could request negotiations for a higher premium and if the negotiations were unsuccessful after fifteen days, could cancel upon sixty days’ notice.

As originally put into effect, the plan embraced activities in the continental United States and Canada, or within 300 miles of the coasts thereof. The Company refused to grant broader coverage at the outset, preferring to await developments. On March 24, 1943, coverage was extended to the British Isles, Greenland, Iceland, South America, Central America, the West Indies, Hawaii and Alaska, including travel to and from such places. The premium for this foreign coverage was $25 per month. If the traveler were already an assured, the domestic premium was credited and the net cost of the foreign extension was $12.50 per month. Later foreign coverage was extended to additional areas.

In order to avoid the administrative nuisance of constant monthly re-
newals, the danger of lapse through inadvertence, etc., contractors normally insured an employee for the full remaining policy term. Insurance for a shorter term was placed when it was clear that the proposed assured would be engaged in extra-hazardous activities for a shorter period of time and there was no probability that any other persons would perform extra-hazardous work under the pertinent contract. Since substitutions with premium credits were permitted under the Master Policy, this system allowed the contractor to maintain a separate running account with the company for each OSRD contract. An attempt to treat all contracts with the same contractor as a group was abandoned as unsatisfactory in practice.

A superficially vexing problem was presented by the fact that OSRD contracts were normally written for fairly short periods (usually six months), with an informal understanding that in all probability they would be renewed for at least a similar period. It would have been manifestly disadvantageous for contractors to have taken out insurance for a period not exceeding the then existing term of the contract with subsequent renewals from time to time. Such a system would present not only administrative complications but also substantial risks of lapse. Contractors frequently continued work when no formal contract supplement was in existence while awaiting formal approval and execution of the necessary documents. The insurance remained in force at such times.

Experience under the Master Policy was favorable from an actuarial point of view. With the favorable turn of the war, the insurance situation became easier and it became possible to obtain a policy carrying a lower premium rate. Transfer of some OSRD contracts to the Navy was under discussion and the Navy was confronted with the necessity of finding an insurance plan comparable to that of OSRD. On its own behalf and on behalf of OSRD the Navy began negotiations which eventually resulted in the issuance of Master Policy FD-502 by the Indemnity Insurance Company of North America to the Navy Department, under which world-wide, extra-hazardous insurance was available in the principal amounts of $5000, $10,000, and $20,000 for individual certificates and at a premium rate of $62 per year for $10,000 of insurance. The provisions of the new policy closely resembled those of the earlier one.

In view of the lower premium rate and broader geographical coverage of the new policy, extra-hazardous insurance requested by OSRD contractors subsequent to April 1, 1945, and approved by OSRD was placed under the new Master Policy. Insurance under the Fidelity and Casualty Company Master Policy was cancelled and coverage was transferred to the new carrier in appropriate cases.

To benefit by the coverage under the Master Policy the Government representative negotiating a particular contract determined whether the contractor's employees would perform such extra-hazardous activities that
special insurance should be provided. If so, the contractor was told about the insurance provided under the Master Policy and was furnished a set of forms. The contractor then sent a request to the Contracting Officer asking for approval for the special insurance, and authority to include premium payments therefor as an item of “actual cost” under the contract.

This request was required to be supported by a certification that (a) the insurance was necessary for the successful completion of the work, (b) Workmen’s Compensation was either unavailable or insufficient, and (c) the contractor had obtained from the individual to be insured an executed “partial release.” The request was accompanied by the individual application filled in to contain the required information concerning the assured, and the executed partial release. The limit of insurance was $10,000 per individual.

The contractor’s request for approval with its attachments was sent to the OSRD Contracting Officer through the Government representative supervising the particular contract for his recommendation and certification that the proposed assured was performing extra-hazardous work under the contract in question. Following receipt of approval from the Contracting Officer, the contractor forwarded an “insurance notice” to OSRD, which forwarded it to the Company. Upon the mailing of the notice, insurance was effective as of the preceding midnight by the terms of the Master Policy. The Company sent an insurance certificate to the contractor for delivery to the assured, together with a premium invoice payable within thirty days. After payment of the invoice, the contractor billed OSRD on a public voucher for the amount of its expenditure.

Clearance Prior to Final Payments

Article 2(a) of the standard OSRD contract authorized the Contracting Officer to withhold all or any part of the final reimbursement payment until receipt of the reports required under the contract. In a few cases there were differences of opinion between contractors and the OSRD as to the meaning of the term “final” payment. In order to secure reimbursement promptly and in the largest possible amount certain contractors conceived the idea of covering in two vouchers what would normally have been the final payment voucher; and they insisted that the OSRD approve for immediate payment the one covering the larger portion of the total amount as a prefinal payment, leaving OSRD with a final payment voucher in an insignificant amount. This procedure would obviously defeat the purpose of the withholding provision — to stimulate the contractors to comply promptly with the provisions of the contract.

To meet this situation the practice was adopted of withholding an amount not to exceed 10 per cent of the total dollar value of the contract concerned, but not less than $1,000 nor more than $50,000, until the contractor had
filed an acceptable final technical report, property accounting, invention disclosure and patent designation as required by the contract. When final payment vouchers exceeded the amount to be withheld under this policy, only the excess was approved for payment, with the remainder suspended pending receipt of the final reports.

The establishment of flexible financial controls, adequate to protect the public interest without imposing unnecessary restraints upon the conduct of needed research, was a progressive development which kept pace with the growth of OSRD. Working closely with the General Accounting Office, it was possible to obtain a sympathetic hearing on problems confronting the agency. From this experience, precedents developed which will be of substantial benefit to other agencies charged with the promotion of military research in the future.
CHAPTER XV

PATENT POLICY

NDRC early recognized that the handling of patent rights to inventions made under its auspices would present a major problem not easy of solution. The point was discussed at some length at the informal conference of June 25, 1940, preceding the organization of the Committee.

There is no uniform policy applying to inventions made by Government employees, and NDRC had a wide range of precedents upon which to base its decision with reference to its own employees. NDRC technical personnel were employed to supervise research under contracts, not to make inventions. It was highly desirable that there be no possibility of their being charged with using information obtained in the course of their duties to establish patent rights for themselves. Accordingly the adopted policy, which was put in writing as Administrative Circular 10.06 of September 15, 1943, was that technical personnel should assign to the Government the titles to inventions and discoveries made by them in the line of their duties. The limited extent to which OSRD employees engaged in making inventions of their own is indicated by the fact that as of April 8, 1946, only twelve inventions had been reported under this circular.

Development of the Patent Clause in OSRD Contracts

At the informal conference of June 25, 1940, Commissioner Coe was requested to draft a tentative contract clause providing generally that whenever an invention was made in the course of research work financed in whole or in part with funds advanced by the Committee, the NDRC should decide whether a patent application should be filed and, on the basis of equity, what were the respective rights of the inventor and of the Government. The matter was again discussed at the first meeting of the Committee on July 2, 1940; and on August 29, 1940, the Committee adopted a principle which was incorporated in its early contracts in the following language:

It is understood and agreed that whenever any patentable discovery or invention is made by the Contractor or its employees in the course of the work called for in paragraph 1 hereof, the Committee shall have the sole power to determine whether or not a patent application shall be filed, and to determine the disposition of the title to and the rights under any application or patent that may result. It is further understood and agreed that the judgment of the Committee
on such matters shall be accepted as final, and the Contractor, for itself and for its employees, agrees that the inventor or inventors will execute all documents and do all things necessary or proper to carry out the judgment of the Committee. The Contractor agrees that it will include the provisions of this paragraph in all contracts of employment with persons who do any part of the work called for in paragraph 1 hereof.

At the same time the Committee authorized the Chairman to appoint an Advisory Committee on Patents to advise on general principles and on procedure in specific cases. Coe was appointed Chairman of this committee and Loyd H. Sutton, a Washington attorney, was designated to serve with him. On the basis of a report by this committee, a resolution was adopted at the October 25, 1940, meeting of NDRC which directed that every contract should provide that no suit should be brought against the Government on any patent granted upon an invention made under the contract; that, whenever, with the assent of the Committee, the contractor should assign to the Government the entire right, title and interest in an invention made under a contract, the Committee should pay all costs incident to the filing, prosecution and issuance of the application for patent; that, wherever, with the assent of the Committee, the contractor retained all rights in any invention made under a contract, it should pay such costs; and that special circumstances might justify a departure from these general principles in a particular case.

The patent policy adopted by NDRC up to this time left the contractor completely subject to the judgment of the Government as to the disposition of rights to inventions made under NDRC contracts. Some industrial contractors refused to sign contracts with such a provision. The situation was, in fact, somewhat anomalous. The United States was at peace and many people believed it would not become involved in the war being waged in Europe. On the other hand, NDRC was obsessed with the urgency of its task, fearing that the United States would be forced into the war while still unprepared from a scientific standpoint. To avoid delays it was essential that NDRC deal with organizations possessing the best available scientific manpower and facilities. Time was of the essence. There was need, not only for the facilities of the best equipped and most advanced groups in the country, but for their best brainpower as well. In effect NDRC was asking America’s leading companies to take their best men off their own problems and put them (at cost) on problems selected by NDRC, and then leave it to NDRC to determine what rights, if any, the companies would get out of inventions made by their staff members.

These companies had acquired a great deal of “know-how” as a result of years of effort and the expenditure of their own funds, often in large amounts. The research they were being asked to undertake was in many cases in line with their regular work (which made the companies particu-
larly valuable to NDRC for it meant avoiding a loss of time while the contractor familiarized himself with a new field) and might result in some cases in inventions they might be expected to make at some future date at the appropriate place in their own programs. In some cases the Government contract involved minor adaptations of past inventions made by the contractors, and in such cases the contribution to the final product attributable to the work financed by the Government was relatively insignificant. But under the patent clause thus far offered by NDRC a company might be excluded from using its inventions under an NDRC contract in its own business, and might even find its competitors licensed by the Government while licenses were refused to it.

The Army and Navy had rarely, if ever, asked for rights as extensive as those demanded by NDRC. Instead they took licenses which varied in different situations but left commercial rights in the contractor. NDRC was created to aid the country to get ready for war, not to cure any inequities which might have grown up under the patent system created by Congress. The position expressed in the patent clause was hardly as important as getting the country ready for a technological war if the situation was as serious as it seemed when NDRC was created. It was true, of course, that many patriotic citizens did not regard the situation as serious, and the compulsion exerted by an appeal to patriotism in time of war was lacking.

Such a compulsion might have caused some companies to accept the proposed patent clause in time of war when they were unwilling to do so in time of peace. There was no occasion to find out, for negotiations could not be permitted to drag until the United States entered the war. Drag, they did, for months, but not at the expense of the scientific research program. The principal companies involved in the early negotiations over the patent clause were General Electric, Radio Corporation of America, Western Electric and Westinghouse Electric. None of them was willing to accept the NDRC patent clause; and until agreement could be reached, no contract could be signed. All four companies, and others later, worked under letters of intent, expediting the needed research and relying upon later agreement to pave the way for reimbursement for their costs.

The Patent Advisory Committee was given the task of obtaining agreement upon a patent clause. Extended negotiations were had with proposed contractors. At its meeting on January 17, 1941, the NDRC adopted in principle a recommendation of the Patent Advisory Committee which in essence provided that the Government should receive a royalty-free, irrevocable license for military, naval and national defense purposes under inventions made under a contract. Minor modifications were made in the clause which was textually approved at the March 7, 1941, meeting. A further minor modification was made in June 1941. With the formal changes made to fit it into the revised OSRD contract form, this patent
clause came to be known as the "long form" clause. (See Appendix 2, Article 5.)

The main points in this rather lengthy article were: (a) that the contractor granted to the Government an irrevocable option to purchase a license on reasonable terms, arrived at through negotiations, under any inventions heretofore owned or controlled by the contractor, concerned with the subject matter of the contract; (b) that the contractor granted to the Government an irrevocable royalty-free license to make, have made and use for military, naval, and national defense purposes any invention made during the performance of the work of the contract; (c) that the contractor would, prior to final settlement, make a complete disclosure of all inventions made in carrying out the work under the contract; (d) that he would inform the Government of inventions he had covered or would cover by application for patent; (e) that the Government should have the right to file applications for patent on any invention that the contractor elected not to cover by application for patent; (f) that in the event the Government filed the application for patent, there would be an assignment of that invention to the Government subject to a royalty-free, non-exclusive, nontransferable license to the contractor.

The Patent Advisory Committee was unsuccessful in trying to have the license required by the long form clause extend to all governmental purposes. The argument advanced for the more limited license was that the whole purpose of NDRC was to contribute to national defense and that it would be unfair to require the contractor to give a general license covering fields which had nothing to do with national defense. Coe consulted the War and Navy Departments and was told that the more limited license would be satisfactory to them. The clause adopted by NDRC was recommended by the Patent Advisory Committee as the one which would "come as near meeting with general acceptance as anything we can draw." The NDRC adopted the clause as equitable under the circumstances.

With the adoption of the long form clause the log jam in the signing of contracts with industrial concerns was broken. The long form was not a substitute for the earlier clause (which, with the adoption of the long form, came to be called the "short form" clause); rather the two forms were used concurrently as alternative clauses. Formal changes were made in the short form when the OSRD contract form was revised, but in substance it did not vary from the time of its original adoption on August 29, 1940. (See Appendix 2, Article 5.)

The short form clause was adopted as the standard for contracts recommended by CMR because of the broad public interest involved in medical research. It was also used in contracts in the field of atomic energy, about which more will be said later. The third principal category of contracts using the short form consisted of so-called "central laboratory" contracts—
those where it had been necessary for OSRD to contract with an academic institution to build up a special staff for work in a field in which there was no existing composite group of specialists, e.g., radar, rockets and anti-submarine devices. The long form was standard where the contractor had an established position or an existing fund of knowledge upon which OSRD wished him to build for the development of specialized equipment or instruments.

OSRD adhered closely to the two standard forms of patent clause as being adequate to meet all situations. Many industrial contractors were originally reluctant to accept the long form without change; it seemed that patent counsel for nearly every firm wanted to modify the language to conform to his favorite modes of expression. Many of the suggestions cancelled each other out, although this was not very helpful as the suggestions originated with different counsel and were presented by different contractors. Believing that uniformity of language was essential if the possibilities of later misconstruction of intent were to be minimized, OSRD permitted few variations from the standard clause.

The permitted variations were largely by way of additions to the standard clause. Thus in a few cases a clause was added to assure the contractor that the Government would hold him harmless under the provisions of the Act of June 25, 1910, for infringement of any patents involving equipment used under the contract. In a few other cases the subject work was more accurately stated in the patent clause than in Article 1 of the contract, i.e., certain aspects of a problem not intended to be worked upon, but capable of inclusion by a broad construction of Article 1, were specifically excluded in the patent clause. In another group of contracts the interpretation OSRD gave to the long form was spelled out in slightly different terms upon the insistence of the contractor; these included such points as that the applicability of the license to "processes" was coextensive with the license covering "materials," and a refinement of the obligation to grant licenses under prior developed inventions.

The short form clause was used by OSRD in 780 contracts involving $338,911,644.92 and the long form in 1410 contracts under which $165,675,748.52 was obligated. The distribution is given in further detail in Bush's testimony contained in *Hearings on Science Legislation (S. 1297 and Related Bills)*, 79th Congress, First Session, Volume 5, pp. 1118–1121.

An entirely different patent clause was used in a group of contracts directed toward the synthesis of penicillin or a therapeutic equivalent thereof. The commercial organizations most concerned had been carrying on research in the field at their own expense for some time and they desired to continue at their own expense. Some of them had already discovered valuable information although mostly not of a patentable nature. OSRD's primary interest was to work out a procedure whereby the synthesis of peni-
cillin for war casualty use could be expedited by a full interchange of information among all research teams so that one team would not waste valuable time on work already done by another team. With the advice of the Commissioner of Patents and after clearance with the Department of Justice, an arrangement was worked out with the commercial organizations under which (1) there would be complete interchange through OSRD of information discovered by all the OSRD contractors; (2) the commercial organizations would continue to finance their own work, and (3) OSRD would have the right to determine the disposition, among the organizations that made contributions through OSRD of valuable information or inventions, of all patents covering discoveries or inventions made under the contracts that were attributable to the interchange of information through OSRD. In addition the Government was to receive a royalty-free license for military, naval, and national defense purposes under all patents resulting from work done by these contractors in the synthetic penicillin field, both before and after the execution of the OSRD contracts. Finally, OSRD was given the right to require contractors who would ultimately become the titleholders of the patents to license other designated organizations, whether or not they contributed inventions or relevant information, upon the payment of reasonable royalties.

**Administration of the Patent Program**

Bush wanted to place the active administration of the OSRD patent program in the hands of a man familiar with Army and Navy patent practices. At his request the Secretary of the Navy assigned to OSRD Commander (later Captain) Robert A. Lavender, U.S.N. (Retired), who was designated as Advisor on Patent Matters on October 16, 1941. Lavender’s first assistant was Lieutenant Colonel Paul P. Stoutenburgh.

It was realized that the full enjoyment of the rights under inventions made in carrying out the subject work of OSRD contracts could be had only by the careful administration of the patent articles. Not only should the reports of inventions be complete in their technical details so that the Government would be in a position to prepare and file applications promptly, but also the original records of the making of the inventions should be accurate and complete to establish the Government’s position before the Patent Office in interference proceedings, as well as before the Court of Claims in case the Government should be sued later on a patent under which it had no license.

The Division Chiefs were selected as the logical officials, technically and administratively, to supervise the reporting of inventions. They had the assistance of Technical Aides, each of whom was in close touch with the work carried on under certain contracts. The Technical Aides were also
in close contact with officers in the War and Navy Departments who were familiar with the results to be accomplished through the research and the applicability of inventions and discoveries to existing or prospective equipment.

The standard procedure was for the Division Chiefs to call upon the contractors to file invention reports with them as soon as practicable after each invention was completed. The Division Chiefs then transmitted copies of the invention reports to the Advisor on Patent Matters, identifying the contract under which the invention was developed and the project to which it related. These reports were in turn transmitted to the War Department through the Office of the Judge Advocate General or to the Navy Department through the Office of Research and Inventions according to which Service had the predominating interest. In accordance with arrangements entered into with the War and Navy Departments in September and October 1941, the preparation and filing of applications for patent arising under OSRD contracts were handled by the patent divisions of those departments rather than by OSRD.

It was recognized that many questions involving a knowledge of patent law were bound to arise within the divisions, particularly with reference to the sufficiency of original records and the presentation of technical information in proper form. It was, therefore, decided that patent attorneys should be assigned to the Division Chiefs for consultation on patent matters. These patent advisors to the Division Chiefs were stationed, as personnel became available, at Cambridge, New York, Chicago, and Washington. Because of the diversity of research supervised in the vicinity of Washington, separate advisors were located there for chemistry, electronics, mechanical and medical activities. It was impossible to obtain a sufficient number of civilian patent attorneys to fill all of these positions and, at the request of the OSRD, a number of Army and Navy officers were made available.

Uniformity and adequacy in handling the details of compliance with the patent clause were sought through a series of administrative circulars devoted exclusively to patent matters. Efforts were made to insure that contractors would keep their records in such form and detail as to simplify the reporting of inventions and the preparation of patent applications.

As an extracurricular activity OSRD assisted the Patent Office, at its request, by examining filed applications for patent with a view to recommending which of them should be kept secret for reasons of national security. The persons reviewing filed applications were different from those responsible for selecting the claims to be made for inventions under OSRD contracts, a precaution dictated by the desirability of avoiding any possibility that an OSRD application might be influenced by information derived from a review of applications of others.
Under the Act of July 1, 1940, as amended (35 U.S.C. 42), an applicant against whom a secrecy order has been issued by the Commissioner of Patents is entitled to make "tender" of his invention to the Government and to receive compensation for the use of the invention from the date of such use rather than the date of issue of the patent. The purpose of the statute was to make the latest inventions available to the Government; and the Secretaries of War and the Navy were authorized by the Act to negotiate with the owner of the invention for the settlement of claims for compensation while the application was pending, although no claim might be filed against the Government in the Court of Claims until after issuance of the patent.

In order that the OSRD divisions might have the benefit of the inventions claimed in applications tendered to the War and Navy Departments, a procedure was established whereby those Departments referred copies of the tendered applications to the OSRD divisions through the Advisor on Patent Matters. It was realized that the Technical Aides to whom these applications were referred were in the best position to furnish available information useful in the settlement of any claim. Accordingly, they were requested to inform the Advisor on Patent Matters as to whether the alleged invention in the application was new, operative or adaptable to immediate use.

In administering OSRD contracts containing the short form patent clause, Lavender operated under a general delegation of authority that provided (1) for a reference of each invention either to the War Department or the Navy Department, depending upon which department was the source of a request to OSRD to undertake the particular project, for a determination as to whether or not an application for a patent should be filed on behalf of the Government; (2) that if the interested department determined that such an application should be filed, it should file the application and arrange for the assignment of the entire right, title and interest to the Government; and (3) that if the interested department determined that no patent application should be filed on behalf of the Government, it should notify the contractor that it might file in its own behalf, subject to the grant to the Government of a nonexclusive, royalty-free license for governmental purposes.

The correspondence load of the Patent Division frequently ran as high as 600 to 700 letters a week; by January 31, 1946, 6746 invention reports had been processed by the division. Of these, 2601 had been covered by applications for patent filed in the United States Patent Office, of which 1276 were filed by the contractors, 805 by the War Department, and 520 by the Navy Department. The Services had notified the patent division that they would file applications for patent on 513 additional invention reports, but that 1432 were not of sufficient interest to warrant the prep-
aration of applications for patent. The Patent Division at that time had not been informed of the election of the Services as to the remaining 2200 invention reports.

There are two fields of OSRD research and development which merit special mention from a patent standpoint: (1) radar, in which OSRD, the War Department, and the Navy Department established a definite patent program integrated among the three agencies; and (2) atomic energy, a new field opening up untold possibilities for the future in both military and civil applications.

The Government Radar Patent Program

In early 1942, OSRD, the Army, and the Navy were all engaged in research and development in the field of radar. The OSRD program was centralized in Divisions 14 and 15, the principal laboratories being the Radiation Laboratory at M.I.T., and the Radio Research Laboratory at Harvard University. It was under the short form patent clause, which meant that the Government had to arrange for the preparation, filing and prosecution of the applications for patent under these contracts.

The first plan was for a small group of attorneys to be employed at the Radiation Laboratory to make invention reports in the form of applications to be forwarded to the Navy Department for filing and prosecution. It soon became apparent from the number of inventions processed in this manner, not only that the Navy Department Patent Section was unable to secure a sufficient number of attorneys to handle the applications originating in OSRD, but also that there was an overlapping of claims of inventorship as between naval personnel and M.I.T. personnel. This conflict focused attention upon other possible conflicts with inventors in the War Department laboratories. As a result of a series of conferences of representatives of OSRD, the Army and Navy, it was agreed that, in view of the enormous sums of money being spent by the Government in the development of radar equipment, a Government Radar Patent Program (GRPP) should be established. This program provided for a monthly meeting of the representatives of the several laboratories. At each meeting matters of policy were decided and the latest technical developments at each laboratory reviewed, to the end that possible conflicts in claims of inventorship could be determined at that time.

To resolve possible conflicts, a system for the exchange of information known as Exchange Sheets was established, under which the representative of each laboratory prepared and transmitted to the others, prior to a meeting, a brief description of each invention made at his laboratory and considered as the subject of an application for patent. Upon receipt of these Exchange Sheets each laboratory located any conflicting subject matter that
had come to the attention of the officers in charge of the various groups, and at the next meeting of the GRPP a determination was made as to the scope of the invention to be covered in the applications to be filed by the War and Navy Departments. As the volume of new cases increased, the War and Navy Departments established patent sections in Cambridge, where they could work closely with the Radiation Laboratory and the Radio Research Laboratory. As of January 1, 1946, 2600 Exchange Sheets had been submitted to the GRPP, 603 being the subject of applications for patent filed in the Patent Office.

The Atomic Energy Patent Program

When the program on atomic fission was taken over by NDRC in 1940, the initial contracts were executed with organizations which already had done work in that field or related fields. The program started on a small scale, and the chances of success in terms of weapons (which was the NDRC interest) were considered relatively modest. The early NDRC and OSRD contracts in the field of atomic fission contained the long form patent clause under which the contractors would receive titles to patents and the Government would receive a royalty-free license. As the project grew, as the contracts began to produce successful results, and as the tremendous possibilities of those successful results extending far beyond the field of military weapons began to take shape, Bush communicated the results of the combined efforts to President Roosevelt, who fully grasped the significance of the project and the results of its solution. The President decided that Government control should, at least initially, be exercised through the handling of patent rights, and he directed Bush to arrange as far as possible for the vesting in the Government of the title to patents on inventions and discoveries made on the project.

Because of the unusual public interest involved, all the OSRD contractors in the field of atomic fission agreed to accept a change to the short form patent clause covering all research and development work in the field under OSRD contracts, and to make that change retroactive to the beginning of work under those contracts. It was agreed that no monetary consideration would be given by the Government for the patent rights that already had been vested in the contractors through operation of the original provision, but instead that the necessary legal consideration would be supplied by the signing of supplemental agreements to continue the work, as each of the contracts involved required renewal. The process of supplementing and amending the contracts case by case took a few months, but all necessary contract amendments were executed well before the OSRD research and development contracts were terminated and the project transferred to the
Manhattan District in the spring of 1943. The termination agreements expressly stated that the Government retained all its patent rights.

The result was that, under all NDRC and OSRD research and development contracts in the field of atomic energy, the Government received the right to determine the disposition of all patents covering inventions and discoveries made during the course of the required work. The practice was uniformly followed of vesting title to patents in this field in the Government.

At the time of the transfer of responsibility for research in the field of atomic fission to the Manhattan District, the Secretary of War told Bush that in his opinion it was advisable to have one centralized administrative group handling all patent rights on the atomic fission project, and he requested that the OSRD Director be the custodian of such rights. Major General Leslie R. Groves, Director of the Manhattan project, pointed out that Lavender had already set up a patent administrative organization and was familiar with the problems. As a result of those discussions, the War Department atomic fission research and development contracts provided that the OSRD Advisor on Patent Matters should be the Contracting Officer's representative for patent matters. Lavender was the OSRD patent advisor and as such acted as the patent advisor for the Manhattan District; Bush, as Director of OSRD, received, on behalf of the Government, assignments of rights to inventions made under the Manhattan District contracts.

During the period when OSRD was active, there was considerable agitation in various quarters for modification of the patent system of the United States and a feeling in some places that whenever any Government funds were spent on a project, all rights to inventions flowing from that project should vest in the Government. In general the OSRD position was that it was not created to rectify abuses which might exist in the patent system; and that until such time as Congress should modify the system or Government policies within the existing system, OSRD would be guided by practices theretofore followed. The primary result of OSRD activities was a large number of contributions to the winning of the war; an incidental, but important, result was placing in the hands of the Government substantial rights under many developments, some of them of great potential peacetime significance.
CHAPTER XVI

PRIORITIES AND PROPERTY

Priorities

ORSRd contractors spent approximately 457 million dollars through November 30, 1945; and it is estimated that about 200 million dollars of this amount went for material and equipment. The variety of items was infinite—from airplanes to white mice, from machine tools to dog food, from electronic components to sugar. Though the amount was modest compared to the figures for armament procurement, it was large in its own right; and its expenditure in view of competing demands was an extensive undertaking.

Prior to the attack on Pearl Harbor the Government agency for controlling material and equipment was the Office of Production Management (OPM); after that event, the War Production Board (WPB). Production was necessarily the keynote in the planning of these agencies. Restrictive orders by the hundreds were issued, designed to channel the flow of scarce materials into war equipment and to prohibit their use for other purposes. The difficulty for research was not a lack of recognition of its importance but the fact that the various plans for dividing scarce items were based on forecasting requirements for months in advance. Normally the scientist could not foresee that his research would progress to the point that in three to six months he would need a specified number of radio tubes of stated characteristics or a definite number of feet of wire of a certain gage. Yet the absence of those tubes or that wire at a critical time might occasion serious delay in a large and important program. The problem was to find a way in which research could flourish within the system established for a production-conscious world.

A complicating factor was the confidential nature of the majority of OSRD research and development contracts. Inability to disclose the subject matter of contracts brought many problems. Even if the subject matter could have been disclosed, it would have been extremely difficult for anyone to judge whether a particular research project of OSRD was more important than a Service production contract. The Joint Chiefs of Staff could determine whether ships or airplanes or tanks were most important at a given time, but it was more difficult to weigh the importance of a research program which might succeed or fail against an important production program.
One point always stressed was that only small amounts were needed for research and the diversion would be relatively negligible. This was generally well received but it had a hollow sound on those occasions when a research program demanded a high proportion of the units of an item in very short supply. It was the practice to enlist the aid of Army and Navy officers familiar with particular projects; they helped to establish the importance of the research projects but they were not in a position to judge the relative value of those projects and the specific Service production contracts with which they might conflict.

A conspicuous example of the secrecy problem was the case of priorities for the development of the atomic bomb. The research and development program grew to substantial proportions under OSRD with requirements for large quantities of critical items; but the subject matter could never be mentioned and it became increasingly difficult to get necessary action from WPB. The OSRD priority section breathed a sigh of relief when the project was transferred to the Manhattan District where it was given an overriding priority.

The Army, Navy, Lend-Lease, OSRD, and other war agencies were very often put in a preferred status as regards compliance with various limitation, conservation and other restrictive orders issued by WPB and OPA. As OSRD purchased little equipment directly, it contended that the purpose of the preferred status could be achieved only by the extension of the preference to its contractors. The interpretation of the orders varied, but it was only in exceptional cases that OSRD contractors were able to take advantage of the favored status of OSRD.

One of the basic theories of WPB in controlling materials was that each production contract should carry a project priority rating dependent upon a determination of its relative importance in the procurement picture. Under this system producers were allowed to use a project rating only to get the materials which would go into the “end item,” viz., the bombs or radios or planes. As applied to the activities of OSRD, this principle sometimes led to absurd results, as in the case of a research contract calling for the delivery of a report. Under a strict interpretation of the theory, the project rating in such a case would cover only the paper on which the report was written. Other contracts called for the delivery of a model but even here a literal interpretation of the end item theory would not cover any of the material used in the basic research or in the breadboard or intermediate models. Obviously research could not live under such a system.

Fortunately OSRD was successful in maintaining throughout the war that the end item was research and development and the priority rating assigned covered all materials, supplies and equipment needed to carry on the research and development. As plans for controlling materials changed and personnel were transferred in the WPB and the Army and Navy
Munitions Board, this interpretation was constantly subject to attack. It was upheld, however, although not without some minor setbacks and continuous struggle.

Formulation and administration of a priorities program for NDRC and OSRD was one of the functions of the Executive Secretary. The small unit in the Administrative Office handling priorities was reconstituted as the priorities and property control section in the spring of 1942, when the increase in volume of OSRD activities occurred simultaneously with a tightening of the materials situation. Marvin L. Faris was the first head of the section. When he left to join the Navy in October 1943, he was succeeded by Roy C. Bowker. By July 1942, the section had a staff of fifteen, of whom eleven were working on priorities. Property control activities consisted largely of diverting property from terminated contracts to those active contracts in which it was most needed.

NDRC contractors early ran into difficulty in procuring necessary equipment and materials. The Administrative Office accepted the responsibility for seeing that they were available. The guiding principle in OSRD priority operations was that the scientist should have what he wanted, when he wanted it and with a minimum diversion of his time from research activities. This meant that the priorities section acted as an intermediary between the contractor and WPB and, upon occasion, between the contractor and the supplier. It also meant that OSRD carried the brunt of the case whenever WPB issued, or considered issuance of, an order the effect of which was an undue restraint on research activities. An effort was made to keep OSRD contractors informed of all WPB actions affecting the supply of materials and equipment and to help them with all possible short cuts.

The first procurement difficulties occurred late in 1940 when a few contractors found that delivery of a machine tool or a bit of aluminum would not be immediately forthcoming. In such cases the Administrative Office asked for and received copies of purchase orders which were forwarded to the Priorities Committee of the Army and Navy Munitions Board (ANMB) and the Office for Production Management with covering letters reciting the circumstances. Priority ratings were not always necessary where the items were small; and release was often effected by a telephone call from a person officially connected with the OPM. In other cases almost any priority was sufficient to provide for an early release of the material. It was not until early in 1941 that the need for a more precise procedure became evident.

Discussions with OPM officials resulted in the establishment of a procedure which was communicated under date of February 11, 1941, to OSRD contractors. It provided for the submission of an application (OPM Form PB8) through NDRC Technical Aides to the Administrative Office. The
latter then forwarded the forms with covering letters explaining the circumstances and stating the urgency of the research project to the priorities division of OPM. Ratings were assigned to the certificates which were returned to the Administrative Office and thence to the contractor for transmission to the supplier. This procedure, while cumbersome because of the number of hands through which the papers had to pass, was adequate since the number of requests processed was small. A minor change in the procedure occurred in March 1941, when the old form was replaced by a new one in two parts (Form PDi and PDiA). The method was the same except that the second form was sent to the supplier for additional information and then sent on to OPM.

In the late spring of 1941 materials became more scarce and the procedure began to break down because of the increased number of cases sent in for processing. Conferences between OSRD and OPM in June 1941, resulted in an OPM decision that war research projects of the NDRC could be placed in the highest priority category for entire programs (A-r-a). OPM also authorized the Secretary of NDRC to issue and sign A-r-a priorities for specific materials after the projects had been established with the OPM at that rating. The only rating higher than an A-r-a at this time was an AA which was not assigned to any program but was reserved for issuance in emergencies for bottleneck items, where, for example, a whole production line was about to close through the lack of a single item.

Under the new procedure as soon as the NDRC voted money for a contract, a prime priority certificate was made out and sent to the OPM for authentication. Along with this certificate went a generalized description of the research to be conducted. After OPM had authenticated the prime certificate, it was sent to the contractor together with short application forms which he could make out for specific items and send to the Administrative Office. The procedures within the Administrative Office were such that the certificates were usually issued within twenty-four hours after the applications were received.

With NDRC research established in the highest category possible in the priorities framework, contractors had relatively little difficulty in obtaining the materials and equipment they required.

This procedure continued without change until March 15, 1942, when WPB Priorities Regulation No. 3 became effective. That regulation provided that a contractor holding a prime project rating could extend that rating merely by a certification on his purchase orders, thereby eliminating the mass of paper work required in the issuance of priority certificates covering the items included on purchase orders and saving the time previously lost in sending applications to Washington. One qualification was that extensions of prime ratings could not be made for capital equipment, facilities and repair, maintenance and operating supplies. It was at this time that
the WPB (which had replaced the OPM shortly after Pearl Harbor) delegated responsibility for administering OSRD's priority program to the Army and Navy Munitions Board.

By July 1942, the priority rating structure required revision because the AA rating originally intended as an emergency rating for limited assignment, had been assigned to a considerable number of Service production contracts. As a result the A-1-a rating, which had hitherto been used for all important war production and for OSRD research as well, became increasingly ineffective. The WPB then amended the priorities structure to provide for five categories of AA (AA-1, -2, -3, -4, -5) for war work and superimposed AAA as the emergency rating. The Joint Chiefs of Staff recommended and the WPB approved certain production and other programs for the various ratings. Among these was that research programs and pilot plants of the OSRD, Army and Navy should be placed in the AA-3 category. This lowered the position of research to fourth place in the priorities structure where formerly it had been in second place. The rating covered all materials, supplies and equipment needed with the exception of machine tools, building construction materials, and office equipment which required special handling.

Fortunately, OSRD was able to obtain AA-1 and AA-2 ratings for certain of its contracts and for portions of others where it could be argued that the development work had reached the prototype stage or where operational use of the devices would begin in a comparatively short time. This was an informal arrangement but it helped to solve the problem for some of the larger contractors, especially in the field of electronics.

In July 1942, the WPB also announced the Production Requirements Plan. This plan provided that manufacturers and others who could anticipate their requirements for three months in advance could be given ratings upon the submission of such information and approval of the program by WPB. Only a few of the larger OSRD contractors, such as M.I.T. for the Radiation Laboratory and C.I.T. for the rocket program, could take advantage of this plan and thereby receive sufficiently high priority ratings for their purposes.

In time some new projects for the production of limited amounts of equipment for Service use or test were placed in the higher categories, but most of the OSRD contractors were forced to struggle along with the AA-3 rating assigned to research. They were able, of course, to apply for out-of-line ratings through the priorities section and so were not permanently stymied in the procurement of materials, but this made for much paper work and was naturally slow and cumbersome.

In September 1942, at the request of OSRD the WPB set up an out-of-line priority rating procedure which made it possible to receive ratings including AAA where designated persons in the safety and technical equipment
branch of WPB were convinced of the need. It was necessary to prepare a complete story concerning the importance of the scarce item on a project, but the advantage was that only one person had to be convinced of the need. This procedure worked well for two months before it was withdrawn.

Late in 1942 the WPB announced the Controlled Materials Plan (CMP), which was to become operative on April 1, 1943. This plan was, like all the others, based on anticipating requirements for a number of months in advance, but it was different from other plans in that it was limited to copper, steel and aluminum. It was believed that by parceling out the available production of these basic metals during a certain period the entire production picture could be brought into line. While the amounts of these materials needed by OSRD contractors was relatively small, it was necessary to use CMP allotment symbols and numbers in ordering other materials so that a definite procedure had to be established. OSRD was designated to be one of the claimants under the War Department. The CMP remained throughout the war and operated satisfactorily from the standpoint of OSRD.

Late in 1942 and early in 1943 it became increasingly apparent that the lowered position of research at AA-3 in the priorities picture was resulting in delays to the research program. Contractors found that many items were unobtainable without an AA-1 rating. This predicament was especially serious in the electronics field where virtually every component or piece of electrical testing apparatus had many willing buyers with AA-1 ratings. At the urging of OSRD the ANMB on April 30, 1943, issued a directive providing for AA-1 ratings for the procurement of supplies and equipment for research projects sponsored by the military and approved by the ANMB. Under this procedure OSRD was authorized by ANMB to assign a rating of AA-1 for the procurement of materials by its contractors. Beginning in May 1943, all prime priority certificates were issued directly to contractors by the priorities and property control section over the signature of the Chief of the section. After V-E Day the priorities system was again revised by WPB and a rating of MM was substituted for AA-1 for contracts of military importance. OSRD was authorized by ANMB to use the MM rating and it was assigned for use by a few contractors just prior to V-J Day. The need for ratings diminished very rapidly after V-J Day and the MM rating was used thereafter on a spot basis only to facilitate the completion of work before contracts terminated. Under the blanket authorization from ANMB ratings having a total dollar value of $102,000,000 were issued between May 1943 and October 1945.

Coincident with the raising of war research programs to AA-1 through the ANMB was the revision of the WPB order covering priorities for laboratories in general. This order, P-43, as amended, provided a rating of AA-1 for qualifying laboratories under the order and AA-2 rating for all other
laboratories. Provision was also made for obtaining materials under the CMP. OSRD encouraged its smaller contractors to use the rating assigned by P-43 since the WPB had promised that they would immediately qualify for the use of the AA-1 if working on an OSRD contract. Many of the contractors working on NDRC projects, and all of those working on CMR projects, did operate under this plan until the war's end with success.

One important function of the priorities section was to maintain an expediting service to obtain out-of-line ratings on scarce items and to effect the release of specially controlled materials. Whenever the production of material or equipment did not meet the demand of those purchasers with equally high ratings, the orders began to stack up and delivery would be quoted at increasingly remote dates. Since research requirements were seldom known far in advance, OSRD contractors were at a disadvantage, for they would learn from suppliers that there were many orders with either higher or equally high ratings ahead of them. The contractor would then enlist the aid of OSRD in obtaining whatever relief was necessary to effect delivery by the desired date.

There were two major methods followed by WPB in handling these tight situations. One was by the assignment of an out-of-line priority rating including the emergency rating, and the other was by scheduling every order for a particular product in each manufacturer’s plant. Usually as a situation became acute and it appeared that it would remain so, scheduling was instituted. In either circumstance complete information had to be presented to the WPB industry division having cognizance of the item. If concurrence by that group, and usually of representatives of the Army and Navy attached to the division, could be obtained, an out-of-line rating could be secured or the order scheduled for a satisfactory delivery. From the beginning of 1943 until the end of hostilities four expediters and a supervisor together with secretarial help spent full time on this aspect of priorities work. Figures available indicate that more than 10,000 separate requests for expediting and special handling were received and acted on by the priorities section. It is estimated that less than 1 per cent of these requests ended in failure; those were usually because the request proved to be unjustified or because the items requested were not being produced.

Among the efforts to aid contractors in carrying on research and development was the establishment of the Electronics Research Supply Agency. Upon the recommendation of the Army, Navy, OSRD and WPB, this organization was established in April 1943, to act for the Defense Supplies Corporation as a central source of supply for electronic components and raw materials required by Government, institutional and industrial laboratories engaged in electronic research and development projects for the Army, Navy or OSRD. Between June 1943 and September 1945, OSRD contractors made substantial use of this additional source of supply.
Throughout the war electronic components were extremely scarce due to the great demand for large quantities of newly developed electronic devices. The Services themselves attempted to alleviate the confused production picture first by expediting and then by a system of allocation of component parts to their most important production contracts at the expense of the lesser ones. In the early days of the war the Army Signal Corps maintained a large group of expediters in strategic manufacturing plants with considerable success. This was followed by a joint Army and Navy expediting group, operating under the name of Army and Navy Communication Production Expediting Agency (ANCPEA), which continued its activities until October 28, 1942, when the Army-Navy Electronic Production Agency (ANEPA) was formed. By this time practically all electronics production was in the AA-i priority category since that rating was necessary for the procurement of component parts. Another organization known as the Procurement Precedence of Supplies, Material, and Equipment Committee, was established to operate under the authority of the Joint Communications Board of the Joint Chiefs of Staff. The task of this committee was to set up each production contract in a precedence category. The precedence categories ran from A, which was the best, to L which was last in importance, and there was a set of “ground rules” to guide the placing of contracts in the various classes. The expressions “precedence category” and “precedence listing” were used rather than “precedence rating,” for priorities were still in effect and this undertaking was to be operative within one priority rating — AA-i.

When a contract received its precedence number, ANEPA was charged with expediting the contract in accordance with the precedence listing. The WPB on January 1, 1943, recognized this system of precedences to the extent that manufacturers were authorized to observe them, but it stated that an order without a precedence listing would still be filled in the regular manner. In the beginning there was no provision for research, but later a listing of D-250 was designated for research programs. In addition there was provision that when a laboratory project reached the stage of development where quantity production was envisaged, application could be made for a better listing. The priorities section did not limit its expediting activities to ANEPA channels so far as research requirements were concerned because the D-250 rating was not sufficiently high to be of much benefit. In some development and limited production, however, it was necessary to work closely with ANEPA because the Services had specifically asked that crash programs be undertaken. The Engineering and Transition Office of OSRD took over the responsibility for obtaining these specific listings.

ANEPA was dissolved in June 1944, mainly because of the confusion which existed in industry due to the fact that both ANEPA and WPB had regional office representatives in the field doing the same job. WPB took over most of the expediting activities for the Services. The Precedence Com-
mittee continued to assign precedence listings which were promulgated throughout the electronic industry through its subsidiary organization, the Electronics Production List Agency.

In general it may be said that research and development on war weapons fared well under the priorities system; but this was true only because of the intensive work of a small group who were constantly fighting the battle on behalf of research. Without a system of priorities, research could not have competed with production; within the priority system, it maintained its position through constant attention and vigorous action.

Property

In general a contractor was free to purchase any item of personal property that he or the Scientific Officer considered necessary for the work called for by the contract without the specific approval of the Contracting Officer. An exception was motor vehicles, the purchase of which required prior approval. Alterations and construction work which cost in excess of $500 on the contractor's owned or leased premises was permitted only with the specific approval of the Contracting Officer. The acquisition of real property by purchase or lease likewise required the approval of the Contracting Officer.

The sense of urgency which OSRD brought to its task made it imperative that research work not be delayed while the necessity for the purchase of a particular piece of equipment was debated. The risk that a contractor might purchase in excess of his requirements was less serious than the risk of delayed results if an elaborate system of controls were imposed. As a matter of fact, the character of OSRD contractors was in itself a considerable guarantee against reckless spending, and the difficulty of making purchases as the supplies of materials and equipment grew tighter operated as an automatic control on purchases.

The responsibility of the contractor for property in his possession is discussed in the chapter on fiscal aspects of OSRD operations. The rules governing its disposition were covered in Article 3 of the standard contract form (See Appendix 2).

Property developed or constructed under the terms of a contract was controlled by Article 1(a) which provided that models, devices, or prototypes developed or constructed under the contract were to be delivered as directed by the Contracting Officer or his authorized representative (later changed to the Scientific Officer or Scientific Assistant).

Provision for handling property accounting and the disposition of property and improvements became necessary as the first OSRD contracts terminated. In July 1942, a group to handle property matters was attached to the group working on priorities. As long as the war lasted, both groups were working essentially on procurement, the priorities unit expediting the deliv-
ery of new equipment, and the property unit making equipment on hand
at the expiration of contracts available for use under other contracts.

Property Accounting

The first major task of the property group was to issue adequate instruc-
tions for the use of contractors in preparing the property accounting reports
required by the contract. Tentative instructions were issued to contractors
to cover the 350 contracts which had terminated up to the fall of 1942. These
instructions, as revised in February 1944 (Administrative Circular No.
15.03), proved adequate even in the liquidation period.

Upon the termination of a contract a letter was sent to the contractor
requesting the submission of a property report in the prescribed form, and
follow-ups were made at appropriate intervals. When the report was re-
ceived, it was checked for completeness and forwarded to the appropriate
division for recommendations as to the acceptability of the report and the
disposition of the property on hand.

As soon as a property report was considered acceptable and the disposi-
tion of all property on hand had been completed, a certification to that
effect was sent to the contract and fiscal sections as notice that the final
voucher could be paid insofar as property matters were concerned. At the
same time the contractor was notified that he had completed his property
accounting. As of January 31, 1946, 1480 contracts had been cleared with
reference to property.

Disposition of Property

While the war continued, the major emphasis in connection with the dispo-
sition of property was to provide for its use under other contracts. The
division supervising a terminated contract was given the first opportunity
to obtain the property on hand for use on other contracts under its super-
vision; if not needed by that division, the property was made available for
use by the contractors of other divisions.

For a time OSRD maintained a storeroom in Washington to which sur-
plus equipment not immediately needed on OSRD contracts could be
shipped. The arrangement was never fully effective because of the diffi-
culty of getting and keeping a properly qualified technician to run the
storeroom. Many critical items were issued to contractors, however, before
the storeroom was liquidated in 1945 by transferring the property on hand
to Government laboratories having a use for it.

The problem of statutory authority for the disposition of property outside
the agency was solved by the inclusion of the following enabling legislation
in the various War Agencies Appropriation Acts which provided funds
for OSRD:
Provided further, That the Office of Scientific Research and Development may sell, lease, lend or otherwise dispose of, under such terms and conditions as it may deem advisable, devices, scientific or technical equipment, models, or other articles of personality, developed, constructed, produced in or purchased for the performance of its scientific or medical contracts, except articles acquired for administrative purposes, and all receipts from such dispositions shall be covered into the Treasury as miscellaneous receipts.

In accordance with this authorization, the provisions of the Surplus Property Act of 1944, and the regulations issued pursuant to that Act, the policy followed for the disposition of property no longer needed for OSRD work was (1) to transfer to other Government agencies (particularly the War and Navy Departments) that property required for use in continuing work initiated by OSRD; (2) to permit contractors, under the terms of their contracts, to retain property not needed by the Government, and (3) to dispose of any remaining property in accordance with Surplus Property Regulations. Preference to the Army and Navy was in accord with a resolution adopted by NDRC in August 1945, that the Army and Navy should be given an opportunity to acquire without reimbursement any property required for the continuance of the work taken over from NDRC. A similar preference was accorded the Public Health Service when it continued medical research initiated by CMR. As a result the property on hand at the termination of a large number of OSRD contracts was transferred to other Government agencies and, although many problems of detail arose, the disposition of the property became a relatively simple problem.

Disposition of Property by Transfer

Property on hand under one contract was frequently made available for use under other contracts upon the recommendation of the appropriate Technical Aide simply by directing the contractor in possession of the property to deliver it for use under another of his own contracts or to another contractor. The receiving contractor was required to acknowledge accountability for the property to OSRD under the terms of the pertinent contract, and the original contractor was relieved of accountability. Such transactions occurred with regularity from the middle of 1942 until shortly after V-J Day.

During the same period the work on atomic energy was taken over by the War Department, and the work of Section T on fuzes and of Division 6, NDRC, on underwater sound studies was taken over by the Navy Department. Property acquired under the approximately 170 contracts involved was transferred to the interested Services.

In the case of the large central laboratory contracts, neither the contractors nor the Services desired to continue the contracts under the existing arrangements although the latter were interested in carrying on some portions of
the work in their own laboratories or elsewhere and definitely desired to obtain most of the property. After numerous conferences among OSRD, the Army and the Navy, 98 per cent of the property on hand at the California Institute of Technology acquired for use in the rocket program under Contract OEMsr-418 was transferred to the Army and the Navy; the property at the Allegheny Ballistics Laboratory operated under Contract OEMsr-273 by George Washington University was transferred to the Navy; that on hand under Contract OEMsr-164 with the Research Construction Company went to the Army Air Forces, and that at the Radio Research Laboratory operated by Harvard under Contract OEMsr-411 went to the Navy.

In the case of the Radiation Laboratory operated by the Massachusetts Institute of Technology under Contract OEMsr-262, there were different Service interests in the work and many conflicting requests for the property, much of which was highly important to the continuation of general research and development work on radar. A plan was devised under which property on hand under this contract, except that to be retained by OSRD for basic research work, was transferred to the Army and Navy on the basis of Service requests and recommendations made to the Contracting Officer of OSRD by a Joint Army and Navy Panel especially created for the purpose.

Disposition of Property by Sale

Receipts from the sale of property amounted to $1,374,711.65 for the twenty-five months ending with December 31, 1945. Most of this amount came from the sale of personal property, with about $100,000 being paid by contractors for the retention of improvements made under contracts. A substantial portion of the total represented proceeds derived from the sale of property at cost by the Radiation Laboratory under Contract OEMsr-262 as a part of the normal operations of that laboratory. Speed in microwave research and in the building of an industry capable of producing equipment of Radiation Laboratory design required the loan of a great deal of such equipment to other laboratories and to industrial concerns. When these loans were liquidated, the proceeds of the sales at cost were turned in to the Treasury of the United States.

The greater portion of the receipts were from perhaps 2000 sales covering thousands of individual items of property which contractors exercised their right to retain under the terms of their contracts. As most OSRD contracts were small, the property on hand at termination was not substantial. It normally consisted of small quantities of a wide variety of used property from one to five years of age, and many of the items were such as did not enter largely in normal trade channels. To determine the fair value of the heterogeneous lot of property taxed the wisdom and judgment of those concerned. There were, however, certain guides, among them the price
policies established by the Surplus Property Administration (later War Assets Corporation), OPA Maximum Price Regulations for different commodities, depreciation schedules, condition of the equipment, technical advice regarding a particularly critical piece of equipment, and the cost of disposition if packing, crating and shipping were required; and to all of these was added the exercise of common sense.

Disposition of Improvements

Disposition of improvements to real property was a troublesome matter. Initially there was an effort to determine at the time building construction was authorized the disposition which would be made of the construction at the end of the contract. From the standpoint of good business operations this was a desirable procedure, but from the standpoint of OSRD operations in general, it was simply unworkable. Construction was authorized because it was needed to speed research; to postpone construction until arrangements could be completed for its later disposition would have greatly hampered research programs. It would have been impossible for OSRD to have staffed itself with enough construction experts to enter into such negotiations without weeks of delay. Moreover, in the case of academic institutions, the changes were frequently of a kind which the institution would never have made because they were not needed in the course of its normal operations. Whether they might have some residual usefulness would depend upon the state of the academic program upon the termination of the contract. Flexibility in determination was therefore indicated; but, in adopting Article 3(b) of the contract form which provided that flexibility, it was recognized that the Government would be at some disadvantage when the time came for the ultimate determination.

In accordance with the terms of Article 3(b) of the contract, the contractor could elect either to retain improvements and return a negotiated sum to the Government or to have his premises restored to substantially their original condition at the cost of the Government. The disposition of improvements offered no serious problem when the contractor needed to retain them for use under a Service contract for continuing the work. It was usually possible to transfer the OSRD right and interest in the improvements to the interested Service, with the assumption by the Service of the OSRD responsibility for their disposition. In the few cases where substantial structures were retained by the contractor, he returned a sum usually equal to 50 per cent of the original cost of the work.

Minor alterations, which the contractor would not have made under normal circumstances and which often resulted in no permanent benefit, presented many problems. In many cases, sums varying from 10 to 50 per cent of the original cost were returned by contractors for the retention of improvements. In others, particularly on leased premises, it seemed advisable
to abandon improvements in lieu of restoration where no substantial excess value remained. In cases where the situation warranted, an expert appraiser employed by OSRD visited the premises and made appropriate recommendations.

Whenever the contractor elected to have the premises restored to substantially their original condition, he was authorized to proceed immediately with the restoration and to charge the net cost to the contract.

**Disposition of Surplus Property**

The Surplus Property Act of 1944 and the various regulations issued thereunder established a procedure for disposing of surplus property by an authorized disposal agency as defined by the Act. This did not apply to the major portion of the property from OSRD contracts which was retained by the Government for its own use, nor did it apply to that retained by the contractors. Most of the items remaining as surplus came within the classification of nominal quantities which the authorized disposal agency would not handle or were refused on the basis of a predeclaration inspection because of their special nature or poor condition. While some single items and groups of items were declared as surplus, this method of disposal did not reach the proportions originally anticipated. When used, it resulted in material delays in moving the property from contractors’ premises. The few pieces of surplus real property were disposed of in accordance with the provisions of the Surplus Property Act.

At various times the suggestion was made that OSRD should distribute the property remaining under its contracts to educational institutions to enable them to build up their research activities. It was never given favorable consideration within OSRD partly because the policies governing the disposition of surplus property were for the determination of Congress and partly because OSRD had dealt with only a fraction of the educational institutions in the United States and a policy of building up research facilities should not be confined to that fraction. In 1944 and early 1945, however, when it appeared that large quantities of new and special equipment would become surplus, a number of conferences were held with officials of the Office of Education and of the Surplus Property Board with a view to developing a procedure under which the property could be turned over to those agencies which would make it available to educational institutions of their designation for research purposes. The decision of the Services to expend their peacetime research programs, with the resultant transfer of the property to them for that purpose, made it fruitless to pursue those plans to a conclusion. Nevertheless, some of the more specialized property doubtless found its way into the possession of institutions able to make the most effective use of it under contract with the Services who received it by transfer from OSRD.
CHAPTER XVII

SECURITY

The problem of security was one of the first to concern NDRC, and the decisions made in the early days held throughout the history of OSRD. While some aspects of the security problem will be expanded in the following pages, the account of security operations contained in the first chapter on the NDRC including the discussion of compartmentalization of information will not be repeated here.

The problem is simple of recognition, but impossible of satisfactory solution in a country where freedom of the individual is a precious heritage. No man has the right to imperil the safety of the state by revealing its military secrets to an actual or potential enemy. Premature disclosure of the existence of a new weapon might eliminate the element of surprise, enable the enemy to develop counters for it, and cost the lives of many American soldiers. Disclosure to the enemy of progress in the development of a new weapon might enable him to improve his own weapons so as to make them more devastatingly effective against American troops. Even the disclosure that great effort was being concentrated in a particular field might enable the enemy to plan his campaign with a relative impunity to certain measures because of the assurance that the United States was not adequately prepared in that area.

Most American citizens go through life without accumulating police or other records which would stamp them as unfit to be trusted with classified military information, which is as it should be. At the same time, the mere absence of a police record is no assurance that a man can be so trusted. He might be completely lacking in discretion, or in an extreme case might even be disloyal without any occasion having arisen for the disloyalty to have been revealed.

In the OSRD philosophy, there was need for a balance between security precautions on the one hand and speed on the other. Undue security precautions would occasion delay and sometimes so restrict the transmission of knowledge that the best minds could not be made fully available for a project. On the other hand speed at the expense of proper security might occasion untold harm. In general the inclination of the scientist was to favor speed and to resent the delays imposed by security precautions; but the record of the agency shows that the security restrictions were well observed.

The necessity for freedom of action within limits was well illustrated in a few instances where the using Service was exhorting OSRD to the greatest
possible speed in a particular development, and speed was possible only by making use of an individual against whom an intelligence service had discovered something which it interpreted as barring him from the project. In such cases OSRD would bring the using Service and the intelligence service together to decide which should give way. Agreement was soon reached in all such cases.

The magnitude of Army and Navy operation and the extreme pressure incident to war combined occasionally to produce upsetting incidents in connection with security. Press releases at times emanated from the Services, describing developments on which OSRD had been rigidly enforcing security precautions, and naturally disturbing the groups responsible for the developments, who found it hard to reconcile OSRD’s insistence upon secrecy with the unexpected appearance of newspaper accounts telling most if not all of the story. OSRD was never quite able to convince the scientists that it was not insisting upon precautions which the Army and Navy ignored, or to prevail upon the Services to prevent such incidents.

Personnel Security

All OSRD employees were investigated prior to the release to them of classified information, and there was never any reason to question the loyalty and discretion of any of them. During the rapid expansion of the OSRD program weeks would elapse while security reports were being awaited, before new employees could carry their full share of the load. Only the willingness of the staff to carry work overloads for extended periods prevented serious delays in the OSRD program during the interval before security reports were received. New employees were indoctrinated as a matter of routine; and there was a continuing program designed to keep employees constantly aware of the need for security.

As for contractors, the security provisions were embodied in Article 6 of the standard OSRD contract form which is printed in the appendix. In substance that article required the contractor to (1) refrain from disclosing any information concerning the contract or obtained as the result of his performance under the contract to any person except employees assigned to work under the contract, without the consent of the Contracting Officer; (2) report to the Contracting Officer whenever there was active danger of espionage or sabotage; (3) obtain the consent of the Contracting Officer before permitting an alien to be employed on or have access to work under the contract; (4) report to the Contracting Officer, on request, the citizenship of his employees engaged in or having access to, work under the contract, and (5) refrain from employing on, and to exclude from the site of, work under the contract any person designated by the Contracting Officer as undesirable to have access to such work.
Investigation of contractors’ personnel was never on as comprehensive a scale as for OSRD employees. Primary responsibility for the security of work done under contract rested with the contractor. OSRD recognized, however, that in many cases contractors had no way of assuring themselves that their employees were both loyal and discreet. The contractor might feel perfectly secure as to his old employees, but when new employees were being added by the dozen, and particularly when the bottom of the manpower barrel was reached, he could not have the same assurance as to them.

OSRD sought to assist the contractors, and also to assure itself, by making it possible for a contractor to obtain a security investigation of personnel. It specified that clearance should be obtained for all persons who would have access to or who would be working with classified information, but these conditions were never clearly defined, with the result that the practice varied widely among contractors. In some cases OSRD contractors were also doing work for the Army or the Navy and the same employees were working on OSRD and Service contracts. Arrangements satisfactory to the Services were acceptable to OSRD, and few investigations of such employees were made for OSRD. In other cases, contractors submitted the names of all employees engaged in work on an OSRD contract, regardless of the type of activity in which the employee was engaged. Clearly if all contractors had followed such a course the investigative machinery would have broken down under the load. As it was, the breakdown was perilously close at times. Various expedients were adopted from time to time by the investigative agencies with a view to cutting down on the amount of time required for routine cases in order to permit concentration upon those where there were factors which might indicate a real danger of espionage.

There probably is no satisfactory answer to the problem of reconciling speed with absolute security; but if there is, OSRD did not find it. The results were surprisingly good, however; at least, OSRD did its job with reasonable celerity, there was no known case of improper disclosure or "leakage" of information, and there was no infringement upon individual rights so far as is known to OSRD.

Under the plan first adopted, NDRC submitted requests for investigation to both Army and Navy, which resulted in some duplication of investigations. The system was changed, therefore, to one under which NDRC submitted roughly one half its requests to the Army and the remainder to the Navy; each Service checked with the other to the extent it felt desirable. In the spring of 1942, the Army took over from the Navy the responsibility for personnel security investigations with a few limited exceptions. Thereafter OSRD dealt exclusively with the Army, and the Army determined the extent to which it made use of other agencies.

Prior to June 1942, the reports from the Services to NDRC and OSRD indicated whether they objected to disclosure of classified information to
the individuals who were the subjects of the reports. Subsequent to that
time the investigative agency submitted to OSRD the information developed
in the course of the investigation and the decision as to its bearing upon
the release of classified information was made by OSRD. In making its
decision, OSRD kept constantly in mind that decisions on its part which
would release classified information to persons who might make improper
use of it, would inevitably make the Services unwilling to release to OSRD
information essential to its operations. The situation was complicated by
the fact that the investigative agencies, to protect the sources of their infor-
mation, stipulated that OSRD might not involve the agencies or reveal the
fact that the information upon which OSRD action was based came through
a particular agency.

In line with the theory that the contractor was responsible for the security
of its operations, OSRD never discussed investigations with the individuals
concerned. If OSRD had informed one man that he was “cleared” for classi-
fied work on OSRD contracts, it could hardly have avoided discussions with
other persons as to whether they also were cleared. Instead, until July 1945,
OSRD notified the contractor who had submitted a man’s name that it
did not object to his employment in cases where the investigation had re-
vealed no reason for objection. The form was intended to make it clear
that OSRD was not relieving the contractor of his primary responsibility
for the security of his operations. As it became clear that some contractors
were apparently regarding this OSRD notice as superseding their responsi-
bility, the OSRD policy was changed and the contractors were informed in
July 1945, that in the future the “no objection” notices would no longer be
sent out by OSRD.

A review of the procedures with respect to personnel security shows that
OSRD might well have been more explicit. A large part of the OSRD work
was done by academic institutions which had never had occasion to give
any thought to the handling of classified information or to precautions
against espionage. Obviously they had no easy way to detect individuals
who might engage in espionage, although for the most part they might be
expected to know those of questionable discretion or with loose tongues.
They had no way of knowing the extent or thoroughness of any investi-
gation which might follow their submission of personnel questionnaires to
OSRD and might well assume that the indication of “no objection” was
complete assurance of both integrity and discretion. The length of time
required for a report might in itself be taken as an indication of the thor-
oughness of the investigation rather than for what it was—an index of
the overloading of the investigative agencies. On the other hand, OSRD
recognized that in some cases the contractor could develop at least as much
information by brief but intensive investigation on the site as was to be
found in the reports reaching OSRD from the investigative agency.
The number of cases in which the information developed by an investigation resulted in an adverse decision by OSRD was quite small. In all such cases, the OSRD action was merely an instruction to the contractor not to release classified information to the individual or to permit him to have access to it. Whether the information developed by the investigation required any other action was a decision to be made by the investigative agency and not by OSRD.

A limiting factor on the ability of OSRD to expand the program of investigations was the size of the investigating staffs. Other agencies needed investigations for the same reason OSRD needed them. The investigative agencies were not, and in the nature of things could not be, staffed to handle an unlimited number of investigations. The number of investigations conducted for OSRD was in the neighborhood of 45,000 to 50,000. Any increase in that number would probably have increased the time lag between the submission of a request and the receipt of a report. Greater security might have caused greater delay in getting results from OSRD operations. As there were no known leaks of information from OSRD operations, OSRD has a pragmatic justification for not having gone farther in its security program. Whether less security would have been justified on the chance that it might have speeded results might be a subject for speculation; although there is no doubt that the measures adopted were conducive to the disclosure of large amounts of highly classified information to OSRD with the assurance that it would be secure.

The employment of aliens by contractors was covered by a provision in OSRD classified contracts requiring the Contracting Officer’s permission in each case. The contractor was required to submit a specially prepared form for each alien. The form was then submitted to the proper investigative agency which in due course replied by indicating whether or not the alien was eligible for employment on War and Navy Department classified contracts. The decision was accepted by OSRD as equally controlling for OSRD contracts.

**Classified Information**

As recounted in an earlier chapter, OSRD attempted to follow the Army and Navy rules for handling classified information and in case of discrepancy between them to observe the more restrictive. When NDRC was established, the Army and Navy regulations recognized three security classifications which may be summarized as follows: (1) *Secret*: Documents, information, or matériel, the unauthorized disclosure of which would endanger national security, cause serious injury to the interests or prestige of the nation, or any governmental activity thereof, or would be of great advantage to a foreign nation. (2) *Confidential*: Documents, information, or
materiel, the unauthorized disclosure of which, while not endangering the
national security, would be prejudicial to the interests or prestige of the
nation, any governmental activity, an individual, or would cause adminis-
trative embarrassment, or difficulty, or be of advantage to a foreign nation.
(3) Restricted: Documents, information, or materiel (other than secret or
confidential) which should not be published or communicated to anyone
except for official purposes.
A fourth category, “Top Secret,” was added in 1944 primarily to protect
operational information as the United States moved toward large-scale
offensive operations. This classification was to cover certain secret documents,
information, and materiel, the security aspect of which was paramount, and
whose unauthorized disclosure would cause exceptionally grave damage to
the nation. “Top Secret” followed by a short time a Navy classification of
“Secret Security,” which was designed to achieve a greater measure of
security than a minimum observance of the requirements of the “Secret”
classification would produce.
The purpose of classifying information was to indicate the measure of the
precautions to be taken to prevent its unauthorized disclosure. “Restricted”
matter was plainly marked as such, largely to prevent its unauthorized dis-
semination to the public. Aside from being kept in locked files at night, it
was afforded little more protection than that normally afforded Govern-
ment papers. From the standpoint of the scientist it caused practically no
delay in his operations. However, very little of the work on weapons by
OSRD received a classification as low as restricted.
“Confidential” and “secret” matter required greater precautions in their
handling, transmission and filing, the latter classification being more rigid
in its requirements than the former. The precautions to prevent disclosures
to unauthorized persons were necessary and were followed; but the inevi-
table result was to delay research and development. As an illustration may
be mentioned the requirement of transmission by officer courier or regis-
tered mail. As OSRD had no officer courier, registered mail was the normal
method of transmission of papers. OSRD operations were relatively wide-
spread and different aspects of the same project were frequently under way
at different places. Registered mail is slow, and the requirement of its use,
many times multiplied, had a delaying effect.
meant more serious delay, for officer courier or its equivalent was a require-
ment. As applied to OSRD this would have meant the use of scientists as
couriers, and the manpower situation was such that they were not available
for the purpose. There was little reason for research and development to be
as highly classified as top secret. OSRD took the position that the top secret
classification required such an inefficient use of manpower that it would
not normally be justified in accepting top secret projects. The Services were
invited to carry on their own research so far as they felt it must be done on a top secret basis. There was no refusal to accept top secret research; rather OSRD called for a conference before top secret projects were submitted so that it might be convinced both that the classification was justified and that OSRD was the only place where the desired work could be done. No top secret project was in fact submitted to OSRD nor was any conference involving OSRD called to consider submitting one. It is understood, however, that several projects which were tentatively proposed as top secret were marked down to secret before their submission to OSRD. The normal tendency to play safe makes for overclassification and the interposition of a "caution" sign in the case of top secret projects was a desirable step.

When the Army or Navy submitted a project to OSRD, it indicated the recommended classification, which was invariably adopted by OSRD. Occasionally, the two Services would submit almost identical projects, but with different classifications, and then an attempt would be made to get agreement as to which OSRD should use. For projects originating in OSRD, the tentative classification was established by the originating divisions; as the divisions were working on related classified Service projects, there was little difficulty in determining the appropriate classification. Circulars were issued by the Executive Secretary from time to time on such topics as how to determine whether an item should be classified, and how to mark, store, transmit or reproduce classified items.

As a general rule, OSRD contracts bore the same classification as the projects to which they were devoted. The correspondence between contracts and projects was not complete, however, as in some cases several projects were handled under the same contract. Normally, the contract carried the highest classification of any project worked on under it, with the contractor being separately authorized to handle projects of lower classification according to their respective rules. On occasion this was reversed, so that a contract would carry a confidential classification when most of the projects under it were so classified, and an occasional secret item would be called to the attention of the contractor with instructions to apply to it the rules governing secret matter.

One criticism of the OSRD practice which probably would apply to security precautions generally was the persistence of a classification after the reason for its establishment had ceased to exist. A periodic review of all classified items would doubtless have shown many for which the classification could have been lowered or even removed. The volume of current work always seemed to be so great that the time could not be spared for such a review until after the end of hostilities when there was a general declassification. In retrospect it seems possible that the saving in time resulting from handling documents of lower classification would have justified strenuous efforts to find the time for reclassification at an earlier date.
PLANT SECURITY

In the case of academic institutions, OSRD proceeded upon the assumption that there was no occasion for a check on the loyalty or integrity of the institution itself although the personnel were subjected to the same check as others. A separate check was made in the case of other OSRD contractors and subcontractors; approximately 2600 organizations were checked for such points as subversive or other disloyal activities, violations of law, faulty performance of Government contracts, and fraud against the Government. The check was not as thorough as that normally made of individuals but was thought to be adequate to bring to light any glaring reasons which would preclude the awarding of a classified contract. The individuals within the company to whom classified information was to be released were also subject to the security check which normally preceded the release of such information.

The number of OSRD contractors and the even greater number of plants and laboratories where they performed their work made it impossible to arrange for physical inspections of all plants and laboratories. In most cases, the contractors themselves determined their security requirements by reference to the security material furnished them by OSRD or by the War and Navy Departments.

For contractors performing a considerable portion of the total national effort in important fields of research and for contractors participating in research fields which were recognized by common agreement among the federal research agencies involved as requiring special security, the War Department provided an inspection service. Twenty-five contractors were so inspected on the basis of their work for OSRD, while other OSRD contractors were inspected on the basis of other war work. The inspections made by the War Department were to determine whether the plant security system employed was necessary and adequate, whether the work was such that intraplant controls of movements were necessary, what areas needed special protection, and what other security measures were necessary to prevent unauthorized access to classified information from within as well as from outside the plant.

These inspections were made for advisory purposes only, and, with the exception of measures which the contractor would be expected to take without consideration of his wartime classified research, all recommendations were made to OSRD and not the contractor. It was the responsibility of OSRD to review the recommendations and to effect compliance with those it believed warranted.

For its own offices, OSRD adopted a system of photographic badges similar to those used by the Army and Navy. Guard service on the buildings in
Washington was provided by the Public Buildings Administration of the Federal Works Agency. In addition electrically operated burglar alarms were installed in those parts of buildings where the greatest amount of protection after office hours was believed to be essential.

**Organization for Security**

Responsibility for security was delegated by the Director to the Executive Secretary. It entailed the formulation of regulations by which classified matter was protected, the establishment of procedures by which active security programs could be conducted, and the execution of those programs. As the Executive Secretary was the Contracting Officer on most OSRD contracts, he was in a position to issue the necessary instructions to put the regulations into effect so far as contracts were concerned. In order to assist the Executive Secretary in carrying out his responsibilities as security officer, a security section was established in the Administrative Office with William A. Osborne as Chief. At the peak of its activity twenty-two persons were assigned to the section.

The security section had the task of conducting the security programs, maintaining the records of security activities, and preparing and enforcing security regulations. By placing responsibility for the enforcement of regulations in the group responsible for their preparation, there was assurance that the problems involved in administration and enforcement would be considered at the same time as the necessity for the regulation itself. This centralization also made it possible to keep close watch over the operation of security regulations and procedures. A number of inquiries on any point in the regulations or a number of inquiries on a point not covered by the regulations frequently indicated the need for new or revised regulations and procedures. The centralization of security functions also simplified the understanding of the over-all security picture of any organization engaged in OSRD work. Comprehensive files made most of the information immediately accessible.

On the average the security section handled between 150 and 300 reports per week. The number of cases pending completion of investigation usually equalled the number of cases submitted for investigation in the previous four- to eight-week period. All cases where a possible adverse decision was indicated were submitted to the Executive Secretary for review, and occasionally a particularly difficult case would be discussed with the Director.

OSRD never seriously considered setting up its own investigative service. The Army and Navy had their intelligence services and there were others in different parts of the Government. If there had been a comparable OSRD service, it might have been possible to get reports more speedily than they
were furnished by the channels actually employed. There can be no assurance that this would have been the case, and, on balance, the probabilities are that the results would have been otherwise. OSRD had no competence in the field of personnel investigations, and as the existing investigative agencies were continually short of personnel, there is no reason to believe that OSRD would have been more successful in recruiting competent manpower in the field. In any event, the manpower shortage which continually plagued OSRD's normal operations affords no ground for optimism that the situation in the field of investigations would have been different.

Although OSRD security arrangements worked satisfactorily to the extent that no leaks of information are known to have occurred, there were several anomalies, particularly in relations with the investigative agencies, which should be eliminated in connection with civilian participation in military research in the future.
CHAPTER XVIII

SCIENTIFIC MANPOWER

Organization

Aside from the employment of a limited number of scientists for its own staff and assistance to contractors in meeting the problems of selective service, the initial approach of NDRC to the problems of scientific personnel was through a contract with the National Academy of Sciences. Under that contract the National Research Council established an Office of Scientific Personnel in May 1941, with Henry A. Barton, Director of the American Institute of Physics, as its Director and George W. Bailey, President of the American Radio Relay League, as Chairman of its radio section. The first task of the new office was to locate and certify to the Signal Corps young electrical engineers who could be commissioned as second lieutenants in the Electronics Training Group and sent to England for training in the practical operation of radar under battle conditions. The successful execution of this assignment was followed by comparable tasks for various Navy bureaus as well as the stimulation of a special course in the latest developments in electronics to equip instructors in a selected group of colleges to train the large number of men who would be needed to operate the radar gear then in the process of development.

By the spring of 1942 the scientific manpower situation had become much tighter, and there was a real danger not only that the Army, Navy, OSRD, industry and educational institutions would find themselves bidding actively for the services of the same individual but also that such competition would develop among OSRD contractors trying to build staffs to carry rapidly expanding programs. To consider this and other problems hinging around scientific personnel, Bush appointed a Committee on Scientific Personnel, which held its first meeting in June 1942, with Frank Aydelotte, Director of the Institute for Advanced Study, as Chairman and Bailey as Secretary. The principal functions of the Committee were to recommend policy in regard to scientific personnel of OSRD and to advise contractors with respect to bases of compensation for scientific workers and handling of problems arising from the Selective Service Act, as well as assisting them to obtain personnel which they required.

The problems of scientific manpower became more and more pressing as the war progressed. The other demands upon Aydelotte's time were such
that he felt impelled to resign the chairmanship of the Committee on Scientific Personnel in December 1942. He was succeeded in April 1943, by John V. L. Hogan, a well-known radio engineer. Hogan also was designated as Bush's alternate on the Committee on Scientific Research Personnel of the War Manpower Commission, which is described below.

Hogan recommended that OSRD scientific personnel activities be concentrated in a new operating unit of OSRD headed by a single individual in place of the existing committee. Bush accepted the recommendation and the Scientific Personnel Office (SPO) was established as a principal subdivision of OSRD by Administrative Order No. 3 of August 21, 1943. After providing that the head of the office should be appointed by the Director, the Order continued in Section 2(e):

Under the general supervision and direction of the Director and subject to the directives and regulations of the Chairman of the War Manpower Commission, the Scientific Personnel Office shall have charge of administering the duties as set forth in Section 2.b. of Executive Order No. 8807 with respect to scientific personnel utilized in developing and applying to war purposes the scientific research and development sponsored by the Office of Scientific Research and Development. Principal among such duties shall be (i) handling the relationships between the Office of Scientific Research and Development and other governmental agencies with respect to scientific personnel, and (ii) dealing with the problems relating to scientific personnel employed by or associated with the Office of Scientific Research and Development or its contractors, particularly problems in connection with policies and procedures relating to the evaluation, training, allocation, compensation and requests for deferment by the Selective Service System of such scientific personnel.

The head of the SPO was authorized to administer the duties set forth in Section 2(e) and to delegate any of his powers or duties to such assistant as he might designate with the approval of the Director. Hogan was named as head of SPO, to which was transferred the Selective Service unit of the Administrative Office, also described below.

In a memorandum of June 10, 1943, to Hogan, Bush outlined three major functions of SPO. The first was to handle relationships between OSRD and other agencies on matters relating to scientific personnel. This included furnishing the Committee on Scientific Research Personnel (CSRP) of the War Manpower Commission information concerning OSRD and OSRD contractors' personnel for possible inclusion in the Reserved List (described later); maintaining liaison with the National Roster of Scientific and Specialized Personnel, as well as with various branches of the Army and Navy and other agencies; and making recommendations regarding the flow of scientific personnel outward from OSRD. The Chief of SPO served as alternate to the Director of OSRD as a member of CSRP. The second function was to serve as the center for handling matters relating to scientific personnel
within the OSRD. This included making recommendations regarding the flow of personnel among projects within OSRD, serving as a center of information for OSRD and its contractors with reference to scientific personnel, handling relations with the Selective Service system and all deferment requests made on behalf of contractors' personnel and OSRD personnel, promoting stabilized compensation of scientific personnel, and recommending effective utilization of facilities for advanced training of personnel with general scientific background to fit them for work in fields where there were serious shortages of experienced scientific personnel. The third function was to advise the Director and to execute his instructions on general policy and procedures relating to the recruitment, evaluation, training, allocation, compensation, and requests for deferment of scientific personnel.

Bailey succeeded Hogan as Chief of SPO in March 1944. By January 1, 1945, the Scientific Personnel Office had a detailed record of over 13,000 scientific and technical personnel who had contacted the office either by correspondence or in person. Persons on this list were assisted in obtaining commissions in the armed forces, assignments as noncommissioned officers or other grades, civilian positions in the armed forces, teaching positions in schools and colleges (including the United States Military Academy), and positions with contractors of OSRD. This work was performed under the supervision of Miss Sandy X. Demou.

Salaries of Scientific Personnel

One matter to which a great deal of attention was given was that of salaries for scientific personnel. The "no-profit-no-loss" principle adopted by NDRC and followed by OSRD was not easy to apply in the case of salaries paid by academic contractors. There was no particular problem in connection with salaries paid by industrial contractors as personnel working on OSRD contracts were merely a part of the total organization, and the salaries paid to them conformed to the pattern of the organization.

The original position of NDRC in the matter of reimbursement of salaries paid to regular staff members of academic institutions was that the time devoted by the individual to work on an NDRC contract was diverted from that which he normally would spend in peacetime research and consequently should not be the occasion for compensation by the Government either to him or to the institution. As academic enrollment dropped due to the drafting of students into the Army, and as staff members devoted more and more time to work on NDRC contracts, it was recognized that this policy was inequitable. Accordingly, the policy was modified and the contracting institutions were authorized to claim reimbursement for the time of staff members spent on NDRC contracts. CMR adhered to the original NDRC policy for approximately a year after it had been abandoned by
NDRC, but was finally forced by circumstances to drop it in favor of the new NDRC policy.

Work done by staff members of academic institutions during their vacations was always recognized as presenting a special case. The regular academic practice is to pay staff members for work done during an academic year which is usually of approximately ten months' duration with the individual staff member free to supplement his income by teaching during his vacation. Since work under NDRC contracts during the vacation period represented a net loss of salary to the individual, it was recognized as appropriate that NDRC should pay for work spent on its contracts during that time.

As OSRD contracts increased in size and academic institutions were forced to supplement their regular staffs, the matter of proper salary levels assumed increasing importance. The supply of well-qualified physicists was soon exhausted and the competition for less experienced men and for men in related fields became keener. Situations began to develop in which OSRD contractors were not only in competition with industrial establishments but also with each other. OSRD recognized that, having pressed upon its contractors the responsibility for obtaining highly important results from research in a relatively short time, there were limits beyond which it should not go in dictating policies to be followed by contractors in acquiring necessary personnel.

The first problem given the OSRD Committee on Scientific Personnel when it was created in June 1942, was that of studying the salary practices of OSRD contractors and making recommendations on the subject to the Director. Aydelotte's study showed considerable difference of opinion among contractors as to the proper policy. Salaries were on the increase throughout the national economy. It was not unusual for skilled mechanics to receive higher salaries than junior scientists. The latter were leaving academic institutions to go into war work paying higher salaries and NDRC contractors were finding it necessary to meet competitive salary scales. Contractors who had succeeded in building up satisfactory staffs vigorously defended their salary scales, which they felt were entirely justified by the manpower situation and by the salaries paid for comparable positions in industry. Contractors who had sought unsuccessfully to build up satisfactory staffs were equally vigorous in expressing their opinion that the salary situation had begun to get out of hand; and academic institutions losing personnel both to OSRD contractors and to industry were gloomy in estimating the effect which the general increase in salaries would have upon the ability of colleges and universities with limited endowments to carry on their postwar work.

It was, of course, impossible to reconcile the various views; and it would have been equally impossible to establish a firm salary schedule which
would not have within it the seeds of a possible disruption of parts of the OSRD research and development program. The conclusions of the study were embodied in a circular of March 6, 1943, which stated that salaries fixed in good faith by one or more of the following methods should meet the test of reasonableness: individual bargaining, objectively (categories of positions carrying established salary schedules), comparatively (where there were more or less well established rates in the locality), and subjectively (considering present earnings of a prospective employee). Differences in living costs were recognized as being entitled to consideration in the case of men called upon to change their places of residence in order to take employment on a project.

Reserve Officers

In October 1940, NDRC became acutely aware of the fact that a few appointees and a larger number of employees of NDRC contractors were holding reserve commissions in the Army or the Navy. The primary value of the reserve military organization lay in its immediate availability in an emergency. The War Department quite properly recognized only a single valid reason for excusing a man from the obligations assumed when he became a reserve officer, namely that he could render greater service to the Nation in his civilian status. Accordingly, the Department established a Reserve Pool in which reserve officers who were key men in industries related to national defense and whose retention as key men was absolutely necessary might be placed. The Department reserved the right to approve or disapprove the request that an officer be assigned to the Reserve Pool and to return him to eligible status whenever it deemed necessary. An officer in the Reserve Pool was not eligible for promotion, assignment or active duty.

The position taken by Bush was that the armed services were best able to judge whether a reserve officer would be of greatest use in the emergency as an officer or in a civilian capacity. Accordingly the only action which NRDC took with reference to deferring the calling of reserve officers to active duty was to bring to the attention of the appropriate Service pertinent information which should be considered by it in determining whether or not to issue the call.

In addition to the Reserve Pool the Army had another procedure for effecting temporary deferment of reserve officers. This was applicable in cases where only a short time was needed to permit the reserve officer to complete a particular important assignment. It involved placing the name of the officer as far down on the list of available reserve officers in a particular corps area as would be sufficient in the opinion of the command to provide the requested deferment. This did not automatically assure the
deferment, however, as the actual time of call fluctuated with the rate at which reserve officers were needed.

A number of reserve officers were deferred for NDRC work prior to the entry of the United States into the war. After that, deferment was extremely difficult to obtain. The matter, which was of much more importance to industries engaged in production of military equipment than to NDRC, was finally solved by the decision of the War Department to consider all reserve officers available for call to active military service on and after April 1, 1942. This decision was communicated to reserve officers in February 1942, with the information that those employed in key positions in which their continued services beyond March 31, 1942, were deemed necessary to the maintenance of national health, safety or interest might before that date tender resignation of their reserve appointments. The Department reserved the right to decline any resignation so tendered as a matter of military necessity. Reserve officers whose resignations were accepted became subject to the provisions of the Selective Service Act in the same manner as other citizens.

The situation with respect to reserve commissions in the Navy was a little different from that in the Army. The Navy made no provision for a reserve pool comparable to that of the Army. In the spring of 1941 it took the position that reserve officers should in most cases accept a call to active duty or submit their resignations as reserve officers with the understanding that the Navy retained complete liberty to determine whether the resignation should be accepted. There was provision for deferment, however, and a number of deferments were granted. After the attack on Pearl Harbor, however, there was little chance of either deferment or acceptance of resignation except in the case of older reserve officers who would probably be used by the Navy only in a consultant capacity not requiring the usual call to active duty.

Problems of Selective Service

Ideally a war should be fought with every man in the position where he will make the greatest contribution to the over-all war effort. The ideal is impossible of attainment in any large country. In its place there is a tendency to substitute general rules, and the most general of those rules is that every able-bodied young man should be in the armed services. But the general rule is recognized as too sweeping and administrative machinery is established to permit exceptions from it in cases dictated by public interest. Blanket exceptions from the application of the general rule in the case of activities recognized as essential had led to abuses in World War I, so blanket exceptions were not permitted in World War II.

This is not the place for a review of the operations of the Selective Serv-
ice Act and the system which it created. A blanket exception of scientists from the operations of the Act, if carefully administered, would probably have materially aided in the scientific research program underlying the war effort, but the exception of an entire group might have entailed such bad results because of the example it set that the over-all war effort would have suffered. The subject is certainly one which should receive careful study over the next few years in order that the whole problem of scientific manpower may be better handled in the future if the occasion for it should arise, for it was badly handled in World War II.

The most ambitious attempt of OSRD to meet the scientific manpower problem intelligently did not receive a trial, but the importance of the subject warrants mention of it here so that it may be considered if a comparable emergency confronts the country in the future.

**Proposed Scientific Corps**

The impact of the Pearl Harbor attack upon the availability of scientific manpower promised to be serious. The Army promptly started calling more reserve officers into active service, the Navy stepped up its commissioning of highly selected scientific and technical men, scientists began to volunteer for the Army and Navy although their usefulness to the war effort might be greater if they remained in their laboratories, the calls upon Selective Service became greater, and the demand for scientific manpower in research and industry increased. Bush requested President Robert G. Sproul of the University of California to come to Washington to make a study of the scientific manpower situation. After discussing the matter with Bush, Conant wrote to Sproul on January 1, 1942, suggesting what he described as "the most radical solution of our personnel problem; namely, that there be created by law a Scientific Research Corps into which men would be forced by fear of the draft, as well as by patriotic motives, and this Research Corps would be distributed around in various laboratories to carry on the necessary research work required by the Nation in time of war."

Sproul came to Washington and, after canvassing the situation, met with the Advisory Council on January 17, 1942, for a discussion of the proposed Scientific Corps. The subject was again discussed by the Council on January 23, at which time it began to take rather definite form. The proposed Civilian Scientific Corps was to consist of approximately 25,000 men drawn from civilian life, including civilians in the Army, Navy and Civil Service. Except for administrative officers, members of the Corps would be required to have a bachelor's degree or its equivalent and to have demonstrated special skill in research in an educational, industrial or governmental institution or in a research laboratory. The Director of the Corps, appointed by the President, would have the power to assign members and to allocate the
services of the Corps to the Army, the Navy, the OSRD and to industries and educational institutions serving those organizations. He would be guided in the enrollment and allocation of members of the Corps by a board composed of representatives of the Secretaries of War and Navy and the Director of OSRD.

Members of the Corps were to be classified after the fashion of the professional grades of the Civil Service of the United States with their salaries to be paid by the Service, institution or contractor to which the Corps member was assigned, but with the salaries guaranteed by the Corps for the duration of the war and for three months thereafter. Members of the Corps when assigned to the Army, Navy, OSRD, industries, laboratories, or educational institutions would be under the orders of the appropriate officer in each organization but would not be subjected to reassignment by that organization. Members of the Corps assigned to the Army or Navy for service with combat forces would wear a uniform prescribed by the Director; other members would wear appropriate insignia.

Provision was to be made for a reserve category of especially selected essential men to constitute not more than 10 per cent of each age group beginning at 17 and including the groups 18 and 19, to be placed under the control of special boards in each State with Army and Navy officers attached to them. These boards would have the power to allocate the men under their control to the Army and Navy as enlisted men, to the Civilian Scientific Corps, to schools or colleges for additional training, to officer training corps or for commissions. They would not be permitted to resign or to enter civilian positions unless directed to do so by the board.

A reserve technical training corps would be established to correspond to the senior ROTC in colleges and universities and would be open to students in science or engineering who had shown marked ability and promise. Provision would also be made for a junior division of the Scientific Corps in which students of science or engineering with marked ability and promise could enlist under conditions laid down by the Director of the Corps and be assigned to colleges, universities, and technical schools for further training. Upon completion of the training they would be eligible for the senior division of the Civilian Scientific Corps or for such service in the armed forces as might be determined by the board of that Corps.

The proposal for the establishment of the Corps did not obtain the support of the Army and the President declined to authorize its establishment. By Executive Order No. 9078 of February 26, 1942, however, the President established the Army Specialist Corps in the War Department under the supervision and direction of the Secretary of War to consist of a corps of uniformed civilian employees appointed by the Secretary of War. Responsibility for recruiting persons for the Corps was vested in the Civil Service Commission. It was thought for a while that the Army Specialist Corps
might afford a means of helping OSRD meet its scientific manpower problems, but the Corps had very little impact upon OSRD and gave no relief for its manpower problems.

**Reserved List of Scientific Personnel**

The next attempt to meet the scientific manpower situation on more than a piecemeal basis was more successful. After consulting with the Advisory Council as to ways of holding essential research personnel, Bush addressed a memorandum to the War Manpower Commission on October 16, 1942, suggesting the establishment of a Reserved List of Scientific Personnel. He pointed out that comparatively few additional young men could be trained so that they would be effective in research during the progress of the war and that therefore the country must depend upon those individuals who already had the ability, training and professional experience to qualify them for scientific research. Men qualified for research in crucial fields should not enter any other service but should concentrate upon the work which, if not done by them, could not be done at all. The decisions as to where these men should be employed should be made by a board which could take a broad view of the whole situation, so that men who could be of the greatest use in scientific research would be directed to and kept at work in the particular field in which they could contribute most to the national war effort. The concrete suggestion made by Bush was the creation of a board on scientific personnel to include representatives of OSRD, Army, Navy, NACA, and the National Roster of Scientific and Specialized Personnel. The specific function of the board would be:

1. Prepare a list of reserved scientific and technical research workers of professional grade engaged on research or development of instruments of war or on medical problems important to the war effort and in the employ of OSRD, Army, Navy, and NACA or of firms and institutions working under contract with those organizations.

2. Determine the places in which these individuals could most effectively serve the war effort and implement its determinations by suitable recommendations to the agencies concerned.

3. Inform individuals whose names appeared on the list that changes in their connections should not be made without prior reference to the board.

4. Maintain a continuing study of the need for scientific personnel in the armed services and in civilian agencies to the end that its recommendations might reflect the soundest judgment possible as to what would best serve the war effort.

5. Maintain continual contact with the personnel sections of Army, Navy, OSRD, and NACA in order that it might be able to meet their needs to the fullest possible extent.
It was proposed that the board should furnish information regarding particular individuals to the local Selective Service Boards and to the Army and Navy. It should have the responsibility to recommend transfers of individuals on the Reserved List from one project to another in accordance with the varying needs of research and the importance of different projects to the total war effort. The names of individuals persistently refusing to conform to the recommendations of the board might be removed from the List. Bush expressed the belief that individual scientists, Selective Service Boards and the armed services would welcome and follow the advice of the proposed board on scientific personnel.

In a letter of February 26, 1943, the War Manpower Commission accepted Bush's suggestion with very little change. The letter proposed the establishment within the Commission of an agency to be called the Committee on Scientific Research Personnel and to have the composition suggested by Bush with the addition of a representative of the Office of Production Research and Development of the War Production Board. Mr. McNutt placed the upper limit on the proposed Reserved List as 7500 names until additional permission should be received from him to include a larger number. In the same letter he asked for suggestions as to individuals who might be designated as members of the proposed committee; and he promptly accepted the suggestions made by OSRD in its reply of March 11, 1943. President Leonard Carmichael of Tufts College, Director of the National Roster of Scientific and Specialized Personnel, was designated as Chairman of the new committee which had its organization meeting on April 8, 1943. Bush was the OSRD member of the committee with Hogan as his alternate. OSRD informed its contractors of the proposal to establish the Reserved List and requested them to send in the names of qualified persons working under their OSRD contracts for entry on that list. The response was immediate in most cases. Through follow-up correspondence an attempt was made to keep the list correct as to OSRD contractors.

After a review within OSRD to eliminate names which clearly should not have been included, OSRD referred the names and supporting data to the Carmichael committee which made its own investigation as to the propriety of including each name on the Reserved List. After accepting a name for inclusion on the List, the Committee informed the candidate's local draft board of his inclusion on the List. At the same time it notified the Director of Selective Service who in turn informed the State Selective Service Director by whom the candidate's local board was informed of the qualifications of the individual and the importance of his position to the war effort. In addition a certificate was sent to each individual whose name was included on the List. On his part, the registrant entered into an agree-
ment with the committee not to change his occupation without prior permission of the committee.

As of December 7, 1945, there were approximately 7000 names on the Reserved List; of these about 5600 were on the List because of work on OSRD contracts. Inclusion on the List, which received consistent support by Secretary Stimson, afforded a substantial measure of assurance that an individual would not be taken from war research and inducted into the Army or Navy. At one stage when the Army was making its greatest demand for young men there appeared danger that the List would be abandoned and a substantial number of the men on it called into the Army. The storm was weathered, however, when the Army itself stressed to Selective Service the importance of keeping the List intact. By the time the war ended only twenty men on the Reserved List had been inducted.

**OSRD Personnel**

As was the case with contractor’s personnel, NDRC had little difficulty in obtaining deferments for its own key personnel in the beginning. Although a few administrative posts were initially made the basis for deferment requests, most of the requests were for incumbents of scientific positions—largely Technical Aides and field service specialists. A Presidential Order of November 17, 1942, introduced a measure of uniformity in the requests for deferment of employees of all Federal departments and agencies. A more rigorous procedure was established by Executive Order No. 9309 of March 6, 1943, which directed the establishment in each agency of an “Agency Committee” to be responsible for requesting occupational deferment of employees of the agency, with its actions to be subject to review by a Presidential Review Committee in the War Manpower Commission. The criterion to be followed by the Agency Committee was “that the employee’s civilian services are essential in that the loss thereof would substantially impair activities essential to the war effort (including necessary supporting activities and the maintenance of the national health, safety and interest).”

The Agency Committee was to submit to the Review Committee for its approval a list of those positions in the agency deemed necessary to carry out activities essential to the war effort. All such positions approved by the Review Committee were to be known as “key positions.” Key positions were limited to positions involving serious difficulty of replacement because of a scarcity of available qualified personnel and because any incumbent of the position must have had, in order to perform his duties effectively, an extended period of training or specialized experience.

Only one “key position” in OSRD was approved. All other requests made
by OSRD were made under the provisions of Part IV (1-b) of Executive Order No. 9309 which covered "any employee of the Agency not occupying a key position whose civilian services are essential, if unusual and special circumstances, such as the employee's unique fitness for the work or unique familiarity with a specific project in the course of completion make such deferment request necessary. No request for deferment shall be made under this subparagraph except with the prior specific approval of the Review Committee." The Agency Committee procedure did not extend to persons serving OSRD without compensation or part time. This was immaterial as most such persons were not within the age limits of Selective Service.

The OSRD Agency Committee was originally composed of one representative each of NDRC, CMR, the Liaison Office, and the Committee on Scientific Personnel with Stewart as Chairman. When responsibility for relations with the Selective Service System was transferred to the newly created Scientific Personnel Office in June 1943, Hogan succeeded Stewart as Chairman of the Agency Committee and was in turn succeeded by Bailey in March 1944.

A statutory basis was provided for the procedure initiated under Executive Order No. 9309 by Public Law No. 23 of April 8, 1943.

As it had early become apparent that it was only a question of time until practically all administrative employees would be refused deferment, a policy of recruiting such employees from among women and men rejected by Selective Service for physical reasons (4F) was actively pursued. As a result the operations of Selective Service occasioned little difficulty to the administrative aspects of OSRD work, aside from occasional flurries when a lowering of physical standards brought a 1A classification to a man who had been put in a responsible position in reliance on his 4F classification.

The men for whom OSRD sought deferment because of their scientific or technical qualifications and responsibilities fell into two groups, Technical Aides and contract employees of the Office of Field Service. After the issuance of new regulations tightening deferment requirements in February 1944, OSRD was for a time in danger of having its program interrupted by losing part of the Technical Aide staff supervising research contracts. A procedure was worked out, however, under which a maximum of seventy-five men engaged in highly technical and scientific work might be deferred upon the request of the Director of OSRD endorsed by the Secretary of War or the Secretary of the Navy. Actually forty such requests were made, all were approved by the Review Committee, and the men deferred.

A comparable situation arose with respect to OFS contract personnel, many of whom were following the performance of new equipment un-
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der battle conditions. A similar arrangement was made for not to exceed eighty OFS contract employees; actually only thirty-two requests were made, all were approved by the Review Committee and the men deferred.

**Contractors’ Personnel**

The Selective Training and Service Act became effective on September 16, 1940. It was obvious that some of the men working on NDRC projects would fall within the provisions of the Act and that even more men who might be expected to be engaged in NDRC projects in the future would be lost to NDRC through the operations of the Act. As to this latter group, NDRC early took and constantly maintained the view that the proper use of scientific manpower was a matter of great national importance, and that appropriate measures should be taken to utilize that manpower most effectively; but that it was not a proper function of NDRC to endeavor to withhold from the operation of the Selective Service Act persons of scientific training who might at a future date be engaged in military research. It was equally insistent, however, that the operations of the Selective Service Act must not be permitted to wreck the program of military research carried on under NDRC auspices by the indiscriminate drafting of persons actually engaged in NDRC research and necessary to its effective continuance.

After conversations with the Civilian Committee on Selective Service, NDRC called the Selective Service Act to the attention of its contractors in October 1940. The letter merely observed that there might be men of draft age in the group assigned by the contractor to work on defense research carried on under contract with the NDRC. If the institution planned to petition the local boards to have any of these men deferred, NDRC stated that it would be glad to prepare a supplementary statement to accompany the contractor’s request. The NDRC statement would be limited to presenting the facts with respect to the importance of the NDRC program and the place within that program of the research being carried on by the particular contractor. The effect of this was to place NDRC upon record as to the importance of the research. It was left entirely to the contractor to establish with the local board that the particular individual for whom deferment was requested fulfilled the requirements which would make him a “necessary man” within the meaning of the Selective Service regulations. Under the regulations the local boards were directed to place in class 2A each registrant found to be a necessary man within the meaning of the regulations. Persons placed in class 2A might be deferred for a period not longer than six months with the provision that there might be additional deferments of not to exceed six months each unless the local board should reclassify the registrant.
This simple procedure was adequate to protect the essential personnel of NDRC and OSRD contractors during the period preceding the entry of the United States into the war in December 1941. With that entry the manpower situation became much tighter, and a special Selective Service unit under Miss Miriam Madden was established within the Administrative Office whose sole function it was to work with Selective Service headquarters on the one hand and the local boards and the contractors on the other. Miss Mary Lee Jones succeeded Miss Madden as head of the unit on August 11, 1942, and directed it in a highly competent manner throughout the war.

OSRD contractors were informed on February 4, 1942, of a newly established procedure for requesting occupational deferment of essential personnel employed on OSRD contracts. The memorandum pointed to the probability that Selective Service classifications would be reopened and thus introduce the possibility of reclassifications. Contractors were advised to ascertain immediately the Selective Service status of each employee deemed essential to the progress of work under an OSRD contract and to consider the advisability of requesting an occupational deferment. The OSRD policy was stated to be that such a request should be made only when the loss of the individual's services would result in detriment to the OSRD work at hand because of his unusual qualifications or because of the existence of a shortage of men of his particular type of training. To meet Selective Service requirements, the requests were to be made on Selective Service Form 42A filled out by the contractor. In order that they might be adequately reviewed within OSRD, the requests were required to be supplemented by a detailed statement from the contractor reciting specifically why the particular individual was essential to the progress of the work and what steps the contractor had taken to recruit other persons of equal or similar qualifications. As this information was intended for use only within OSRD, the contractor was able to use information of a classified nature which could not be put on the form itself. The form and letter were sent through the appropriate NDRC division for review and endorsement to the Administrative Office which in turn reviewed the correspondence and in appropriate cases transmitted the Form 42A to the local Selective Service board with a suitable letter reciting OSRD's interest in the case. The Selective Service regulations made provision for appeal of adverse decisions by local boards, and OSRD required the appeals to be filed through the OSRD if they were to be supported by it.

OSRD kept in sufficiently close contact with the National Selective Service Headquarters to anticipate probable developments in order that it might advise its contractors. It was clearly apparent that the constantly increasing military needs for manpower would multiply the difficulties encountered in obtaining deferment of essential scientific and technical personnel.
OSRD contractors were advised on November 7, 1942, to employ women and older men wherever possible. They were warned on December 17, 1942, of the increasing difficulty of obtaining extensions of deferments, many of which were scheduled for termination in the near future. The limits within which an OSRD endorsement of a request for a deferment would be granted were again stressed and the contractors were put on notice that they would have to convince both OSRD and Selective Service that they had in fact tried to comply with the Selective Service requirement of attempting to obtain a substitute for a necessary man who had been previously deferred. The emphasis on the part of OSRD that the Selective Service requirements be observed in good faith probably forestalled the filing of deferment requests in many doubtful cases. It may have resulted in the failure to defer some men-who should have been deferred even under the Selective Service regulations. On the other hand, it built up within the National Selective Service Headquarters a feeling that OSRD was acting in complete good faith and that its representations could be relied upon. This was invaluable in getting the backing of the national headquarters where appeals had to be taken in important cases. It also helped in obtaining favorable action from the local boards. By the end of 1942, OSRD had endorsed requests for deferments for 3602 scientific and technical men employed on OSRD projects. The requested deferments were granted in all except sixteen of these cases.

With the establishment of the Scientific Personnel Office as a principal subdivision of OSRD in June 1943, responsibility for handling requests for deferment of scientific and technical personnel from calls under the Selective Service Act was transferred to that office. The Selective Service unit was transferred in a body from the Administrative Office to the Scientific Personnel Office.

Pressure for the induction of all physically qualified young men continued to mount. In August 1943, the local boards were informed by national headquarters that one half million fathers would need to be inducted before January 1, 1944, in order to meet calls from the Services. This did not immediately affect OSRD as deferments upon the endorsement of OSRD had been based upon occupational qualifications, not upon family status. It did serve to increase the pressure upon the local boards to induct more nonfathers and it increased their reluctance to grant deferments to physically fit unmarried men for any reason. In September 1943, national headquarters in Local Board Memorandum 115B called for increasing scrutiny of occupational deferment of registrants between the ages of 18 and 26. The thoroughness with which the persons deferred on the recommendation of OSRD had been screened originally was such that this additional scrutiny did not affect the situation.

By an act approved December 5, 1943, Congress directed that men mar-
ried prior to December 8, 1941, who had maintained a bona fide relationship with their families since that date and who had one or more children under 18 years of age born prior to September 15, 1942, should not be inducted as long as qualified unmarried men remained available. This act again served to increase the pressure for the induction of physically fit unmarried young men who had been deferred for occupational reasons. At the same time, however, the procedure for appeal from decisions of local boards was changed to give jurisdiction of the appeal to the appeal board in the area in which the registrant’s principal place of employment was located. This change operated to the advantage of OSRD as the board physically located near the site of work was in a better position to judge its importance than one situated several hundred miles away, as had frequently been the case previously.

Experience showed that although OSRD had tried to establish a procedure for screening requests to local boards made in connection with employment on OSRD contracts, contractors would occasionally try to supplement the OSRD efforts by direct representations on their own behalf to the local boards or in some cases on appeal. The resulting confusion led OSRD to announce in November 1943, that if OSRD endorsement of a request for deferment of a contractor’s employee was desired the OSRD Scientific Personnel Office must conduct all correspondence and communications with any branches of the Selective Service system that might be concerned except that the Form 42A should be filled out and signed by the contractor. This was not intended as a usurpation of the contractor’s rights, as the contractor was perfectly free to prepare and prosecute the request for deferment without involving OSRD at all. It did serve to keep contractors from involving OSRD in statements which OSRD was not prepared to substantiate, and it eliminated the confusion which followed the descent of information upon local boards from two different sources in the same case. In practice a contractor had very little chance to obtain deferment of personnel on the basis of OSRD contract work without the intervention of OSRD itself.

January 1944 saw a revision of Local Board Memorandum 115 with many changes as to occupational classifications which the local boards were requested to consider in connection with deferment applications. Among the changes was the provision that no registrant of the ages 18 through 21 should be granted occupational deferment, with very limited exceptions requiring the authorization of the State Director in each individual case. The number of such cases relying on OSRD endorsement was relatively small and the necessary endorsement of the State directors was forthcoming in all except a few cases.

The next move which complicated the OSRD manpower picture is effectively described in the following quotation from page 73 of the report of the
Organizing Scientific Research for War

ORGANIZING. Deferments.

Director of Selective Service entitled Selective Service as the Tide of War Turns:

. . . On February 26, 1944, the President sent to the Director of Selective Service and to the Chairman of the War Manpower Commission a memorandum which read in part: "The present allocations of personnel to the armed forces cannot be further reduced, and there is a very real danger in our failure to supply trained replacements at the time and in the numbers required. Selective Service has not delivered the quantity of men who were expected . . . we are still short approximately 200,000 trained men . . . Today, as a result, we are forced to emasculate college courses and trained divisions and other units. The Army will not reach its planned January strength until sometime in April, or even later if Selective Service continues to fall behind on its quotas. The Nation's manpower pool has been dangerously depleted by liberal deferments and I am convinced that in this respect we have been overly lenient, particularly with regard to the younger men . . . Deferments for industry include over a million nonfathers, of whom 380,000 are under 26 years of age. Of almost a million nonfathers deferred in agriculture, over 550,000 are under 26. Agriculture and industry should release the younger men who are physically qualified for military service. The present situation is so grave that I feel the time has come to review all occupational deferments with a view to speedily making available the personnel required by the armed forces."

The President's memorandum was sent to all Selective Service local and appeal boards with an instruction to review all cases of registrants aged 18 through 37 who held occupational deferments, "giving particular attention to registrants under 26 years of age." A telegram of March 24 from national headquarters required the calling of all registrants under 26 to report for preinduction examination whether or not they still held occupational deferments (other than those in agriculture). On March 25 OSRD contractors were instructed to submit a new form 42A Special for each man under the age of 26 for whom they desired deferment regardless of previous requests for deferment.

Naturally all this had an upsetting effect upon OSRD contract operations. In the fields in which OSRD was operating most actively many of the key men were under 26 largely because they were dealing with relatively new techniques in which older men had not been trained. Many a conference was held by OSRD officials with Selective Service, the War Manpower Commission, the Army, and the Navy to insure that too literal a compliance with the President's instruction of February 26 should not completely wreck large segments of the OSRD program. The contractors were vigorous in their statements as to the work which they could not do if key individuals were lost, and the men themselves were considerably disturbed in their own minds as to where their duty lay. The pressures against occupational deferment designed primarily to squeeze out unnecessary deferments tended to throw a shadow over all occupational defer-
ments. It was not clear how long a man might expect to remain on a particular job, and in such circumstances the proffer of an Army or Navy commission proved too tempting for a number of scientists. Yet OSRD succeeded in retaining the services of practically all of the key men deferred on its recommendation.

On March 24, 1944, the War Manpower Commission created an Interdepartmental Agency Committee authorized to endorse deferment requests for the employees of the constituent agencies and employees of their contractors. Failure to include OSRD on the committee required the endorsement of OSRD requests by the War or Navy Departments or, in the case of men on the Reserved List, by the Committee on Scientific Research Personnel. As a result of its protest supported by the Army and the Navy, OSRD was later added to the Interdepartmental Agency Committee with the authority to endorse requests for deferment.

Even the inclusion of a man’s name on the Reserved List and the endorsement of a request for his deferment by a claimant agency under the procedure of the Interdepartmental Agency Committee was no assurance of continued deferment of an individual under 26 after the President’s memorandum of February 26, 1944. In fact, for a short period there seemed to be some danger that the Army and Navy might even withdraw their support from the Reserved List. OSRD found itself in the uncomfortable position of being requested to take on more and more research and development work for the Services and even to enter into the field of crash procurement which the Services were poorly equipped to handle, while at the same time the removal of key personnel through the operations of Selective Service was constantly threatened. Effective support of the Reserved List came only after some plain talking in which OSRD pointed out to the Army and Navy the extent to which military research programs would have to be abandoned unless key scientists under 26 were left in positions to carry out those programs. The total number involved was not large, as only approximately 1350 individuals under 26 had been included in the Reserved List.

The rapidity with which the situation changed can be illustrated by two letters written by Bush to members of the NDRC. As a result of prolonged discussions with Selective Service, the Army and the Navy, he wrote Conant on March 10, 1944:

... I am convinced, having reviewed the entire affair, that no qualified scientific research man, now working on a piece of research which is vital to the war effort, will be called upon to serve in the United States Army as a result of the functioning of the Selective Service System, so long as a fully qualified and representative committee considers that he is qualified and his work is important. ...

The situation changed so drastically, however, that he wrote Jewett on April 6, 1944, that
There is no doubt that the manpower situation is in a very bad way, and that it is likely to injure the scientific effort seriously. There is also no doubt that it has already inflicted considerable injury on the effort, for the confused and chaotic situation has badly affected morale.

One new element was introduced into the situation by the requirement that the Army and the Navy certify which projects that they had submitted or would submit to OSRD in the future were of such a nature as to justify a request for the deferment of personnel. This was the occasion for a great deal of work. It involved a re-examination by the Army and the Navy of all projects which they had submitted to the OSRD. The re-examination resulted in the certification of practically all projects but due to the length of time required for the examination within the Services, information as to the certification of particular projects came in at different times. The certified projects then had to be traced through the various contracts under which work was being conducted and the connection of each individual for whom deferment might be requested with the particular project which had been certified had to be established. For those projects which were initiated by OSRD itself there was initially no provision for certification. The Army acted as the certifying agency for such projects until OSRD a short time later was authorized to certify its own projects. The principal effect of the requirement of certification of projects was to overload a number of busy people for a substantial period, but the net result was the continued endorsement for deferment of the men who had been so endorsed prior to the requirement of certification. The initial screening which had been established by OSRD was at least as effective as that established as a result of the President’s memorandum of February 26 and the ensuing regulations.

The Radiation Laboratory at M.I.T. had been extraordinarily successful in developing radar equipment of which the Services were making very effective use. There was strong pressure from the Services for handmade preproduction models of various radar devices for actual operational use during the interval before equipment would be available from the production lines. Ultra-high-frequency radar was distinctly a young man’s game built upon information acquired by young men and for the most part unknown to older men. The insistence of the Army upon the induction of young men led to the requirement by the State Selective Service Director in Massachusetts that fifty young men be taken from the Radiation Laboratory. This would have seriously upset a substantial part of the radar program.

While this situation was developing, the Undersecretary of War, Robert P. Patterson, wrote a letter to the New York Times stressing that the policy of the War Department was to insure the utilization of scientific research personnel where they were urgently needed on war jobs. This was too
much for President Compton of M.I.T., who sent a letter to Mr. Patterson on May 11, 1944, which read in part as follows:

... they [scientists] have had to struggle for months to prevent a very substantial throttling of their efforts by the regulations imposed or permitted largely by the War Department. ... the draft policies of recent months have driven our scientists from pillar to post in search of some way to carry on. I think it no exaggeration to say that half the time and nine tenths of the worries of my most effective colleagues have been spent on this subject in the past two months. It is also no exaggeration to say that our morale is therefore at an all-time low, and that nothing but sense of duty keeps very many men on the job.

I know that the scientific-military co-operation was proceeding smoothly until the War Department announced its policy of recruiting young men at all costs. The supplementary explanations or special adjustments that have since been devised to avoid the disastrous effects of such an undiscriminating policy have produced great confusion and have partially averted the threatened damage. But the general performance of draft officials and related agencies now rests on the assumption that the War Department insists on securing all possible young men, let the chips fall where they may. It is as if the general policy of the War Department were designed to make it as difficult as possible for the scientists to perform the tasks that the operating men within the Army are pressing for completion, and which no other group or agency can possibly carry through.

As a result of urgent requests by Bush and Compton, Secretary Patterson assured the retention of the particular fifty men by the Radiation Laboratory. The incident is worth mentioning primarily as an illustration of the extent of disruption of normal operations incident to retaining scientific personnel. While the final result was the deferment of a group of essential scientists, the incident, and others like it, was extremely depressing to the morale of the younger scientists.

With the end of the war and the consequent cessation of most OSRD work the basis for the continued deferment from calls under the Selective Service Act of most men who had been deferred on the recommendation of OSRD disappeared. After some discussions, National Headquarters of the Selective Service System recognized that the long-range national interest required the resumption of advanced studies for men having high technical and scientific qualifications where those studies had been interrupted. At the request of the Director of War Mobilization and Reconversion, Selective Service established the Reconversion Working Committee on Deferment and Selective Release consisting of ten Government agencies including the OSRD. The committee was directed to (1) indicate to OSRD the specific occupations in which shortages of personnel threatened to interfere with the national health, safety or interest; (2) formulate the specific standards indicating that a man is qualified to engage in a selected occupation; (3) certify to the Director of the Selective Service System those individuals meeting the standards established by the committee, and (4) in-
dicate to the War and Navy Departments the categories of occupations in which shortages detrimental to the national interest could be relieved by release of men from the armed forces. OSRD was authorized to examine all proposals by the committee relating to deferment of teachers, university research workers, and students pursuing scientific courses, and to certify such persons for deferment in accordance with item (3). Any registrant accepted by an accredited college or university as a candidate for a master’s or doctor’s degree in the physical sciences or engineering might be certified by OSRD to the Director of Selective Service as essential to the national interest in a civilian capacity. The same was true of a registrant employed by an accredited college or university as a teacher of physical sciences or engineering and also under certain conditions of a registrant engaged in research in the physical sciences or engineering in an accredited college or university. The last category of registrants who might be so certified consisted of those who had satisfactorily completed at least three years of work leading to a bachelor’s degree in physical sciences or engineering where the registrant had served for a period of not less than two years on a project directly connected with the war effort. As of March 15, 1946, 928 registrants had been certified as essential to the national interest in a civilian capacity in the foregoing categories which are defined in more detail in Local Board Memorandum No. 115–M issued by the Selective Service System.

In summary it may be said that from the time of American entry into the war until the cessation of hostilities, there was a series of crises with respect to scientific and technical personnel of OSRD contractors.

Taken by itself, however, the record was startlingly good. A total of 9725 employees of OSRD contractors were endorsed for deferment and of these only 63 were inducted. This would seem to indicate that the Selective Service System operated satisfactorily so far as OSRD requirements were concerned. The figures do not reflect the constant effort required to maintain the staffs carrying vital programs nor the cost to over-all OSRD operations of the amount of time which had to be devoted to Selective Service problems.

The problem of scientific personnel within OSRD was only a part, although an important part, of the total problem of the handling of scientific manpower in World War II. The outstanding fact from OSRD experience supported by observations in other fields is that at no time during the war did methods of dealing with the problem of scientific manpower reach a stage which could be offered as a model for any future emergency. In the nature of the case, this fact had to be expected; everyone involved was pressing to get on with the war, with the single motive of finishing it successfully and early. But no one—not even the scientists, who were
in the best position to do so—could at the outset entirely visualize the complete revolution in the methods of conducting warfare which impended. Hence the handling of scientific manpower had to pass through a transition as all concerned gradually reached new conceptions. In spite of the inevitable confusion in such a process, the system did work because the individuals involved, whatever their convictions and disagreements, were all actuated by the overriding desire to get on with the war.
CHAPTER XIX

ACCEPTANCE OF VOLUNTARY SERVICES

ONE of the most striking features of the organization of both NDRC and OSRD was the extent to which use was made of the voluntary part-time services of outstanding scientists (referred to as "WOC"—without compensation—in the jargon of personnel administration). The pattern was set in the order of June 27, 1940, which created NDRC and later in the Executive Order establishing OSRD; in both cases it was specified that the top personnel should serve as such without compensation. The President of the National Academy of Sciences who served as an ex officio member of the NDRC under the terms of both orders was the President of Bell Telephone Laboratories. The Director of OSRD and the civilian members of NDRC and CMR who received their appointments at the hands of the President were receiving compensation from outstanding educational and scientific institutions, all of which had Government contracts. The same pattern was followed by NDRC and CMR in setting up their divisions and sections; legal authority was expressly given in several appropriations acts for the "acceptance and utilization of voluntary and uncompensated services" by OEM agencies. The reason for the emphasis placed in the previous sentences on the industrial and professional employment of OSRD WOC personnel will appear later in this chapter. The extent to which the OSRD relied upon WOC appointments was periodically reported to the Bureau of the Budget and the Appropriations Committee of the House of Representatives.

Conceivably OSRD could have been built up without utilizing WOC services. In that case, it probably would have been manned by different personnel; for it is unlikely that Bush, Conant, Compton, Jewett and Richards would have resigned the Presidencies of Carnegie Institution of Washington, Harvard University, Massachusetts Institute of Technology and Bell Telephone Laboratories and the Vice-Presidency of the University of Pennsylvania, respectively, to accept full-time positions with the Government.

The same is true of their colleagues. The public interest would have suffered if many of them had left their regular posts for full-time employment with the Government. The total war effort was much broader than OSRD. The several hundred (the average number in 1944 was about 430) WOC appointees of OSRD played very important roles in the winning
of the war in connection with their regular occupations, and the war effort would have been affected adversely had they severed those connections. If OSRD had been restricted to persons willing to accept full-time Government employment, it would have lost the benefit of some of the most creative imaginations which were brought to bear on its problems. This statement can be made without reflecting in the slightest degree upon the small but highly capable full-time scientific staff which OSRD had for the day-to-day supervision of its scientific research and development program.

Use of WOC appointments brought OSRD the services of scores of outstanding scientists who otherwise would have been unavailable. It also brought speed because part-time voluntary service could frequently be obtained by a telephone call, while full-time employment took days of processing and occasionally weeks of waiting while the prospective employee was winding up his affairs in the post which he was leaving. Parenthetically, it is inconceivable that any Government agency would have been permitted to have as many full-time top officials as OSRD would have needed had it not been for the WOC appointments.

It was recognized that the situation was one in which conflicts of interest were possible. In the interest of speed and success, OSRD needed to contract with the outstanding research organizations in the country; for its scientific advice it needed to go to the best-qualified men, and they were frequently employed by these same organizations. Members of NDRC and CMR were officers of Harvard University, Massachusetts Institute of Technology, California Institute of Technology, Columbia University, University of Illinois, University of Pennsylvania, Johns Hopkins University, and Bell Telephone Laboratories. Clearly, no research program could be well rounded which ignored these institutions.

The committees early adopted the rule that no member would participate in the discussion of, or vote upon, any proposal affecting the institution from which he received his salary. A similar rule was followed in the divisions and sections. The rule eventually found embodiment in Administrative Circular 2.02 dated February 17, 1943, which emphasized that no OSRD officer or employee should represent the Government in any of its business transactions with a nongovernmental organization which paid all or part of his salary. All such transactions were to be turned over to some member of the division, section or other part of the office having no connection with the organization involved. In appropriate cases, an Acting Division Chief or Acting Section Chief was appointed to handle the case. The circular pointed out that this procedure merely followed the example set by Bush who, as OSRD Director, had delegated complete exercise of judgment in negotiations with the Carnegie Institution of Washington to the Executive Secretary of OSRD and who, as President of the Carnegie Institution, had delegated to the Executive Officer of the
Institution authority to act on its behalf in all future negotiations with OSRD.

Bush sought and obtained a ruling on his own case. During the time NDRC was a part of the Council of National Defense it had entered into several contracts with the Carnegie Institution of Washington of which he was President. The Executive Order creating OSRD provided that OSRD should assume the NDRC contracts. On August 8, 1941, Bush addressed a letter to Wayne Coy, Liaison Officer for the Office of Emergency Management, requesting legal opinion as to his authority as Director of OSRD to take over contracts with the Carnegie Institution of Washington and to enter into new contracts with that Institution. Bush pointed out that he received compensation as President of the Institution but not as Director of OSRD; that the Institution was a nonprofit corporation, and that contracts between NDRC or OSRD and the Institution would be for research work for which the Institution would be paid only its out-of-pocket expenses.

On August 21, 1941, Coy replied enclosing an opinion by Oscar S. Cox, counsel for the Office for Emergency Management, concluding that there would be no violation of any law if Bush, as Director of OSRD, should take over or enter into contracts with the Carnegie Institution. In his opinion, Cox stated that Section 41 of the Criminal Code was the only one which raised any question in the situation. The purpose of that statute was to protect the Government in its business transactions with corporations from being represented by an officer who might have an interest adverse to the United States due to his connection with the corporation involved. The danger sought to be avoided was the temptation of the officer to favor the corporation at the expense of the Government for his own financial gain. The instant case was one in which Bush’s relationship to the Institution offered no opportunity directly or indirectly for personal financial gain from the corporation’s “pecuniary projects or contracts,” and therefore there was no possibility of his having an interest adverse to the Government in its transactions with the Institution. Since the Institution itself was a nonprofit educational corporation, it was not within the intent of the statute, as the nature of its operations precluded its officers from any financial interest direct or indirect in its contracts or business transactions.

Having taken care to avoid actual conflicts of interest, OSRD felt that opinions of the Attorney General (e.g., Op. Attorney General, Vol. 40, Opinion No. 47, April 27, 1942) were adequate to insure that there was no impropriety in the use of WOC personnel. This belief was rudely jarred, however, by an opinion of the Attorney General dated December 9, 1943, involving members of local OPA War Price and Rationing Boards in which Sections 109 and 113 of the Criminal Code were construed to be more generally applicable than had theretofore been indicated.
The two statutory provisions involved read as follows:

18 U.S.C. Section 198 (Criminal Code, section 109)

Officers interested in claims against United States. Whoever, being an officer of the United States, or a person holding any place of trust or profit, or discharging any official function under, or in connection with, any executive department of the Government of the United States, or under the Senate or House of Representatives of the United States, shall act as an agent or attorney for prosecuting any claim against the United States, or in any manner, or by any means, otherwise than in discharge of his proper official duties, shall aid or assist in the prosecution or support of any such claim, or receive any gratuity, or any share of or interest in any claim from any claimant against the United States, with intent to aid or assist, or in consideration of having aided or assisted, in the prosecution of such claim, shall be fined not more than $5,000 or imprisoned not more than one year, or both.

18 U.S.C. Section 203 (Criminal Code, section 113)

Whoever, being elected or appointed a Senator, Member of or Delegate to Congress, or a Resident Commissioner, shall, after his election or appointment and either before or after he has qualified, and during his continuance in office, or being the head of a department, or other officer or clerk in the employ of the United States, shall, directly or indirectly, receive, or agree to receive, any compensation whatever for any services rendered or to be rendered to any person, either by himself or another, in relation to any proceeding, contract, claim, controversy, charge, accusation, arrest, or other matter or thing in which the United States is a party or directly or indirectly interested, before any department, court-martial, bureau, officer, or any civil, military, or naval commission whatever, shall be fined not more than $10,000 and imprisoned not more than two years; and shall, moreover, thereafter be incapable of holding any office of honor, trust, or profit under the Government of the United States.

The language of the opinion in the OPA case was broad enough to indicate that practically all of the WOC appointees of OSRD might be held to be in technical violation of Section 113 and that a few might also be in technical violation of Section 109. Discussion with members of the staff of the Attorney General confirmed this impression. When a series of hypothetical cases was discussed by members of the OSRD legal staff with members of the staff of the Solicitor General, the view was informally expressed that while most of the cases were not within the spirit of the statute, they were all within the technical language of Section 113. Thus an OSRD appointee who held an administrative post in an educational institution which operated a school for chaplains for the Army was thought to be in technical violation of Section 113 because some part of the payment made by the Government toward the expenses of the school for chaplains might be held to go toward the payment of his salary. While sympathizing with the predicament in which OSRD was placed by virtue of the change in the Attorney General’s interpretation of the statutes, the Department of Justice
was reluctant to issue a clarifying opinion for OSRD for fear that such an opinion would be more broadly applied by other Government agencies not having OSRD's peculiar factual situation. It was indicated, however, that the Department of Justice would support legislation to exempt OSRD in appropriate cases from the operations of Sections 109 and 113.

The opinion in the OPA case was given considerable newspaper publicity, and WOC appointees working with OSRD quite understandably became somewhat concerned that their efforts to help the United States win the war had the immediate consequence of making them criminals under Section 113. This arose from the fact that nearly all of them were receiving compensation which was "directly or indirectly" attributable in some degree to services rendered by themselves "or another" for their educational institutions or commercial organizations under one or more of the thousands of Government war contracts that had been let within the past few years. In addition, a few of them were on notice that they might also be violating Section 109 because of activities for their compensating organizations in connection with the negotiation or performance of contracts between their regular employers and Government agencies other than OSRD. The fact that their activities for their regular employers were not related in any way to their duties as OSRD appointees and the fact that there was no actual conflict of interests had become quite immaterial.

Fairness to the persons involved required that the situation be explained frankly to them and this was done by a memorandum of February 9, 1944, to all OSRD employees and appointees. In that memorandum Bush pointed out that in view of the broad language of the Attorney General's opinion, most WOC and WAE (compensated when actually employed) appointees and employees of OSRD were probably in technical violation of Section 113 and a few also in technical violation of Section 109. He stated that he planned to ask Congress to amend the law to exempt OSRD WOC and WAE appointees from its operations except in cases of actual conflict of interest. Even though such an amendment to the statutes should be enacted, obviously there would be a considerable delay in obtaining its passage and during that period the appointees would continue to be in technical violation of the statute. This he could not request of them. The memorandum, however, drew attention to the very serious consequences which would be caused by any general or hasty withdrawal of key personnel from OSRD and requested the appointees to give the matter careful consideration. Bush stated that he intended to continue in his OSRD position for he was convinced that the present technical situation was simply a passing phase that would soon be remedied by Congressional action upholding OSRD's method of conducting business through the use of voluntary and uncompensated services. He expressed the opinion that if a complete remedy were not forthcoming, any action of Congress requiring readjustments of some details of
OSRD's operations could be met in such a way as not to disrupt OSRD scientific operations.

With the approval of the Bureau of the Budget and the Attorney General, H.R. 4446 was introduced in the House of Representatives on March 21, 1944, to exempt certain officers and employees within the OSRD from Sections 109 and 113 of the Criminal Code. The bill was in line with similar legislation which had been enacted on behalf of persons serving on Selective Service Boards, Appeal Boards and Advisory Boards (Public Law 47, 77th Congress) and of persons serving as members of Alien Enemy Hearing Boards (Public Law 376, 77th Congress) as well as with bills which had been introduced to exempt members of the War Price and Rationing Boards in the Office of Price Administration from the provisions of Sections 109 and 113 except in cases involving representation before OPA itself. H.R. 4446 passed the House of Representatives without objections on June 23, 1944. Shortly thereafter, Congress enacted the Contract Settlement Act of 1944 (Public Law 395, 78th Congress) which in its Section 19(e) repeated certain of the provisions from the operation of which H.R. 4446 was designed to exempt OSRD. Accordingly, H.R. 4446 was amended to extend the exemptions to Section 19(e) of the Contract Settlement Act of 1944 and the amended bill was reported favorably by the Senate Judiciary Committee on December 5, 1944. The report came during the closing days of the session at a time when unanimous consent was necessary for the passage of any bill through the Senate. When the bill was reached on the Senate calendar, objection to consideration of it was made by one Senator who as a member of the Judiciary Committee had not objected to its favorable report by that Committee. Accordingly the bill failed of passage.

With the convening of the new session of Congress, a new bill, H.R. 1524, was introduced in the House of Representatives on January 16, 1945. This bill had a somewhat similar fate to that of H.R. 4446. It passed the House of Representatives but in the Senate was held up by an objection of the same Senator. The exact basis of his objection was not defined and consequently the objection could not be met. With the successful outcome of the war, all possibility of getting favorable action on the bill vanished.

Had it been known when the Attorney General issued his opinion in the OPA case that it would not be possible for OSRD to obtain legislation protecting its WOC personnel from the charge of technical violation of the Criminal Code, the effect might have been serious. As it was, there was up to the very last reason to believe that the exemptions would be forthcoming. The House twice passed the bill providing the exemptions and there was a favorable report without dissent from the Senate Judiciary Committee. Under these circumstances for any substantial number of OSRD appointees to resign and by so doing seriously retard research and development essential to the war effort by completely disrupting the administrative machinery
would have been precipitate and conceivably could have been construed as unpatriotic. Yet it is rather ironical that several hundred of the leading scientists in the United States stand in theoretical danger of prosecution under the criminal statutes because of their contributions to the winning of a war.

Fortunately it does not seem at all likely that any of them will ever be prosecuted for those technical violations, for in practice the OSRD avoided situations involving actual conflicts of interest; but there is no denying that the theoretical possibility is there.
CHAPTER XX

PUBLICITY, PUBLIC RELATIONS AND PUBLICATIONS

IN AN early meeting of NDRC, Compton observed that NDRC could either do its job or get credit for doing it, but not both. The emphasis was always upon getting the job done. There was frank recognition that if NDRC became involved in competition with the Services for credit, one result would be a chilling of Service enthusiasm for working with NDRC. It would be expecting a great deal of an Army or Navy officer to assume that he would seek assistance in meeting a problem if there were likelihood of NDRC publicity indicating how good NDRC was and, inferentially, what a poor job he had done. Another compelling reason for silence was, of course, the fact that most OSRD operations were in the area of classified information. Nor did OSRD seek publicity for its policy of avoiding publicity. Members of the working press were early convinced that OSRD was doing an important job, that the job could best be done without publicity, that OSRD was honest in its desire to avoid publicity, and in accordance with the best traditions of their profession, they co-operated.

The policy paid big dividends in aiding to build up a free interchange of information with the Services and in encouraging the Services to come to OSRD for assistance. It had as a disadvantage that the Selective Service boards were not adequately informed of the importance of OSRD operations and thus the problem of retention of scientific manpower was more difficult of solution than it otherwise might have been. In the early days, it also contributed to the restlessness of some scientists who had no appreciation of the scope of the program and who therefore felt that science was not making its proper contribution to the war effort. This feeling died down as more and more scientists were brought into the ever expanding operations.

There were a few speeches and a handful of press releases in the early days but they were largely devoted to matters of organization. Their issuance was dictated largely by the desire to acquaint scientists not already in the program with the possibility that later they might be. On the other hand the subcommittee of the Appropriations Committee of the House of Representatives handling the OSRD appropriations was kept informed of the principal OSRD activities. Organizational matters were spread on the record; but, more important, at the several hearings the Director of OSRD and the Chairmen of NDRC and CMR gave off-the-record outlines of the
more important programs and freely answered questions of Committee members. As a result the reception by that subcommittee was always friendly and OSRD proceeded with the assurance that there was a reasonable probability of obtaining as much money as could be spent wisely.

OSRD maintained no public relations office. For five years the Executive Secretary had the responsibility for press relations in addition to his other duties; and so light was the task, so co-operative the press, and so little the time required that he was able to handle it personally. As the end of the war approached it became desirable to arrange a program of publication of results of OSRD research, a subject which is discussed below in connection with the Committee on Publications. When Burchard succeeded Stewart as Chairman of that Committee, he was also placed in charge of press relations because of the intimate connection between the two subjects.

During the last few months of active OSRD operations there was a noticeable shift in attitude toward publicity. Service press releases on OSRD-developed equipment began to appear, some of which made no reference to OSRD but attributed credit for the equipment to Service personnel. The error was understandable, for often the person preparing the release had no way of knowing the OSRD participation, and he assigned the credit to the officers associated with the equipment when he first learned of it. In other releases, recognition of OSRD participation took the form of naming individuals who were not those who would have been selected by persons intimately associated with the development.

Scientists who had willingly become anonymous to advance the war effort were not particularly happy to have the veil lifted to give credit for their work to other men. To alleviate the situation a joint Board on Scientific Information Policy was established in June 1945, by the joint action of the Secretaries of War and the Navy and the Director of OSRD. This Board, under the chairmanship of John T. Tate, Chief of Division 6 of NDRC and Assistant Chief of OFS, issued four reports entitled Radar — a Report on Science at War, Electronics Warfare — a Report on Radar Countermeasures, Optical Glass Substitutes: A Scientific Answer to Mass Output, and U. S. Rocket Ordnance — Development and Use in World War II. A fifth report, on war metallurgy, was prepared but not issued.

All except the third of these reports were printed by the Government Printing Office; that one was issued in multilithed form. It was the Board's endeavor to have its releases accurately assess the relative contributions made under Army, Navy, and OSRD auspices, give credit where it was due, and apprise the public (within the limits imposed by military security) of the scientific advances in the field of the particular release. The Board's activities were curtailed at the cessation of hostilities, so that, unfortunately, comparable reports were not made for all fields of OSRD operations.

Most of the scientific talent of the country was engaged during the war
years in research of a classified nature under Service, OSRD, or NACA auspices. There was no possibility of publishing the results during the war. Papers submitted to scientific journals, even though not prepared as a result of military research, were submitted by the editors to a self-imposed censorship by a National Research Council Committee headed by Dean L. P. Eisenhart of Princeton University.

As the favorable outcome of the war within a foreseeable time became increasingly apparent, a more far-reaching publication policy was clearly indicated. This policy had to recognize that the five years of scientific silence had left a great deal unsaid which scientists needed to hear. The problem of releasing this mass of information was not simple and could not be solved by the stroke of a pen. The reasons why this was so are worth elaborating. They were:

1. Even if the information were publishable in its extant form, the volume would flood the journals and book publishers far beyond their capacity.

2. Even had there been no security restrictions, the papers were not publishable by and large in their extant form. Rapid progress reporting had been the necessary order of the day. Scientific documentation, which is a *sine qua non* of normal first-rate scientific reporting, had been used only as the occasion really demanded. Most papers needed revision to make them adequate for the scientific library. The problem of persuading any large body of first-rate scientists to engage in this revision after V-E and V-J Days would be no easy one.

3. Within the framework of that material which could be accommodated by the scientific press and which was publishable in the scientific sense, there would still at the outset be an enormous variation in publishability on the grounds of military security. Final decision on this point rested at all times in the military. Fragmentary publication might do more harm than good. A wholesale campaign for maximum declassification to the only generally publishable category “Open” would have to be carried on.

4. Our understanding with our Allies, particularly the British, had to be respected, and any publication program co-ordinated with them. Scientific information had been exchanged on a broad scale, and each Government had respected the security classifications of the other. It would be bad for postwar scientific collaboration if, through hasty action, either side claimed unwarranted scientific accomplishments, or either side failed to pay proper respect to the contributions of the other. Yet, even with all good will, this could happen if the general declassification policy were not the same in both countries, for the open paper could not acknowledge the credit due another whose work was still held classified.

5. With somewhat less force, the same situation applied within the United States. Often parallel and sometimes competing groups had been
put on the same problem. Collaborative reporting would not always be possible. Under these circumstances, it was important that publication be fair and that the race for first publication and its attendant scientific prestige should not go by default to those swiftest with the pen.

6. OSRD had an obligation to protect Government interest in patentable subject matter, and no publication program could ignore the responsibility.

These then were the problems of policy with respect to technical articles. It was essential for the national welfare that accurate scientific literature be available to the general scientific public at the earliest possible date, and equally essential that this be consistent with a sound security policy, a sound policy of adequate credit to contributors, a sound policy of preservation of the national property rights. Important though these questions were for OSRD they went beyond OSRD. The first attempt to meet them was on a broad plane.

Publication Board

Recognizing the desirability of making as much scientific information as possible available as early as possible, Bush took steps in the summer of 1944 to stimulate the establishment of machinery for declassification. After consultation with, and with the concurrence of, the Army and the Navy, he proposed the establishment within the National Academy of Sciences of a board to control the release and promote publication of scientific information. The principal functions of the proposed board would be (1) to review, for the purpose of determining what portions thereof should be released for publication or other public use, all scientific and technical information which might be legally released for publication and which (a) had been, or might thereafter be developed by, or for, or with funds of any department or agency of the Government, and (b) was, or might thereafter be classified (by the War Department, the Navy Department, OSRD or NACA) as secret, confidential, restricted, or by other comparable designation, or otherwise withheld from the public for purposes of the national military security; and (2) to make recommendations to the War and Navy Departments concerning the release of scientific information for publication or other public use and to take such measures as might be appropriate and in the public interest to effectuate the release of such scientific information for publication or other public use after release had been approved by the War and Navy Departments. Provision was made for the co-ordination of the policy of the proposed board with that of countries with which information had been exchanged.

A draft executive order to establish the proposed board was sent to the Bureau of the Budget in September 1944, but the Bureau declined to pre-
sent it to the President for approval. The Bureau at first was unwilling to approve an organization for the release of scientific information until it had decided its position with reference to the postwar governmental organization for scientific research. The Bureau, however, early recognized that the public interest would not permit a delay of such proportions as seemed likely to be involved in decisions on postwar research, and that the board was necessary. But it held that the board should be within the governmental framework, rather than in a quasi-governmental organization such as the Academy, which was the arrangement favored by the Army, Navy, and OSRD. Bush refused to accede to a suggestion that it be established within OSRD, pointing out that OSRD was temporary and that its personnel was largely voluntary and could not be held together after the end of the war for purposes of reviewing security classifications. Finally, the Bureau of the Budget approved a procedure, and Executive Order No. 9568 was issued on June 8, 1945, to provide for the release of scientific information.

The order authorized the Director of War Mobilization and Reconversion to review all scientific and technical information which (1) had been or might thereafter be developed by, or for, or with funds provided by the Government and (2) was or might thereafter be classified or otherwise withheld from the public for purposes of the national military security. The review was for the purpose of making recommendations for publication to the War and Navy Departments. To assist the Director of War Mobilization and Reconversion in the performance of his duties, the order established an interdepartmental board consisting of the Director as Chairman and five Cabinet Officers (the Secretaries of Justice, Interior, Agriculture, Commerce, and Labor) or their alternates. The War Department, the Navy Department, OSRD and NACA (the agencies possessing most of the classified information) were authorized to designate one liaison officer each, with authority to attend and participate in the discussions of the board.

The Director of OWMR was directed to “take such measures as may be appropriate to effectuate the release and publication” of scientific information which it had been determined might properly be released for publication. In consultation with the Department of State, he was authorized to deal with duly accredited representatives of those foreign governments with which exchange of classified information had taken place, in order that so far as practicable similar policies and procedures should be followed by all in dealing with the declassification and publication of scientific information. Machinery for the implementation of the Executive Order was established in the Department of Commerce where an active program of declassification was put in effect.
OSRD COMMITTEE ON PUBLICATIONS

Within OSRD the matter of dissemination of scientific information was recognized as having the dual aspects of declassification and publication. Without the first, the second was impossible; without the second, the first would be only partially effective. As the problem involved all the divisions of OSRD, Bush appointed a Committee on Publications on October 10, 1944, consisting of Stewart as Chairman, Conant (NDRC), Richards (CMR), Compton (OFS), Tuve (Section T), James P. Baxter, 3rd (OSRD historian), and Carroll L. Wilson (Director's Office). Tuve shortly resigned when the Section T program was transferred to the Navy; and in April 1945, Stewart resigned because of the pressure of other duties. He was replaced by John E. Burchard, Deputy Chief, OFS, and at that time Chairman of the Joint Army-Navy-OSRD Committee on Scientific Information Policy, a creation of the Secretaries of War and Navy and the Director of OSRD. Norcross was made Secretary of the Committee.

In establishing the Committee Bush instructed it (1) to co-ordinate the activities of OSRD in connection with the common features of final reports and publications, such as format, printing, distribution, and legal and fiscal questions which might be involved, and to avoid undesirable duplication or omissions; (2) to submit recommendations for over-all OSRD policy on matters which should be so formalized, and (3) through its Chairman to represent OSRD in dealing with other Government agencies in connection with publication problems arising out of OSRD work.

He pointed out that the results of the work done under the auspices of OSRD should be accurately recorded, well indexed and organized for subsequent use by those concerned with these matters in the future. Insofar as possible the large body of scientific information developed in the course of OSRD activities, which could be declassified, should be made available to the public promptly and at reasonable cost. Furthermore, in addition to the classified reports and information to be made public, the various divisions, sections, panels and committees should record their best estimates of the lines of future research and development in specific fields which were likely to be most promising in application to improved weapons and materials, and the advancement of military medicine.

The problem of declassification, which was basic in the NDRC field, was of minor importance in the CMR field. During the first year of OSRD, the Secretaries of War and the Navy decided that in the fields of medical research, publication of new knowledge should be withheld only if that knowledge gave promise of conferring military advantage. It was possible, therefore, to publish most of the newly developed knowledge in the medical field and hundreds of articles were published. The amount of classified
medical material was held to a minimum, confined largely to limited subjects of immediate battlefront importance and to information which might be related to strategy. 

In the course of a trip to Europe in the summer of 1945, Burchard talked with the persons responsible for the British publications program and laid the basis for a mutually satisfactory procedure designed to avoid misunderstandings in connection with publication. 

The work of the Committee on Publications can best be followed by considering each element in the OSRD publication program as it finally took shape. These were: (1) Summary technical reports to the Services; (2) Articles in periodicals, both technical and popular; (3) Monographs for public distribution; (4) History; (5) Official governmental popular scientific releases (not a responsibility of the Committee on Publications); (6) Contractors' reports.

1. Summary Technical Reports. Summary technical reports (STR) constituted the largest and most important part of the OSRD publication program. Rendered by every division and panel except in the medical field, they included a solid summary of technical achievement, an analysis of operational use, and a suggestion for lines of future research, field by field. Because of the breadth of coverage, it was inevitable that security classification would be required at the outset for all STR, and would remain for a long time on many, and perhaps indefinitely on some. Under these circumstances, no general public distribution was conceivable and the issue was, therefore, restricted to 250, most of which are to be deposited with the Army and the Navy, with a limited quantity deposited on an archival basis, so that if declassification should ensue and duplication were then desirable (the contents are likely to be obsolete before declassification), this would then be readily possible.

Responsibility for the content, publication and distribution of STR was delegated to the Chairman of NDRC. These reports were prepared by the divisions and panels under the general direction of H. M. Chadwell, Deputy Executive Officer of NDRC.

The Committee on Publications had one further responsibility in this matter. Under normal governmental procedure, such publications would be printed by the Government Printing Office. These particular volumes were very difficult copy technically and speed of production was important. The Government Printing Office was heavily overloaded. Conferences were, therefore, held with representatives of the GPO and the Procurement Division of the Treasury Department, and, in accordance with a standard governmental procedure, a waiver was procured from the GPO, and a contract entered into with Columbia University for the editing and printing of the summary technical reports under a special reports group, directed by Wallace Waterfall. Chadwell was appointed Scientific Officer of the contract,
Louise Kelley served as Scientific Assistant until February 1946, at which time L. H. Farinholt, formerly Technical Aide in Division 8, was given this appointment. By November 1946, when Farinholt left OSRD, practically all the manuscripts and illustrations for the Summary Technical Reports had been submitted by the divisions and panels. From then on the Executive Secretary in his capacity as contracting officer was directed to exercise supervision of the contract, which is to continue until publication of the reports is completed early in 1948.

2. Articles in Periodicals. Up to June 22, 1945, OSRD referred proposals for publication of specific articles relating to work under NDRC auspices to the War and Navy Departments, which were asked to state whether the publication would assist in the war effort. Unless such a positive affirmation was made by one or the other Service, privilege of publication was withheld. This policy, desirable in the first part of the war, stemmed publication to a trickle, for it was only in rare instances that so positive a statement could or would be made. By June 1945, it was evident that a more aggressive policy was desirable in order to start a flow of properly publishable material, both in the popular and in the scientific press. Accordingly, at a meeting on June 22, 1945, the Committee on Publications recommended a change in policy to the Director. After details of procedure had been worked out, the new policy was made effective on August 1, 1945.

This new policy frankly set out to get as much useful and appropriate scientific information into the regular technical journals as could be properly done before the floodgates were finally opened. It encouraged employees of OSRD contractors to prepare technical papers on their own time whenever they felt that the subject was one with which they would, as scientists, have wished to deal under normal conditions. These papers were submitted to the Committee on Publications by Division Chiefs and Panel Chiefs who indicated their views as to whether publication was in the public interest and as to whether the papers were fair to other workers in the field, especially those of our Allies. Each paper was reviewed in the Office of the Chairman of the Committee on Publications to be sure that it could be published without prejudice to Government patent rights or to the over-all publication program of OSRD; at the same time the office of the Chairman of NDRC referred the paper to the Army and the Navy with a request for a ruling on publishability based solely on the criterion of military security. Under this policy a number of papers were passed for publication covering a wide variety of fields.

This was, of course, only a drop in the bucket; and it was highly desirable as declassification of fields progressed, as patent applications were filed, and as men returned to their home bases outside any jurisdiction of OSRD that the entire system of controls be eliminated and publication be restored to a close approximation of a peacetime basis. This situation had been reached by late January 1946, and at a meeting on January 24, 1946, the Committee
recommended to the Director and received his approval for the final step which became effective February 15, 1946. In this final procedure, articles were to be prepared for journals on the volition of individuals and submitted in the usual prewar way. Security clearance so far as required would be applied for directly to the Services by the writer or the journal. As a final step in seeing to it that proper relations were maintained between coworkers, both here and abroad, the Committee on Publications furnished to the editors of technical journals a list of voluntary referees made up of individuals who had had the greatest experience with the various fields throughout the war.

3. Monographs. As journal publication proceeded, it became apparent that this program could not completely fill the public need. In a few important instances the situation precluded periodical publication. This was the case when the material to be written had to be the collaborative effort of a number of scientists, momentarily together, but soon to be dispersed to their home institutions, when the length of the subject was such as to preclude journal publication, and when speed of production and distribution indicated that the public would be better served by the use of a commercial publisher. The procedure to meet this situation which was evolved by the Committee was approved by the Director on September 19, 1945. It stated the general OSRD policy that there should be an affirmative program to encourage and aid the publication of technical monographs primarily intended for the public rather than for Army, Navy, or OSRD use, provided (1) they either served to mobilize the scientific resources of the Nation or supported scientific research for the national defense (cf. paragraph 2 of Executive Order No. 8807); (2) satisfactory evidence was produced in each case that a public need existed for the proposed monograph, and that existing journal media were inadequate to meet that need; (3) the material contained in the proposed monograph had been declassified or would be declassified prior to publication, and (4) the form and contents of the proposed monograph did not go beyond what was reasonably necessary to mobilize the scientific resources of the Nation or to meet the particular public need which would not otherwise be met by existing journals.

The Chairman of the Committee on Publications was authorized to decide as a matter of administrative discretion whether a proposed technical monograph fell within the foregoing policy. He was also authorized to determine whether or not it would facilitate the prosecution of the war to have the printing of particular monographs handled by private publishers rather than by the Government Printing Office. Private publishers were to be selected only after adequate canvassing of the field to determine which publisher could handle the job most satisfactorily from the point of view of the Government, based upon normal business factors as well as the services he was prepared to render.

The preferred plan was for the Government to contract with private
publishers for the publication of monographs. The theory was that by a grant of the commercial rights to a publisher the Government would at the same time obtain a reduced price for the copies needed for Government purposes and insure the widespread publication required by the public interest. The recommended publishing arrangements for technical monographs called for the payment of royalties payable to the United States, with the royalty rate on a sliding scale to preclude excessive profits on unexpectedly large sales. Copyrights or exclusive publication privileges were not to be granted for a period in excess of that reasonably necessary to insure the initial edition (which might include more than one printing). No rights other than copyright were to be granted to publishers unless unusual conditions made the granting of such rights urgently necessary.

Under this plan the Director approved the publication of thirty-six monographs covering a wide variety of fields, including such subjects as exterior ballistics of rockets, ultra-high-frequency techniques as applied to radar, very high-frequency techniques developed at the Radio Research Laboratory, sampling inspection, studies in applied statistics, and antimalarials.

It was always intended that the monograph series should be sharply limited. Time could permit only those which the writers were enthusiastic to prepare and for which manuscripts could be delivered to publishers before the expiration dates of the primary contracts. No contractor was expected to produce monograph copy at the expense of the STR series which was his first obligation, and no contract was extended for the sole purpose of providing a monograph. Consequently, February 1, 1946, was set as a deadline after which no more monograph proposals could be received. This undoubtedly prevented the publication of a few monographs, but in terms of the general demobilization plan, this was inevitable.

The OSRD plans call for the purchase on behalf of the Government of some 400 copies of each monograph volume — 250 for the recipients of the sets of STR and 125 for deposit with the Library of Congress for its international exchanges. The Library of Congress was expressly requested not to use these in the national depository system, since any member library could purchase the books on the open market.

4. History. Neither the long nor the short history of OSRD was the responsibility of the Committee on Publications save in the single particular of arranging for its publication. Here the technique of the monograph series was used except that the OSRD contracted directly with the selected publisher. The so-called “short history” of OSRD was written by President James Phinney Baxter, 3rd, of Williams College, OSRD historian, and was published on November 1, 1946, under the title Scientists Against Time. The “long history” consists of the present volume on administration, two volumes describing CMR activities, one volume on OFS, and four volumes reporting the work of NDRC divisions and panels. The CMR volumes
include considerable technical detail, so that they serve some of the purpose of an STR. The decision as to the content of the NDRC volumes was left to the divisions concerned, subject to a check by the Office of the Chairman of NDRC as to security and public relations.

Conant delegated to Chadwell the responsibility for seeing that this was done. After the latter's resignation as Deputy Executive Officer of NDRC in April 1946, Farinholt looked after this activity with assistance from Miss Winifred Gosline. Chadwell, as Conant's personal deputy, continued to take an interest in the project, and presided at a two-day meeting the end of August, at which time members of the staff of the Chairman's Office discussed the manuscripts with respect to public relations.

By early November, when the manuscripts of nearly all the volumes were in the hands of the publishers, NDRC was relieved of further responsibility. Shortly before that time John S. Burlew, formerly Technical Aide of Division 1, had been appointed a Special Assistant to the Director to review the volumes and advise him as to their content. Then on Farinholt's departure Burlew was designated by the Director to handle on the latter's behalf all remaining matters relating to the publishing of the "long history," except those within the purview of the contracting officer.

5. **Official Government Popular Scientific Releases.** These were the reports issued by the Joint Board on Scientific Information Policy mentioned earlier. The Committee on Publications was cognizant of, but had no jurisdiction over, those releases.

6. **Contractors' Reports.** As a result of widespread declassification, a substantial number of contractors' reports became available for such public use as the supply would permit. In addition to the distribution to the Publication Board in the Department of Commerce and to the National Archives, OSRD was able in several important instances to collect up to twenty sets of these papers and deliver them to the Library of Congress for distribution to key libraries throughout the country. As a rule, OSRD also furnished the Librarian of Congress with a suggested distribution list which, however, was only advisory. Though many of these reports were ephemeral, they constitute a substantial addition to the scientific literature of the Nation, and their availability in many regional libraries is distinctly advantageous.

**Science — The Endless Frontier**

One OSRD publication deserves special mention here. On November 17, 1944, President Roosevelt sent Bush a letter asking for recommendations on the following four major points:

First: What can be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as pos-
sible the contributions which have been made during our war effort to scientific knowledge?

The diffusion of such knowledge should help us stimulate new enterprises, provide jobs for our returning servicemen and other workers, and make possible great strides for the improvement of the national well-being.

Second: With particular reference to the war of science against disease, what can be done now to organize a program for continuing in the future the work which has been done in medicine and related sciences?

The fact that the annual deaths in this country from one or two diseases alone are far in excess of the total number of lives lost by us in battle during this war should make us conscious of the duty we owe future generations.

Third: What can the Government do now and in the future to aid research activities by public and private organizations? The proper roles of public and of private research, and their interrelation, should be carefully considered.

Fourth: Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?

New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war, we can create a fuller and more fruitful employment and a fuller and more fruitful life.

Bush called upon four committees to assist him in preparing the requested recommendations. The first question was referred to the OSRD Committee on Publications, the others to special committees headed by W. W. Palmer (Professor of Medicine, Columbia University), Isaiah Bowman (President, Johns Hopkins University), and Henry Allen Moe (Secretary-General, John Simons Guggenheim Memorial Foundation), respectively. Drawing upon the work of these committees, Bush submitted his report on July 5, 1945. The report and the underlying committee reports were published by the Government Printing Office under the title Science—the Endless Frontier. It furnished the basis for one of the bills introduced in Congress for the establishment of a National Research Foundation.

Declassification

Executive Order No. 9568 provided a machinery for declassification but it did not exclude the possibility of OSRD working directly with the Army and Navy for declassification when that seemed appropriate. Thus, in July 1945, the OSRD recommended to the Army and the Navy that declassification of OSRD reports be accomplished by broad fields of research with attention being given where necessary to individual projects, contracts and reports.

By a memorandum of August 7, 1945, the divisions of NDRC were requested to forward as promptly as possible their recommendations for de-
classification by broad fields of research. When these had been received, and the declassification approved they were to be translated into terms of projects, contracts and reports. Initial recommendations for the declassification of certain fields were transmitted to the Army and Navy on September 25, 1945. The War Department Liaison Officer with NDRC promptly replied that his office was proceeding upon the basis of a reclassification by Army projects. Immediately thereafter, OSRD began to receive lists of projects for reclassification. The Navy, however, withheld its concurrence to the program.

A meeting on November 8, 1945, of representatives of the Army, Navy, and OSRD outlined a procedure for declassification which contemplated that the Services would indicate fields of OSRD information which might be declassified, either in general terms with specific exceptions noted, or by Service projects. The Services, NDRC, or the Publication Board might initiate requests for declassification of specific reports. It was indicated, however, that NDRC would expect to use this latter system only in unusual cases. The Army gave approval to the proposed procedure with a few minor changes. The Navy expressed agreement with the procedure in principle, but imposed such strict limitations and restrictions that there seemed to be little likelihood that much real progress toward declassification could be made.

In practice, upon receipt of the Army’s declassification of individual projects, the information was transmitted to the Division Chiefs by the project control section with the request that appropriate recommendations with respect to the declassification of related contracts and reports be submitted. The transmittal letter reminded the divisions of possible Navy interest in the declassified subject matter and cautioned against recommendations which would involve Navy projects not yet declassified. On the basis of the replies received from the divisions, a considerable number of contracts and reports were declassified.

While OSRD was proceeding with the declassification of Army projects and related contracts and reports, the Navy proceeded with the declassification of several lengthy lists of OSRD reports without reference to the related contracts or projects. Upon receipt of the Navy’s recommendations, OSRD declassified the reports. The fact that two different bases for declassification were used operated against an orderly program of declassification. In particular, the difference in the timing of the Army and Navy recommendations created gaps which were difficult to fill, in view of the rapid termination of NDRC divisions. The final task of reconciling the various recommendations and assigning proper classification to each project, contract, and report was a large one both for the divisions involved and the Administrative Office, with which they were still struggling when this was being written.

Information regarding OSRD material which had been declassified was
disseminated to the Publication Board and to interested persons in OSRD, the Army, and the Navy by means of periodic lists broken down by NDRC and CMR projects, contracts and reports.

OSRD was fortunate in its public relations, particularly in that it did not become embroiled in controversies with other agencies. Its limited publicity resulted in an unawareness of its existence by most people, but it enjoyed an excellent reputation among those who were acquainted with its accomplishments. The flood of scientific publication resulting from its efforts has hardly begun; it will be years before the appearance of the last paper which is the direct outgrowth of its activities. Although its part in the winning of the war was its greatest contribution, as well as the justification for its existence, the full impact of its work must await the judgment of the future as the civilian counterparts of its military developments begin to exert their influence upon life in the United States and in the world at large.
Part Four: Demobilization

CHAPTER XXI

DEMOBILIZATION OF OSRD

FROM THE OUTSET Bush had clearly in mind that NDRC (and later OSRD) would be a temporary agency and would go out of existence with the termination of the emergency which called it forth. The scientific personnel of OSRD had been recruited on the definite understanding that they would be released as soon as the emergency was over. The program of OSRD had grown so far beyond the original conception of NDRC that a substantial portion of the top scientific talent of the country had been drawn into the endeavor, and it was quite apparent that the reconversion effort following the end of hostilities would need much of the scientific talent embraced within OSRD.

Conant suggested to Bush on July 27, 1944, a plan for handling NDRC contracts essential to the war against Japan after the termination of European hostilities which then seemed to be approaching. He foresaw great difficulty in staffing the NDRC organization after the end of the war with Germany and an almost insurmountable staff problem during the period of liquidation following the end of hostilities with Japan. In his opinion, contracts after the close of the European war would, to a large extent, be concerned with procurement and manufacture of special equipment for the Army and the Navy and the servicing of this equipment and would involve almost no research and very little development work. Accordingly, he suggested that a new executive order be issued establishing a Joint Army-Navy Development Committee with power to take over and administer those OSRD contracts which in its judgment were essential for the further prosecution of the war, with OSRD liquidating all its contracts except those taken over by the new committee.

The Conant memorandum was circulated by Bush to the members of the Advisory Council on July 28, 1944, together with one of his own, putting the members on notice that at its next meeting the Council would approach the difficult problem of the matter and timing of OSRD's liquidation and the transfer of such of its functions as would continue into the peace. The Conant plan and a quite different one by Bush were discussed at considerable length by the Council at its meeting August 4, 1944. The members of the Council
appearing to be in general agreement with the principles outlined by him, Bush next sent letters to Bundy and Furer on August 8, 1944, putting a general program for the termination of OSRD before the Secretaries of War and Navy. The objectives of the program were to continue to render to the Services aid essential in the prosecution of the war until both enemies had collapsed; to make the transition to peace without confusion, and, consistent with the above, to give maximum assistance to reconversion and re-employment by releasing individual scientists, as war needs made such releases practicable, to take up technical problems whose solution was essential to orderly reconversion.

Bush made the following points as being pertinent to the plans for termination:

1. The scale of operation of OSRD was much larger than could be continued during peace on military research and plans for orderly cessation of part of it must be made.

2. Provision for continuance of fundamental research could best be made by transferring it to permanent organizations while the war was still going on.

3. As the war had proceeded, the nature of the work of OSRD had become more and more aimed at immediate application, which approached that normally carried by the Services themselves.

4. The transfer to the Services before the conclusion of the war of a considerable fraction of the research burden should accelerate the establishment of an appropriate organization to handle research within the Services.

5. There was a real danger that with the collapse of Germany a large number of the key personnel of OSRD would feel keenly their obligation to work on reconversion problems and that OSRD would find itself without adequate personnel to administer its expanded program.

6. While development of weapons of great potential importance should proceed at full speed until the end of the war, the number of new weapons of secondary importance already developed was probably greater than could be brought to bear effectively against Japan while the Pacific war lasted.

7. With the collapse of Germany scientific and technical men must pave the way for the employment of hundreds of men in reconverting industry to peacetime operations.

8. When the war with Germany ended, the Army should have an excess of personnel including men competent in scientific and technical fields.

9. In the plans for the termination of OSRD effort beginning with the collapse of Germany, no OSRD program genuinely needed or important in the war against Japan should be allowed to lapse or become stultified.

The plan for the orderly liquidation of OSRD, to become effective upon the collapse of Germany, called for dividing the work of OSRD into the following categories:
DEMOBILIZATION OF OSRD

1. Work which could not come to fruition in time to influence the course of the present war should be transferred to the Services, if they felt it was of sufficient importance to continue into the peace and if they were willing to continue it either in their own laboratories or by arrangements with permanent organizations; otherwise, it should be placed on a schedule of termination which would allow for final reports and the preservation of values already attained.

2. Active jobs on the final engineering of equipment about to move into service should be completed by the groups now doing the work. Any new work of this nature should be initiated by the Services themselves on their own contracts rather than by OSRD.

3. Work in OSRD central laboratories, such as those for microwave radar and countermeasures, should be transferred to the Services early in order that they might continue it during the war and make plans for the continuance of such parts as might be needed in time of peace.

Bush presented the above program to President Roosevelt in his report of August 28, 1944. By a note of September 29, the President indicated that he felt that Bush was on the right track and stated that he was referring the termination program to the Secretary of War and the Secretary of the Navy personally.

In the meantime Bush had sent a memorandum dated September 13, 1944, to the technical personnel of OSRD dealing with plans for the demobilization of OSRD. That memorandum emphasized that as long as the war with Germany lasted OSRD should proceed at full speed. He stressed that the memorandum was designed to initiate the preparation of a plan for demobilization, but that the plan was not to be put into effect until a specific day which he would set following the surrender or collapse of Germany. Planning and action on transfer and termination of certain projects must be so arranged that they would not delay or interfere with the rapid prosecution of projects usable against Japan.

The memorandum pointed out that the fall of Germany would materially alter the military picture. Some types of weapons needed in the German war would not be of equal importance in the war with Japan or would not be completed in time to be useful, and, therefore, research in some of the fields might well be transferred to the Services or terminated by OSRD.

He pointed out that termination of OSRD responsibility on NDRC projects meant termination of the project itself only in those cases in which the project was neither potentially usable against Japan nor of long-range continuing interest sufficient so that the Services were willing to take it over. NDRC personnel were expected to be willing to assist the Services by advice and consultation in connection with transferred projects to the extent that their advice might be requested and their time might permit. Projects were to be divided among the following classes:
Group 1

1. Projects which should be terminated after the defeat of Germany because there is neither a reasonable probability of their being usable against Japan (Group 2) nor are they of long-range continuing interest to the Services (Group 3). These should be immediately placed on a schedule of termination which will preserve values already attained, and provide for the rendering of final reports.

Group 2

2. Projects rated by the Services (and the rating reviewed by NDRC) as having an intrinsic value for use against Japan. These should be subdivided further into:
   (a) Those in which OSRD laboratory development can be completed in 3–4 months (or in exceptional circumstances 5–6 months). Such projects should be completed as rapidly as possible under existing OSRD arrangements. (b) Those in which OSRD laboratory development will require more than 3–4 months to complete. Such projects should be transferred to the interested Service.

Group 3

3. Projects (other than 2 above) rated by the Services as of sufficiently great importance to be classified as urgent, long-range, continuing, peacetime developments and which the Services are prepared to continue into the peace on some scale either by contract or within Service laboratories. Such projects should be transferred to the interested Service or to other postwar military research agencies.

The memorandum stated that after the defeat of Germany NDRC should recommend new projects, or the extension of existing ones, only in order to complete approved schedules of termination, or in cases where it could be clearly shown that a definite result could be obtained in the war against Japan under OSRD contract, which could not be obtained by direct Service contract.

CMR projects were placed in a slightly different category inasmuch as the need for medical work would continue after the end of the fighting. The time lag between the research on a new weapon and its introduction into combat made a reduction of research activity a logical step when the end of a war was approaching. There need be no such delay in the introduction of a new method of treatment of disease. CMR projects were to be classified according to the same schedule as NDRC projects, but it was anticipated that more time would be given to the termination of CMR work, a considerable proportion of which might effectively be taken over by the armed services and the Public Health Service.

The memorandum of September 13 recited that Bush had requested NDRC to supply him at an early date with a list showing the assignment of NDRC projects among the preceding groups and with the termination plans and schedules of each division and panel. These programs were to be prepared on the basis of discussion between OSRD personnel and Service
personnel with whom they worked, but no program was to be considered as definite until after it had been recommended by the NDRC as a whole and approved by the Director.

The memorandum was discussed by NDRC at its meeting on October 3, 1944. By that time it had become apparent that the divisions were having difficulty in classifying their projects under Group 2 because of the uncertainty as to the date on which the defeat of Germany would occur. The designation of those projects which would be completed in three or four months after the defeat of Germany would be quite different if that defeat were assumed for November 1944, than it would if it were assumed for July 1945. The point had purposely been left open by Bush who wished to avoid anything which might be taken as an estimate as to the exact date on which the collapse of Germany would occur. When NDRC attempted to apply the memorandum of September 13, it found its program closely tied to the assumption as to the date of the German collapse. In view of the need for having the divisions and panels prepare their recommendations on a uniform basis, NDRC had to make an assumption of the date when Germany would fall. The date assumed was November 15, 1944, which meant that projects in Group 2(a) would normally be those scheduled for completion before February 28, 1945, and those in Group 2(b) would be those scheduled for completion subsequent to February 28, 1945.

Later events proved the assumption to be wrong. Germany did not collapse about November 15; instead the Battle of the Bulge, which threw a part of the American forces into retreat, started December 16, 1944.

The Division and Panel Chiefs were instructed by NDRC on September 22, 1944, to prepare their termination programs in accordance with the Bush memorandum of September 13. At the same time the Committee instituted a more rigid control over the acceptance of new research projects submitted by the Services. While NDRC had maintained its complete freedom to accept or reject projects submitted by the Army and the Navy, in practice for over four years the decision of the Division Chiefs to accept projects (they rarely refused them) was not reviewed by NDRC, although it had reviewed recommendations of Division Chiefs that projects be refused. Beginning in October 1944, however, every new project was passed upon by NDRC as a whole, although it did permit the acceptance without such review of extensions of existing projects which involved merely the development of specific devices based on research already accomplished.

Bush requested the Secretaries of War and Navy each to name one man with whom he could discuss termination problems. The Secretary of War designated Brigadier General W. A. Borden, Director of the New Developments Division, and the Secretary of the Navy designated Rear Admiral Furer. Under date of September 5, 1944, General Borden informed Bush that while the War Department was in full accord with timely planning
it was apprehensive lest there be some relaxation of efforts before final victory was achieved.

On September 19, 1944, Senator Harry F. Byrd, as Chairman of the Joint Committee on Reduction of Nonessential Federal Expenditures, asked Bush a number of specific questions about the plans for demobilization of OSRD which Bush was able to answer promptly, as many of the points had been anticipated in his memorandum of September 13. Replying to a specific question, he stated that OSRD had no postwar plans inasmuch as the primary reason for its existence would disappear with the end of the war.

The Bureau of the Budget hopped on the demobilization bandwagon by a letter of September 23, 1944, calling for specific information as to plans for the termination of OSRD. In addition to sending the Bureau a copy of his memorandum of September 13, 1944, Bush replied to three specific questions in the sense of the memorandum.

Obviously, as OSRD activities were carried on principally through contracts, plans for the demobilization of OSRD were a matter of great importance to the contractors. The situation with respect to scientific manpower had been critical for a long time and the contractors were entitled to as much notice as possible of OSRD plans which might affect that situation. Recognizing this, on October 3, Bush outlined to all OSRD contractors his plans for the demobilization of OSRD. Again he emphasized that, while it was necessary to prepare plans, those plans would not be put into effect until after the defeat of Germany. He made no prediction as to when that defeat might come. On the contrary, he stated that the contractors should continue at full speed as in the past with no diminution of effort by reason of uncertainty as to the future. With that warning he informed the contractors that the OSRD staff had been requested to prepare plans to be put into operation soon after Germany's defeat and that in the preparation of the plans they would be in touch with the contractors. He told the contractors that the Army and Navy would continue to need their full co-operation in carrying on those programs which might be of long-range interest. He added that while the co-operation between the contractors and the Services must necessarily take a form which would be mutually acceptable to them, OSRD stood ready to be of assistance if needed.

Discussion of the OSRD demobilization plan occurred between OSRD personnel and Army and Navy personnel at all levels. The official Navy view was expressed in a letter to Bush from Furer on October 16, 1944, which stated the Navy opinion "that any abatement of interest and active participation in the administration and scientific effort of your organization will delay the final victory over Japan, and will therefore also result in additional loss of life in our forces." Furer maintained that the Navy could not without loss of tempo undertake those parts of the OSRD pro-
gram which it considered essential, in addition to its own programs, and that the Navy did not know how to arrange for the transfer of OSRD contracts without loss of time. To Bush’s point that if the Services did not learn in wartime how to streamline their procedures there was little prospect that they would do so in peacetime, Furer replied that “it appears to me that this is no time to place this additional burden upon the Navy.” He closed his letter with a statement of three principles which he hoped would be acceptable to OSRD and which in substance made the Navy the judge of what OSRD should do.

In his reply of October 28, Bush again emphasized that OSRD was planning and not terminating. He pointed out that scientists were aware of the time lag of about two years between the undertaking of wartime military research and its application on a large scale in practice, and that OSRD could not agree that the judgment of the Navy could properly be substituted for that which OSRD was required to exercise by the Executive Order establishing it.

As a result of this exchange of correspondence and a number of conferences the following principles governing the OSRD demobilization were agreed upon between OSRD and the Navy and accepted by the Army:

A. That the OSRD would continue the energetic prosecution of all projects which the Services and OSRD considered of value in winning the war with Japan, and which the Services were not in a position to take over without loss of effectiveness. Senior scientists, administrators, and key personnel should be retained even though the release of some of the less important workers might be expected if the load decreased.

B. That the OSRD should use its best efforts to retain sufficient OSRD and contractors’ personnel on any project of predictable value in the Japanese or German wars which was transferred to the Services or other supervisory agency.

C. That the OSRD should continue to accept new projects if the project involved would, in the opinion of the Services and the Director of OSRD, contribute to the winning of the present war and could be more expeditiously completed by OSRD than by the Services or other agency.

Copies of the demobilization plans of the divisions as approved by NDRC were to be furnished by Bush to Admiral Furer and General Borden for their comment before action on his part. The program for the formulation of demobilization plans was given a mixed reception by the divisions. The Radiation Laboratory operating under Division 14 was particularly disturbed at the suggestion that its activities should be curtailed. Preliminary discussion of the transfer of the Radiation Laboratory contract indicated that the Army and Navy organizations were so constituted that neither could successfully undertake such a contract on behalf of both, and that great difficulty would attend effort to set up a single contract for the Army
or Navy satisfactory to the relatively independent Services in the Army and Bureaus in the Navy interested in the operation of the Radiation Laboratory. By the time NDRC met on October 20, 1944, several divisions had submitted their demobilization plans; at that meeting demobilization plans were approved for Divisions 4, 5, 6, 9, and 10 for submission to the Director of OSRD. Not so with Division 14, however. When the Committee met on November 3, 1944, to discuss the demobilization plans for Divisions 14 and 15 two rear admirals and one captain from the Navy, a major general, a brigadier general and a colonel from the Army appeared before the Committee to argue against the formulation of demobilization programs for those divisions. The Service viewpoint was clearly expressed that OSRD should engage in an all-out effort on research right up until the end of the war on all fronts, even though it was obvious that under such a program many of the results would not accrue in time for use in the war then being waged. The suggestion that OSRD might step out of the picture in favor of direct contracts on the part of the Services received a cool reception.

A number of divisional demobilization plans were before the Committee at its meeting on November 3, but it was apparent that some of them had been drawn up on a misapprehension as to the Committee's intention. While the Committee had requested the plans to be prepared with a view to their being put into effect at a future date, some of the divisions had prepared plans to become effective immediately. Accordingly, the Committee took no action on the plans which had been submitted but decided to send out a revised statement of its intention.

One exception to this reservation of action was Division 12, which had felt for some time that it had completed the major part of its activity. That division presented a demobilization program independent of the over-all demobilization of OSRD calling for the termination of the division's activities by December 31, 1944. This plan was approved by NDRC on November 3 and subsequently referred by the Director of OSRD to the Army and Navy for their comments. After both had expressed their concurrence in the plan, Bush approved it on November 16, 1944. A limited amount of report writing made it impossible for Division 12 to terminate its activities as of the scheduled date, but it was in fact terminated as of June 30, 1945.

Division 6 presented a special case. In the race between the German submarine and the Allied antisubmarine activities, the Allies apparently had established a comfortable lead, and the division had for some time been concentrating its activities on the prosubmarine field for use in the Pacific war against Japan. The nature of the prosubmarine activities was such as to call for the closest possible co-operation with naval operations, and the research and development activities had progressed to the point where
they merged rather definitely with regular naval activities. Quite inde-
pendently of the over-all demobilization program for OSRD, discussions
had been under way for some time for the transfer of the entire Division 6
program to the Navy. NDRC on October 20, 1944, had approved the Di-
vision 6 demobilization program, and Army concurrence was forthcoming on
November 9, subject to Navy comments in view of the fact that the
division’s activities dealt almost wholly with naval matters. Admiral Furer’s
letter of November 8, however, indicated that while the Bureau of Ships
was making plans to take over those Division 6 activities which fell within
its jurisdiction, the Bureau of Ordnance was not prepared to take over its
part of the work, and the Navy therefore requested that NDRC continue
to handle that part of the activity until such time as another agency could
be obtained for the continuation of the work. In giving his approval to the
Division 6 demobilization plan, therefore, Bush did so with the understand-
ing that the division would bear in mind the problems presented by the
Bureau of Ordnance.

Action on the demobilization programs of other divisions was withheld
by the Director in view of the expressed intention of the NDRC at its
meeting on November 3 to clear up misunderstandings on the part of the
divisions as to the demobilization program. The next step in this clarifi-
cation was taken at the Committee’s meeting on November 17, 1944, at
which the Committee spelled out its intention in somewhat different words
but to the same purport as before.

During the time the demobilization program was under discussion the
Army and the Navy at the request of OSRD classified the various projects
which they had submitted to OSRD roughly in accordance with the plan
outlined in the Bush memorandum of September 13. These classifications
were communicated to the divisions responsible for the various projects.

At its meeting on January 12, 1945, the Committee recommended a de-
mobilization program for Division 19. It will be recalled that Division 19
worked primarily with the Office of Strategic Services which placed it in
a somewhat different category from the other divisions.

At its meeting on January 26, 1945, the Committee had before it the
detailed estimates from the divisions for the fiscal year beginning July 1,
1945, totaling $110,406,000. At the same meeting the Committee agreed
that it would recommend new contracts and contract extensions through
August 31, 1945, in appropriate cases. Prior to that decision the Committee
had limited its consideration of contracts and contract extensions to the
period ending February 28, 1945, in the absence of a strong showing by a
division that an extension beyond that date was needed.

On February 21, 22, 23 and 24, 1945, the Committee held extended
meetings to review the programs of the several divisions with their re-
spective Chiefs. This was followed on April 6 by the adoption of a tenta-
tive budget providing for a preliminary allocation of $78,250,000 among
the various divisions and panels.

The Committee took the first direct step to curtail the activities of the
Radiation Laboratory at its meeting on April 6, 1945. That laboratory had
reached the stage where the rate of expenditure (including funds trans-
ferred to OSRD by the Services for equipment produced in the laboratory)
approximated $4,000,000 per month. To support activity on such a scale
it was necessary for the contractor to make substantial financial commit-
ments considerably in advance of the date upon which materials were to
be delivered. The action taken was to put a ceiling upon the amount of
those forward commitments, but in doing so the Committee agreed that
upon request of Division 14, it would review the ceiling whenever the
division could show concretely that it would work undue hardship upon
the division in carrying out its program.

On May 7, 1945, Bush, in approving a resolution passed by NDRC,
made the following suggestions:

1. New projects should be undertaken only when (a) the subject work
could be reasonably expected to be completed as far as research and de-
velopment was concerned but not necessarily as to final reporting before
June 30, 1946, or (b) the Services had definitely indicated that they would
take over and the subject work could be placed in form for transfer prior
to that date.

2. In reviewing the division programs for the period following August 31,
1945, NDRC should note carefully the relation of each project to the cur-
rent war situation and provide an estimate of the date of completion of re-
search and development and the date at which the results of the project
might be expected to have an effect on the Japanese war.

3. For the present, there should be no extensions of contracts beyond
August 31, 1945, except that in the case of large central laboratories pro-
vision might be made for one additional month.

Before the Committee held its next meeting on May 18, 1945, Germany
had surrendered. On all new projects considered at that and subsequent
meetings the Committee adopted as a condition of its favorable action that
the conditions set by Bush on May 7 be met. Also at the May 18 meeting
Moreland reported that in response to a request from the Bureau of the
Budget, the Director, after consulting the Chairman’s Office, had agreed to
release $18,000,000 of current OSRD funds of which $15,500,000 was from
funds which had been set aside for use upon recommendation of NDRC
and the remaining $2,500,000 from similar funds for CMR.

On May 26, 1945, Bush addressed a further memorandum to NDRC
summarizing the policy governing the present consideration of the OSRD
program. He emphasized the essential soundness of the general policy an-
nounced in September 1944, and reiterated the obligations laid down at
that time. He suggested the assumption that organized resistance of the Japanese would have substantially ceased by the summer of 1947, which, in view of the inherent lag between research and actual field use, indicated that OSRD research and development on new weapons should terminate by June 30, 1946. Field service activities in the analysis of the use of new weapons and in their effective introduction into combat should continue, however, until the end of hostilities against an organized enemy. This point of view was concurred in by NDRC at its meeting on June 1 and communicated to the Division Chiefs for their guidance.

July 1, 1945, brought a new fiscal year with hostilities still continuing in the Pacific. At its meeting on July 7, 1945, NDRC adopted tentative divisional budgets for the period ending February 28, 1946, aggregating $35,606,000. Those budgets were recommended on a basis which contemplated that expenditures from March 1, 1946, to the end of the fiscal year would be at approximately 50 per cent of the rate through February 28, 1946. At the same meeting the Committee agreed to receive proposals from the divisions for new contracts and extensions of contracts to February 28, 1946.

The meeting on August 3, 1945, devoted considerable time to a discussion of the action which the Committee might take with respect to projects and contracts if the defeat of Japan should come unexpectedly. Definite decisions were postponed until the next meeting of the Committee. Recommendations were adopted for the extension of a large number of contracts to February 28, 1946, in view of the fact that they were presently scheduled to terminate on August 31, 1945, or less than one month from the date of the Committee meeting. Bush, Conant, and Tolman had been high in the councils on the development of the atomic bomb and knew that the stage was being set for the initial use of the bomb over Japan. Although the Committee adopted the recommendations for contract extensions, Bush delayed acting upon the recommendations except for a few urgent cases. When the bombing of Hiroshima and Nagasaki was followed after a short interval by the cessation of hostilities against Japan, Bush withheld his approval from the August 3 recommendations.

The atomic bomb was dropped on Hiroshima on August 6. On August 7, Bush sent a memorandum to the members of NDRC stating that the introduction of atomic bombs required a re-examination of termination plans. Japan surrendered on August 14.

On August 16 Bush informed NDRC and CMR that he would transmit to them the orders from the President regarding termination as soon as they were received. He suggested that the Committees prepare to put the presidential policies into effect by delegating most of the determination to the Executive Officer of NDRC and the medical administrative officer of CMR under the general supervision of the respective Chairmen and in
close contact with the Executive Secretary, leaving only important subjects to come before the full committees. Bush concluded the memorandum in the following fashion:

This memorandum gives me opportunity to remark on a very significant fact. The same civilian personnel that started in CMR and NRDC still remains. We have the same Executive Secretary. We started together and we finished together. I think there never was a more convincing evidence of harmonious teamwork.

Bush also wrote the President on August 16, 1945, outlining a program for the termination of OSRD for which he requested presidential approval. After pointing out that extensive scientific effort would need to be focused on the problems of reconversion and education, he outlined the following program:

A. Research on the instruments of warfare (carried out through the National Defense Research Committee).
1. Continue projects of long-term significance which should become the responsibility of a Foundation conducting, in part, research on military matters until such a Foundation is established, or until they are taken over by the Army or Navy, or until it becomes evident that neither provision for their continuance may be expected.

Continue other projects of a fundamental character only for a brief period to enable the armed services to take them over and incorporate them in their own programs if they so desire. This interval need exceed thirty days only under unusual circumstances.
2. Stop all other work on war weapons which does not appear to have long-term significance. It seems obvious that many weapons which are now near completion will be obsolete before another war would be likely to occur. Perhaps 90 per cent of the present OSRD program in the field of weapons will fall in this category. In the case of work on specific weapons of long-term significance the program should be handled as outlined above in (1).

In both types of cases provision will be made for adequate reporting of work already done in a form which will permit later investigators to take up the work at approximately the point where the OSRD may have discontinued. This work on reporting will need to continue beyond the time intervals indicated above.

B. Medical Research related to national defense (carried out through the Committee on Medical Research).

Much of the work carried on under the auspices of the Committee on Medical Research of OSRD has implications for civilian medicine and public health as well as for military medicine.
1. Transfer to the Services or terminate all research predominantly of military application, with the expectation that the military establishments will continue under their own auspices such part of the program as they may find desirable.
2. Transfer to the Public Health Service that part of the CMR program which
has utility outside the military field and properly within the field of activities of the Public Health Service.

3. Transfer to the auspices of private foundations or private research groups, or to such new governmental agency as may be established, medical research not to be continued under either military or Public Health Service auspices.

I am hopeful that the more significant parts of the OSRD program in the medical field can be handled in one of these ways. Those parts which cannot be so handled, I would propose to schedule for completion not later than February 28, 1946. In the event that a permanent research agency has not been established by February 28, 1946, the OSRD medical projects of greatest long-term significance will not be terminated without a re-examination with you of that policy. In all cases provision will be made for adequate reporting of work already done.

C. Field Service activities.

OSRD had rather extensive operations in the field in close co-operation with the military services. These operations should be discontinued and the men in the field called home as speedily as the transportation situation in the various areas permits, except for a few special instances where valuable work remains to be done for the Services. In these few cases the field service work will be transferred to the auspices of the Services if this proves to be possible.

D. Interchange of scientific information with the British, which has been active in all areas, should continue until the end of the program or until instructions are received to the contrary.

Bush pointed out that the program outlined did not cause a gap between the war research activities of OSRD and the scientific research activities to be undertaken by the National Research Foundation, the establishment of which had been recommended a short time before. Most of OSRD's later efforts had been devoted to the development of weapons rather than to fundamental research. With the changing art of modern war, the new Foundation should take a fresh start and not merely continue research which happened to be under way at the time of its organization. Bush observed that research on atomic energy had been transferred from OSRD to the War Department sometime previously.

The President did not endorse this program for termination but wrote instead, "I am reluctant at this time to see the liquidation of the greater part of the organization which, under your leadership, has contributed so brilliantly to the winning of the war." The President thought that it would be unfortunate to break the continuity of supervision of actual research work essential to the success of any scientific project. In his view it would be desirable to maintain in their present status those major projects under OSRD control until Congress actually established a permanent Federal research agency. The President suggested that if it should appear that Congress did not intend to establish a science foundation, he would consult further with Bush as to the appropriate distribution of projects in progress. He suggested that a number of the projects which
OSRD desired to abandon or transfer to other Government agencies might be treated as suggested by Bush under the general policy outlined by the President. He asked that a detailed analysis of the proposals be submitted to the Director of the Office of War Mobilization and Reconversion (OWMR) with the expectation that OWMR and OSRD could agree as to many of the dispositions which Bush proposed.

Following the President's letter, John W. Snyder, Director of OWMR, designated one of his aides, James R. Newman, to discuss the demobilization program with OSRD. Newman met with NDRC on August 24, 1945, at which time there was a thorough discussion of the actual status of the NDRC program, in which the Committee emphasized that due to the shortage of scientific manpower its program for months had been concentrated upon the later stages of weapon development to such an extent that only a bare minimum of fundamental research of the type which a research foundation would wish to support remained. The Committee adopted the following four categories of NDRC-recommended OSRD contracts for purposes of termination:

A. Basic research of such nature as to fall properly within the scope of a peacetime governmental research agency supplementing the work of the Services on military research. Specific fields shall be described in connection with division programs. Continue under NDRC until taken over by permanent agency or other disposition is determined.

B. Research or development projects essentially completed where limited further work will permit completion and preservation of values. Continue as determined in each case but not beyond December 31, 1945, and generally not beyond October 31, 1945.

C. Research or development projects of long-range significance, generally concerned with specific weapons, which the Services may wish to take over and continue in Service laboratories or under contract. Continue to give reasonable opportunity to complete arrangements for transfer, but generally not beyond October 31, 1945.

D. Development work on specific devices or weapons not having long-range implications, servicing new weapons, and aid to the Services on current military problems. Terminate promptly with every effort to complete final technical reports by September 30, 1945. Continuation beyond that date to be authorized only in special cases to permit completion of technical reports.

Davidson and Stewart were authorized to classify the various contracts into the four approved categories in consultation with the Division and Panel Chiefs concerned. Davidson immediately got in touch with the Division Chiefs by telephone and telegraph and an initial listing of contracts was submitted to the Director on August 28, 1945. Following the Director's approval of the division of contracts among the several classifications, Davidson and Stewart discussed the schedules with Newman
on August 29. Approval of the schedule was given by the Director of
OWMR on August 31, 1945. A comparable schedule of CMR projects was
approved by OWMR on September 18. The final outcome closely approxi-
mated that suggested in Bush's letter of August 16, 1945, to the President
outlining Bush's plans for the termination of OSRD.

Copies of the approved demobilization schedule for each division and
panel were sent to the Division and Panel Chiefs, and except for minor
modifications necessitated by the speed with which the original schedule
had been drafted, were put into effect. At its meeting on September 14,
1945, the Committee formally approved the action which had been taken
since its last meeting and about which the individual members of the
Committee had been apprised as it was being taken.

The demobilization program for NDRC was carried out with only slight
variations from the plan originally approved. This was facilitated by the
fact that most NDRC contracts still carried an August 31, 1945, termina-
tion date when Japan surrendered. Most of them either were allowed to
expire on that date or were given a thirty-day extension to cover the filing
of reports. Work of continuing importance was carried until October 31,
or in a few cases for a slightly longer time, in order to let the Services
make arrangement for its continuance under other contracts or in their
own laboratories. The limited amount of fundamental research on weapons,
continued under OSRD auspices pending the creation of a research foun-
dation, was at the rate of approximately $1,000,000 per year. Except for
that, the total NDRC activity after January 1, 1946, was concentrated on
report writing and upon the details of closing out a going concern.

**Termination Plans for Medical Research**

The first discussion of demobilization plans by CMR occurred at the
meeting on August 3, 1944, when Richards reported that the Advisory
Council at its meeting the next day was to consider future plans for OSRD.
Although the Committee adopted no formal expression of opinion, the con-
sensus was that upon the termination of OSRD provision should be made
for the continuance of some of the fundamental research projects being
sponsored by the CMR; that some of the contracts should be turned over
to the Army, the Navy and the Public Health Service; and that an effort
should be made to advance each CMR-sponsored project to the point at
which it could be most advantageously turned over to other Government or
private agencies.

Discussion was renewed at the next meeting of the Committee on Au-
gust 17, 1944. Admiral Smith indicated that while the Navy might take
over some projects, it would not take over OSRD contracts. General Sim-
mons expressed vigorous opposition to any plan to discontinue the activities
of CMR prior to the end of the war with Japan or even prior to the expiration of six months after the conclusion of that war if that should be necessary. The transfer of large masses of troops from the European to the Asiatic theater would add to the medical load, and the War Department did not have the organization nor the manpower to administer contracts as the CMR had done. Dyer expressed the view that the Committee should continue to the end of the war, but he indicated that there would be no legal obstacle to the transfer to the Public Health Service at the proper time of projects appropriate to its functioning. The members of the Committee were in agreement as to the importance of the establishment of some Government agency for dealing with problems of postwar medical research.

Under date of August 29, Dyer wrote Richards at considerable length outlining the manner in which Public Health Service could take over projects in its field from CMR and administer them through an organization which would have the flexibility of the CMR organization and to a considerable extent might draw upon the same personnel as CMR. This letter was communicated to CMR at its meeting on August 31.

By a memorandum to Richards on September 18, 1944, Bush requested him to begin the formulation of plans for the termination or transfer of work being carried on under CMR auspices. He referred specifically to the letter sent by Dyer to Richards on August 29.

At its meeting on September 21, 1944, CMR discussed at some length Bush’s memorandum of September 13, on demobilization. Division Chiefs were instructed to present their recommendations with respect to the allocation of CMR contracts among the categories laid down in the Bush memorandum. It was the general feeling of the Committee that plans should be made which would permit it to go out of existence as soon after the end of the war with Germany as arrangements could be made for the effective transfer of important contracts to other agencies.

With the adverse turn of events marked by the beginning of the Battle of the Bulge, Richards sought further guidance from Bush, which was forthcoming in a letter of December 20, 1944, in which Bush mentioned briefly the various proposals which had been made for a postwar health program. He reaffirmed that OSRD would continue to exert its full energy as long as the war in Europe lasted and that after the collapse of Germany it would continue such efforts as might be needed for the effective prosecution of the war against Japan. In general, the CMR program should be to continue military research needed specifically in the conduct of the present war, while at the same time steps should be taken to facilitate its gradual transition into peacetime arrangements at an appropriate time. Following consideration of this letter at the meeting on January 18, 1945, the Committee instructed the Division Chiefs that they
might present proposals for contracts to run beyond June 30, 1945, in cases falling within the spirit of the Director's letter.

General Simmons on January 17, 1945, wrote Richards to express the strong desire of the Surgeon General that no step should be taken which would serve to constrict the field of responsibility of CMR or to limit its activity until the war ended and medical problems had become less urgent. As long as fighting continued, the Medical Department of the Army would not have the facilities or the scientific and administrative personnel to take over and continue at a high level of competence the type of research being conducted by CMR. Any plan to transfer contracts to the Medical Department would result only in loss to the Army. In presenting the letter to the CMR at its meeting on February 1, the Chairman pointed out that the Director's instructions with reference to transfers specifically stated that the transfers were to be effected only where this was possible without loss of effectiveness.

For some time Bush was concerned about the possibility that with the successful outcome of the war against Germany there might be so many resignations from the voluntary and paid staff of OSRD that the effective supervision of contracts would be imperiled. Accordingly, on February 23, 1945, he addressed a memorandum to Conant and Richards asking them to bear this possibility in mind. He asked that they assure themselves in connection with programs submitted for his approval that adequate personnel would be available in each division and in the Offices of the Chairmen to insure the carrying out of the obligations to be undertaken. In presenting the memorandum to CMR on March 1, 1945, the Chairman stated that he had discussed it with the Division Chiefs and was convinced that there would be no difficulty in carrying out the views stated in the memorandum.

The emphasis upon the temporary character of OSRD activities and the limited extensions of contracts which were granted as a matter of policy in order to keep CMR in a fluid state caused considerable restlessness on the part of contractors' personnel, who preferred to work under conditions permitting more long-range planning. The situation was reviewed by the Division Chiefs who expressed their views to the Committee in a memorandum dated May 16, 1945. They felt that the pattern of CMR activities had been well conceived and that the organization could provide an equally important service in time of peace. However, they believed that the interest of long-range medical research and of investigators and institutions was not likely to be well served by a succession of short-term extensions of CMR contracts. They had therefore reviewed the CMR contracts to determine which would be likely to have an additional value in military medicine by December 31, 1945. Finding only a small number which promised such results, they recommended that on or before De-
December 31, 1945, all OSRD contracts entered into on CMR recommendation be discontinued or transferred to other Government agencies together with funds to provide for their continuation until June 30, 1946. The Committee discussed this memorandum on May 17. In view of the uncertainties as to the agency which might succeed to CMR-recommended contracts, members of the Committee doubted the feasibility of the recommendation for transfer prior to December 31, 1945.

Following the end of the European war, Bush addressed another memorandum to the CMR on June 4, 1945, repeating that the affairs of the Committee should be kept in a “fluid condition” with CMR prepared to terminate some contracts and to transfer others. He set December 31, 1945, as the date beyond which CMR contracts would not presently be extended.

Following the end of hostilities with Japan and in line with the President’s request for information on specific programs, Bush sent Richards a memorandum on August 24, 1945, requesting Richards to give him a summary of CMR projects with proposed plans for their handling. He indicated that the plans should be prepared in accordance with these principles:

1. Medical research of predominatingly military application should be transferred to the armed services or terminated.

2. Research programs with an important value apart from the military field, which were properly within the scope of operations of the Public Health Service, and which that Service was willing to undertake with the expectation of continuing as long as the results and the public interest justify continuance, should be transferred to the Public Health Service together with funds which had been budgeted for their continuance during the current fiscal year.

3. Research programs with an important value apart from the military field and which could best be conducted by private research groups should be transferred to them as far as they were willing to accept responsibility for them.

4. Research programs of substantial potential value which could best be furthered under the auspices of a federal agency, a part of the program of which was support of medical research, should be continued for the present in the expectation that such a federal agency would be created by Congress. At present, continuation for this purpose would not be provided for beyond February 28, 1946.

5. Programs not coming under any of the above should be placed on such a basis that a completed piece of work would have been accomplished not later than February 28, 1946. If the program was of such a nature that this could not be done, steps should be taken for a prompt termination.

The Division Chiefs and the Committee proceeded promptly with the classification of contracts in accordance with the Director’s instructions;
and at its meeting on September 6, 1945, the Committee adopted a schedule assigning each of its contracts to its proper place in accordance with the Director's instructions. The Director transmitted the schedule with his approval to the Director of OWMR, who in turn approved the program without change. Under the program, most CMR contracts were permitted to expire at their December 31, 1945, termination date. Many of them were replaced by contracts negotiated by the Public Health Service effective January 1, 1946, using funds appropriated by Congress for the purpose. A number of contracts were transferred to the Surgeon General of the Army by a tripartite agreement among the OSRD, the Surgeon General, and the contractor. Because of its complexity, that portion of the antimalarial program involving clinical testing of new potential antimalarials was left under CMR control with the distinct understanding that it would be completed not later than June 30, 1946. A limited amount of research of a fundamental character was continued by the Committee in the expectation that it would be turned over to the National Research Foundation upon its establishment; the cost of this program was of the order of $250,000 annually.

**Transfer of Contracts**

To implement the OSRD demobilization plan, its legal division was requested to devise a procedure under which long-range developments could be transferred to the Services with a minimum of delay and administrative detail. In collaboration with the Army and Navy, OSRD attorneys worked out a three-party instrument of assignment which was drafted in the form of a supplement to the basic OSRD contract concerned. This assignment provided, in brief, for the transfer to the interested Service of all OSRD's rights, powers, responsibilities and obligations under the basic contract, the assumption by the interested Service of such rights, powers, responsibilities and obligations, the consent of the contractor to such transfer, and the release by the contractor of OSRD, its officials and employees from further responsibility with respect to the contract.

Specifically, this meant that on and after the effective date of the transfer, the Army or Navy would undertake to process all unpaid vouchers, settle or otherwise dispose of all outstanding claims, exercise all rights theretofore vested in OSRD to require (a) interim and final technical reports, (b) invention disclosures, reports and records, (c) property accountings and inventories, and would direct the use and ultimate disposition of all contract property both real and personal in which the Government had a vested interest. In other words, the receiving Service would, in effect, step into the shoes of the OSRD and carry forward to completion all business unfinished at the date of the transfer. Unspent contract funds
were to be transferred to the receiving Service to support the contract.

The principal reason for using this simple contractual mechanism was that it avoided interruption of the progress of the actual research work. The first two tripartite supplements assigning contracts to the Quartermaster Corps of the Army and to the Bureau of Ships of the Navy, were executed in strict conformity with the principles set forth above. Subsequent transfers to the Bureau of Ships, the Bureau of Personnel of the Navy, the Signal Corps of the Army, and the Office of Strategic Services modified the standard tripartite supplement to the extent that the receiving Service undertook to reimburse the contractor for only such expenditures as were made by him subsequent to the effective date of transfer, leaving OSRD to make reimbursement with respect to all expenditures incurred prior to the date of transfer.

The Bureau of Ordnance of the Navy declined to participate in tripartite assignments of contracts in which it was interested. Thus in the case of practically all Section T projects taken over by the Navy, the OSRD contract was allowed to expire according to its terms, and a new contract was then written between the Bureau of Ordnance and the contractor. This method of transfer was not without special problems, however. It often happened that the OSRD contractor had altered his facilities for the purpose of conducting OSRD work and that he wished to use the altered facilities under the Navy contract without losing the privilege of having the premises restored to their original condition at Government expense. The Bureau of Ordnance wanted the contractor to continue to use materials and equipment purchased under the OSRD contract, but it was unwilling to assume responsibility for that material and equipment without an inventory which could be made only at the expense of considerable loss of time on the project to which Ordnance was opposed. Furthermore, if the Navy accepted motor vehicles purchased under the OSRD contract, they would become Navy property and would be placed in the Navy motor pool with little chance of being made available to the contractor.

After protracted negotiations between OSRD attorneys and attorneys for the Navy, it was decided that these special problems could best be resolved by a limited tripartite agreement under which (a) the Navy would take over OSRD's obligations with respect to bearing restoration costs, subject to a definite ceiling on Navy's liability; (b) the contractor would release OSRD from such obligations; (c) the Navy would assume blanket accountability for all expendable items on hand without inventory, and (d) legal title to all motor vehicles would be left in the contractor subject to ultimate disposition at Navy direction.

Where the property situation was not complicated by the existence of these special factors, transfers were handled by having the Navy accept accountability for all capital items as listed on inventories certified to by a
Navy Matériel Inspector, and execute a blanket receipt for all expendable items which might be in the possession of the contractor without any inventory thereof being made. Ten transfers were made under tripartite agreements, while seven transfers were handled on the above basis.

In general, as the end of hostilities approached, the Services became more reluctant to accept OSRD contracts by transfer. Therefore, OSRD contracts were allowed more and more to expire in accordance with their termination dates, and the Services undertook to write their own contracts for the continuation of the projects.

Pursuant to the CMR demobilization plan forty-two CMR projects were transferred to the Public Health Service. In each case the OSRD contract was allowed to terminate and a new contract to take its place was executed between Public Health Service and the contractor concerned.

Twenty-three contracts in the medical field were transferred to the Office of the Surgeon General of the Army. Transfers were accomplished in each case by use of the standard tripartite supplement of assignment, except that OSRD agreed to reimburse the contractor for all expenditures incurred prior to the date of transfer and undertook to secure from the contractor technical and invention reports with respect to all work performed up to the transfer date.

**Plans for a Successor Agency**

Recognizing the desirability of a continuing participation by civilian scientists in military research and accepting the fact that OSRD would go out of existence shortly after the end of the war, the Secretaries of War and the Navy established, on June 22, 1944, a Committee on Postwar Research under the chairmanship of Charles E. Wilson, Vice-Chairman of the War Production Board. The Committee was charged with studying the postwar research and development needs of the armed services and recommending a plan for meeting those needs. It recommended the creation within the National Academy of Sciences of a Research Board for National Security composed in approximately equal parts of civilian scientists and military men, with the latter consisting of equal numbers from the Army and Navy. This Board could start functioning without delay, it could be financed by transfers from Army and Navy appropriations until Congress could make appropriations directly to the Board, and when Congress was ready to set up a research organization on a permanent basis, all or any desired part of the Board’s organization could be transferred to the new agency.

The Wilson Committee report was accepted by the Secretaries. At their request the Academy set up the proposed Board which was ready to function until it was completely blocked by the refusal of the Bureau of the
Budget to permit the transfer of funds to support its activities. Bills were then introduced in Congress to establish the Board on a statutory basis, but there was no real effort to get action because of the expectation that legislation to support scientific research on a broader basis might soon be considered by Congress.

Two bills to effect this were introduced in the Senate. The first (S. 1297, 79th Congress), by Senator Harley Kilgore of West Virginia, had gone through several revisions; it proposed, among other things, the creation of a National Science Foundation, one of whose duties would be the promotion of military research. The second (S. 1285), by Senator Warren Magnuson of Washington, was based largely on the Bush report entitled *Science—the Endless Frontier* and was designed to carry out the recommendations in that report. Among other things, it proposed a National Research Foundation, with a division devoted to military research. The bills differed in a number of important respects, but finally after joint hearings on the two bills a compromise bill was worked out (S. 1850) which was approved by the supporters of both the Kilgore and Magnuson bills. The OSRD and its constituent committees were to be transferred to the National Science Foundation under the compromise bill. The compromise bill passed the Senate, but Congress adjourned while the bill was still before a committee of the House of Representatives.

OSRD was created to do an important but temporary job. The organization was built on a temporary basis, drawing upon the best available men for relatively short periods of time without disturbing their regular academic or industrial connections in most cases. This was possible largely because of the pressure of impending and actual war which made men available whose services could not have been obtained on any comparable scale in normal times. The leaders of OSRD were always keenly conscious of this fact, which, however, completely escaped many people on the outside who, seeing the success of OSRD, called for its retention into peacetime. There was never any chance that this could be done. Once the pressure of war lifted, the key men upon whom its success depended responded to the more urgent calls of their regular activities and not all the king’s horses nor all the king’s men could hold the group together. While the name and a shell of an organization could be passed on, OSRD as it operated during the war definitely ceased with the end of hostilities. Had the inevitability of this fact been appreciated in high quarters, the question of a successor might not still be open at this late date.
CHAPTER XXII

RETROSPECT AND PROSPECT

The Office of Scientific Research and Development was highly successful in assisting the armed services by research on and development of weapons and in the field of military medicine. In part at least this was due to the fact that it operated at first under the shadow of an impending war and later under the pressure of war itself. This was, of course, a favorable circumstance for the type of operation in which OSRD was engaged for it meant that the best scientific talent of the country was available, without question and without qualification.

When it started in June of 1940, NDRC’s conception of its task was essentially a modest one. It was to engage in research designed to produce new and improved weapons of warfare. While the charter of the Committee would have permitted a broad interpretation of the Committee’s field of activities, a relatively narrow interpretation was adopted at the outset and maintained with reasonable consistency. This permitted a high degree of concentration in the field which the Committee marked out for itself.

The Committee was not as successful in limiting its activities to research. The original assumption was that the Committee would engage in research which would establish the practicability and usefulness of a weapon or an instrument and that further development would be carried on by the Services. In practice, research tended to merge into development. Further, the Army and the Navy were in the midst of a program of tremendous expansion which required that the major attention be devoted to recruiting and training personnel and to obtaining the large quantities of equipment which could be had only through standardization for large-scale production. They were too busy to take over the results of research programs and carry them through the development stages. It was difficult to arouse interest in an idea until it had been converted into something tangible, complete, ready for demonstration and use. With the creation of OSRD, development was added to research; and with the passage of time an increasingly large amount of attention was devoted to the developmental stages of ideas which had successfully emerged from the research stage.

Even with the completion of development OSRD was unable to withdraw from some programs. The Services were geared to mass production and never succeeded in developing an easy procedure for the procurement of a few devices to cover the period before the production lines could begin to
produce in large numbers. Yet there were cases where a limited number of devices put into use before the mass-produced type was available could be of critical importance. This fact forced a further considerable expansion of the OSRD program into the field of so-called "crash" procurement. As an illustration there may be mentioned the equipment for blind bombing through overcast. The Radiation Laboratory under OSRD auspices completed the research on and development of a device enabling bombers to locate their targets through clouds and overcast which would make visual bombing impossible. The armed services were enthusiastic about the equipment and placed orders for substantial quantities. In the interval before the first of the mass-produced pieces of equipment came off the line, the Radiation Laboratory under OSRD's direction produced twelve sets of equipment. The use of these through the winter of 1943-1944 permitted a larger number of bombing missions and so added a sufficient increment to the damage inflicted by the bombers to carry the bombing program over the hump by inflicting serious damage on German industry from which it was not permitted to recover.

The growth in the program incident to the expansion of the NDRC and OSRD fields of activities is indicated by the change in dollar volume of operations. Thus the amount of money obligated by NDRC and OSRD largely through contracts and through transfers of funds to Government agencies for the several fiscal years was as follows:

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940-1941</td>
<td>$6,161,691.00</td>
</tr>
<tr>
<td>1941-1942</td>
<td>$39,626,839.97</td>
</tr>
<tr>
<td>1942-1943</td>
<td>$142,454,422.35</td>
</tr>
<tr>
<td>1943-1944</td>
<td>$162,513,597.74</td>
</tr>
<tr>
<td>1944-1945</td>
<td>$167,473,101.09</td>
</tr>
<tr>
<td>1945-1946</td>
<td>$17,854,315.33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$536,083,967.48</strong></td>
</tr>
</tbody>
</table>

While the greater portion of this amount was spent for weapons within the field of NDRC operations, $24,689,899.42 was devoted to medical research, $13,041,037.57 to atomic energy (including $920,650.00 while NDRC had jurisdiction of the subject) and approximately $26,400,000 to Section T activities, mostly proximity fuzes for shells. The greater part of it was obligated by contracts, which numbered 2515 on December 31, 1945, distributed as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDRC</td>
<td>1506</td>
</tr>
<tr>
<td>CMR</td>
<td>568</td>
</tr>
<tr>
<td>Atomic energy (where not included in NDRC)</td>
<td>102</td>
</tr>
<tr>
<td>OFS (company contracts)</td>
<td>17</td>
</tr>
<tr>
<td>OFS (personal service contracts)</td>
<td>237</td>
</tr>
<tr>
<td>Section T</td>
<td>62</td>
</tr>
</tbody>
</table>
Committee on Sensory Devices 7  
Special agreements, e.g., space, overhead 16  
Well over 5700 supplements had been executed  
to these 2515 contracts by the same date.

The submission of formal requests from the Services for OSRD assistance is not a proper index of the work done for them as many projects were initiated by OSRD with part, but not all, of them later covered by Service request, and for the further reason that requests varied widely in their scope and the magnitude of effort required to meet them. Because of the way in which CMR work originated, there is no ready method of tabulating Service interest in the origin of its programs. The records of the project control section, however, show the following distribution by origin of project requests accepted by NDRC:

<table>
<thead>
<tr>
<th>Army</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Corps</td>
<td>231</td>
</tr>
<tr>
<td>Coast Artillery Corps</td>
<td>7</td>
</tr>
<tr>
<td>Corps of Engineers</td>
<td>36</td>
</tr>
<tr>
<td>Chemical Warfare Service</td>
<td>30</td>
</tr>
<tr>
<td>Quartermaster Corps</td>
<td>39</td>
</tr>
<tr>
<td>Signal Corps</td>
<td>224</td>
</tr>
<tr>
<td>Services of Supply</td>
<td>12</td>
</tr>
<tr>
<td>Ordnance Department</td>
<td>97</td>
</tr>
<tr>
<td><strong>Total Army projects</strong></td>
<td>676</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Navy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of Research and Development</td>
<td>23</td>
</tr>
<tr>
<td>Aeronautics</td>
<td>124</td>
</tr>
<tr>
<td>Coast Guard</td>
<td>1</td>
</tr>
<tr>
<td>Deputy Chief of Naval Operations for Air</td>
<td>2</td>
</tr>
<tr>
<td>Emergency Rescue Equipment Section</td>
<td>4</td>
</tr>
<tr>
<td>Naval Research Laboratory</td>
<td>38</td>
</tr>
<tr>
<td>Medicine and Surgery</td>
<td>1</td>
</tr>
<tr>
<td>Naval Ordnance</td>
<td>220</td>
</tr>
<tr>
<td>Naval Personnel</td>
<td>3</td>
</tr>
<tr>
<td>Commander in Chief, Readiness Division</td>
<td>12</td>
</tr>
<tr>
<td><strong>Ships</strong></td>
<td>264</td>
</tr>
<tr>
<td><strong>Total Navy projects</strong></td>
<td>692</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Joint Army-Navy</th>
<th>29</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grand Total</strong></td>
<td>1397</td>
</tr>
</tbody>
</table>

The records also show that 231 Service requests were not accepted by NDRC. While many of these were declined because of competing demands for manpower, or because they did not appear possible of completion in
time for use in the current war, many others were rejected for the purely formal reason that the work desired was already under way in connection with some other request.

Shortly after its establishment NDRC discovered that there were areas in which the Army and the Navy did not exchange information. Faced with a common problem, each Service worked out its own solution, and in some cases declined to apprise the other of that solution. The most probable reason for the refusal to exchange information in certain fields was the feeling on the part of the more advanced Service that the less advanced would not keep its secrets. NDRC did not conceive its mission to be the funneling of information from one Service to the other. As a result of NDRC operations, however, many barriers to a complete interchange of information between the Services were lowered. This was brought about usually by the willingness of that Service which was behind in a particular area to seek advice and assistance from OSRD. Concentration upon the problems of the lagging Service enabled OSRD to help bring it abreast or ahead of the other Service and thus break down the reluctance to exchange information.

The degree of independence of each other enjoyed by the various Bureaus of the Navy and Services of the Army made it appear at times as if there were as many armies and navies as there were bureaus and services. In some cases there was an underlying resentment of the intrusion of a group of civilians into an area theretofore reserved for men in uniform. In such matters as failure to provide necessary test facilities a non-co-operating Service could make it extremely difficult for OSRD to function effectively. At the other extreme, there were some Bureaus and Services which were almost embarrassingly co-operative. Not only were they glad to turn projects over to OSRD, they were even reluctant to see OSRD withdraw from the picture when its proper job had been completed. This took the form of an insistence that OSRD, having completed its development work, could better produce or procure the end item than could the requesting Service and a consequent insistence that OSRD remain active in the field although its primary function had been completed.

It will be interesting to see what permanent contribution to the Services will result from the OSRD experience. In the midst of war it is natural that, because of their preoccupation with the operations of the war, the armed services should not undertake to reorient their thinking on research and development. With the cessation of hostilities the pressure for improvement is removed, and inertia coupled with the resistance of officers who believe that the existing system is best makes change extremely difficult. When the period of inevitable reduction in the amount of money available for the military services actually arrives, there is a fair chance that the officers in charge of research and development will concentrate upon protecting the operations in their own laboratories or otherwise within their close control,
and that plans for effective civilian assistance in the development of new weapons will be one of the first items dropped in a program of retrenchment. The proposal for a National Science Foundation independent of the Services with a division devoted to research on weapons carries the greatest promise of effective civilian assistance in the field by assuring funds free of Service control.

Based upon OSRD experience, there are certain points to which persons interested in future research on weapons and in the field of military medicine should give careful consideration. The more important of these as they appear to the author will be mentioned briefly.

Organization for research within the Services. If, unhappily, there should be another war, there should be no need for another OSRD. It will be needed only if there is a large deficit of military research such as existed in 1940. With the experience of World War II behind them, our military leaders should not permit that to happen. But if it is not to happen, there should be more adequate research within the Services and a more adequate use made of civilian research by the Services in the years immediately ahead.

As a first step the Army and the Navy should give research recognition at the highest levels. The Army, including the Air Force, should have all of its own research programs co-ordinated with each other, reporting through a single office and co-ordinated with strategic planning. The Navy should be similarly organized. While the mechanism would be dependent upon the eventual form of defense organization in the United States (one, two, or three departments), these research programs in their turn should be co-ordinated with each other after consideration of the possible requirements of grand strategy. Competent civilian participation should be provided at all levels, for no military man can be assumed or expected to have the competence to assess the possibilities of the contributions of the various fields of science to the military picture.

Service laboratories should continue to make their important contributions to military research, but they should not be permitted to monopolize or dominate the field. For one thing they cannot do the whole job which needs to be done, the scientific talent available to them (in or out of uniform) is not comparable to that in civilian laboratories, and the failure to make adequate use of civilian facilities in peacetime will mean the loss of valuable time if it becomes necessary to use those facilities in an emergency.

The manner in which the Services organize themselves for research will greatly influence the way in which civilian scientists should be brought into the picture. Assuming the plan suggested above (co-ordinated research programs within and between the Services), a joint civilian-military committee within the framework of the armed services could effect the co-ordination of civilian with military research much as OSRD did, but upon a continuing basis. This committee could plan within whatever appropriations were
available to it so that rapid expansion in the use of civilian research facilities would be possible without loss of time if it should become necessary.

The remarks on the succeeding pages will hold regardless of the form adopted for the organization co-ordinating and directing research, although the phraseology in which they are expressed might be different if that form were known at the time of writing.

*Scientific advice at a high level.* In preparation for modern war it is essential that the possibility of new weapons be considered in strategy; that from the very first, persons with adequate and continuing background in science participate in strategic planning. The plans should be made in the light of what is possible today or may be possible tomorrow, not in the light of what was in existence when a two-, three-, four-, or five-star general or admiral went to school. Science moves so fast that only the specialist can keep up with it. It is too much to expect an Army or Navy officer, no matter how brilliant, to maintain continuing and understanding contact with the latest developments in science. It is not too much to expect the Services to recognize their limitations in this respect and to build their plans for the defense of the country around such recognition.

Introduction of science at a high level of planning should serve another purpose as well. The amount of scientific talent available for military research will always be limited. In times of emergency in particular, none of it should be wasted. Unless the scientific high command is conversant with military planning, some part of the scientific effort will be wasted unnecessarily upon projects of marginal utility when it could be more effectively used in other directions. The number of devices which can be invented far exceeds the number which can be used. Effort should be concentrated on those which have the best chance of use. This means that the scientific high command must know what to develop and that it must have the courage to pull reluctant scientists off less important work for the benefit of the more important. The decisions involved are of such importance that they should be made only after serious consideration by both the military and the scientific high commands.

OSRD experience confirmed the ease with which scientists can become immersed in and pleaders for their specialties. The result was a number of truly remarkable developments in the field of those specialties. There was lacking in the over-all military research picture, however, any kind of a scientific council with members drawn from different fields of science and relieved of all responsibility for administration whose sole function would be to let their imaginations run free in an attempt to foresee the scientific and technical possibilities of modern war and to advise the Government on steps to realize upon those possibilities. Such a group completely conversant with scientific developments and scientific research programs in and out
of Government might conceive programs broader in their magnitude and more daring in their conception than anything yet achieved.

*Independent scientific judgment.* Scientists must be free to develop equipment without request and, if need be, over the opposition of military services, and they must be in a position to get it tested and evaluated sufficiently near the top to insure an unprejudiced judgment of its merits. A number of the most valuable of the OSRD developments were made in the face of Service indifference. The demonstration of the usefulness of the completed device to the satisfaction of higher officers was needed to overcome the opposition of others. In some cases, however, OSRD completed projects and was unable to get the necessary Service testing. In other cases, it was possible with large expenditures of time and energy to blast through Service inertia to the point where a test could be had.

This does not mean that the scientist will always be right. He may well be wrong, but he should not be blocked by the lack of imagination of an officer in a key position, by the opposition of a Service branch which has a pet project which it does not want to test against a proposed development, or by the reasoning that what the scientist says he may be able to do is impossible because the Service has already tried it and could not make it work.

*Keeping the interest of top-flight scientists.* Ways must be found to keep the interest of top-flight scientists in military problems during periods of peace. The system of reserve officers is not adequate for this purpose. While many able men will retain reserve commissions at the end of a war, many of the more able will not continue those commissions for long because of the competing demands upon their time and the intensity of their interest in their peacetime activities.

It all too frequently happens that the man who retains his reserve commission is not the most able man in his field. Yet the operation of the reserve system is such that when the reserve officers are called to active duty in time of emergency, they receive rapid promotion as the armed forces expand and they are placed in positions of much greater importance than their relative ability merits. Scientists coming into the Services in time of emergency find themselves subject to the orders of men who are recognized as their inferiors from a scientific standpoint. The situation becomes increasingly serious as the number of scientists called into uniform increases. If it cannot be met within the Services, the machinery for effective co-operation between civilian scientists and the Services becomes of even greater importance.

One way to keep from losing the interest of scientists is to make it easy for them to work with the Services in the fields of their specialties. The mechanics of civilian co-operation must be simplified, particularly in research
contracts. More important, the officers in charge of Service scientific programs must be of such caliber as to merit confidence in themselves and their programs. The temptation to impart to the Service laboratories an omniscience they do not deserve must be resisted, and the civilian regarded as a partner, not as an interloper. Above all, he must be given complete access to all the information he needs to be effective as a scientist.

Close contact with field operations. That persons responsible for designing and developing equipment for field use should have an opportunity for close and immediate observation of its performance under field conditions would seem to be obvious. Where, as in the case of the OSRD-supported branch laboratories in England, the developing group was in immediate contact with the using group in the field, it was possible for the scientist to appreciate the needs of the military, to design for them and to furnish modified equipment in a remarkably short time. Unfortunately, it was never possible for OSRD to work out with the Services a completely satisfactory over-all plan for assuring close contact between the scientists and the forces in the field.

The Office of Field Service played an increasingly important role in many areas, but the degree of its usefulness varied with particular situations. Thus, the Navy made it difficult for civilians to follow the course of new weapons in the Pacific although the difficulty of working with some parts of the Army was almost as great. The gap between the research worker in military medicine and medical officers in the field was at least as great, and little progress was made in bridging it during the course of OSRD operations.

The problem inherent in this situation is not easy of solution, and it offers a challenge to intelligent thinking on the part of the Services. The scientists are by no means blameless in the delay in getting more efficient field use of weapons and instruments. There was a tendency to place great faith in the weapon or instrument itself, and the realization of the importance of the man-instrument combination was relatively slow in developing. The temptation to continue laboratory work for the perfection of a piece of equipment had an appeal which kept men in the laboratories when they might have made greater contributions by moving into the field where they could observe the operational performance of the equipment under conditions of use. With the pull of the laboratory for the scientist and the reluctance of the Services to give him access to operational information or permit him to make his own observations, it is understandable that operational analysis or field service was slow in starting and sporadic in development. While it never attained a position which would warrant its copying in a future emergency, it did progress to the point where it merits close study as an indication of a path to be followed in the future.

Scientific manpower. With the winning or losing of a war dominated by scientific devices hanging in the balance, the United States never worked
out a system for the proper handling of scientific manpower. The men responsible for getting recruits into the Army and the Navy seemed far removed from the men who were responsible for developing the weapons with which the war was to be fought. The two operations were carried on with great independence of each other and with no one working out an intelligent system to permit the objective of the one to be accomplished without endangering the objective of the other.

In modern wars new and improved weapons may well prove decisive. For the development or improvement of such weapons in time of war, a country must depend largely upon its existing reserve of scientists or those in the course of training when the war breaks out. This group should be recognized and treated as any other national asset. They should not only be permitted, they should be forced to work on the development of instruments of warfare and should not be squandered in capacities where men of other training could be used as effectively.

This is not to suggest that all scientists should be kept out of uniform. It may be that the exact opposite is the proper answer and that immediately upon the outbreak of war all scientists should be inducted into the armed services and placed under the instructions of a scientific high command. The problem is as important as it is difficult. It should be faced squarely in the immediate future and the decision as to the proper method of handling scientific manpower made well in advance of the time when it may be put into effect. Though the answer to the problem is not immediately apparent, it is clear that to handle scientific manpower in any future war as clumsily as it was handled in World War II will be to invite national disaster.

The most effective use of manpower reserved for scientific research is also a problem of continuing difficulty. OSRD attained speed in research by granting autonomy to the divisions. Freedom to make decisions at the operating level was essential, but it had as a disadvantage that vested interests in continuing a particular line of research tended to arise. Persons not sufficiently acquainted with the complete research program understandably attached undue significance to the portion with which they were connected, with the result that some programs were probably continued beyond the point of diminishing returns. Proper balance between centralized authority and autonomy is difficult to attain, but as the manpower situation becomes more critical, the correct decision becomes more essential. Had the war continued for a much longer period, OSRD might well have been forced to withdraw some portion of the autonomy granted the divisions.

**Crash procurement.** The Army and the Navy are organized for war in terms of large bodies of men requiring huge amounts of standardized equipment which must be obtained in the necessary quantities within narrow time limits and must be designed for servicing with minimum delay and confusion. Unfortunately in gearing to large things, neither department has
made adequate provision for obtaining small quantities of new and unique instruments and weapons.

Quantity production, with its emphasis upon interchangeability of parts and its discouragement of adaptations, may well continue to be the cornerstone of the Service procurement programs. But the Services must devise some way of introducing a parallel system of obtaining small quantities of new equipment on an urgent basis. The lack of such a provision was glaringly apparent in OSRD relations with the Services. After the procurement agencies placed orders for large quantities of newly developed equipment (the first of which unfortunately would not come from the production line for from six to eighteen months), the Services seemed helpless to obtain the smaller but critical number of those same instruments or weapons which could be made by hand or by other than mass production methods and so be obtainable in the interval before mass-produced equipment was available.

The research groups in the Services maintained that the research was completed, and consequently the procuring of the “few quick” was not properly a research function or one which should be supported by research funds. The procurement agencies on the other hand objected to handling such items because they were not properly standardized and would not fit into the procurement schedules. Both research and procurement groups recognized the existence of a gap between them but neither took the initiative in attempting to fill it.

During the war, much against its will, OSRD filled the breach. In doing so it undoubtedly saved lives and expedited victory, but at the same time it relieved the pressure upon the Services to work out a permanent solution of the problem. Properly organized for the task, the Services could have done a more effective and expeditious job of “crash” procurement than OSRD did, and at the same time have left the scientists to work which only they could do. The Services should work out an effective method of handling such procurement.

One element operating to keep “crash” procurement within OSRD was undoubtedly the reluctance of the scientists working on a device to release it to other hands. Thus the situation frequently was one in which the Services on one side and the scientists on the other joined hands to force a reluctant OSRD into “crash” procurement.


The higher the classification assigned to a research program, the greater is the resultant delay. The cumulative effect of a series of time-consuming details may be serious in the course of a large program. The security officer should distinguish between a strategic plan properly classified secret and a scientific research program which may feed into that plan but may itself better be left unclassified. The compromise between the security officer who
tends to put everything in the highest classification as a matter of caution, and the scientist who wants everything in the lowest classification as a matter of speed and ease of operation should be under continuous re-examination. The fact that part of a program should be carefully protected is not always a valid reason for throwing safeguards (and delay) around other parts. Time can be saved by adequate and continuous attention to this aspect of a research program.

As for clearance, the military authorities should not wait until an emergency arises to decide what scientists they can trust. They should be prepared to evaluate the evidence produced by an investigation and to stand back of their findings. Clearly, this would not be an easy matter in view of the amount of difficulty a disgruntled person can make, but national security is too serious a matter for the issue to be dodged.

Compartmentalization of information can be carried too far, and probably was by OSRD. In theory, it is sound. Its disadvantages can be largely overcome by a continuous review by an adequate staff or by periodic conferences of Program Chiefs in which each would outline his progress and his problems in sufficient detail to permit his colleagues to determine where an exchange of more detailed information would be profitable. Even programs which should be carried on independently of each other may have components which are common and on which an exchange of information would save valuable time and manpower.

Contracting. The OSRD contracting procedure was effective. The contract was deliberately designed to insure the maximum freedom for the exercise of scientific imagination within the limits governing the proper expenditure of Government funds. By contrast, the Service research contracts in existence at the time NDRC was organized seemed to enmesh the scientists in such red tape as to make effective work difficult.

With the transfer of OSRD projects to the Services incident to the demobilization of OSRD, a more reasonable contract has obtained a foothold in both the Army and the Navy. Whether it will become firmly established is still uncertain. Judiciously used, a flexible contract can tie academic and industrial research facilities into the military research program in a very effective manner.

In time of war it will be possible to divert up to 100 per cent of the country’s research facilities to military problems and to expand them if necessary. In time of peace, however, these research facilities quite properly are used primarily for the advancement of science in the case of academic institutions or the improvement of the competitive position of a company in the case of industrial laboratories. Even in time of peace, however, some portion of both academic and industrial facilities can be obtained for military research. This percentage will vary from institution to institution and industry to industry, but it might be reasonable to expect a maximum of,
say, 10 per cent of laboratory facilities in many places to be available for military research under proper circumstances. If this were done it would accomplish a threefold purpose. It would acquaint the military with scientific developments of potential military significance at an early stage; it would give the military and the civilians experience in working together; and it would lay the basis for the expansion of the facilities devoted to military problems if that should become necessary. For this to take place, however, it is essential that the Services work out an acceptable flexible research and development contract and administer it intelligently.

The device of contracting introduces a flexibility impossible in the case of Service-operated laboratories. Operations are not confined to a particular geographical area or to particular groups of people. If one group is unsuccessful in pursuing a lead, it may be diverted to other work or dropped while the original problem is turned over to another group with a different background and facilities. New groups can be used for limited periods because of special qualifications without an implication of continuing employment, and frequently better men can be had than could be obtained on a basis of direct employment by the Government.

OSRD was a unique organization. Successful in its operations, the principal conclusion from its experience is that there should never be need for another like it. There were many organizational anomalies, but an all-pervading sense of the importance of the task and the urgency of its completion. The most remarkable thing about OSRD was the men associated with it. Whether they would have functioned as well in time of peace may be open to question, but from their performance in OSRD, it is possible that they would have done as well at any other job they undertook during the war. The history of OSRD is not in fact the story of an organization. Rather it is the story of a group of highly gifted, patriotic men, who in time of grave national emergency saw a job which needed to be done, sought and received authority to do it, and then carried it through in a manner which was successful beyond even their fondest dreams. While some of their trials and tribulations point the way to future improvements, and the record shows mistakes which they made, the statement of the Appropriations Committee of the House of Representatives on October 17, 1945, with which this volume opened, is an appropriate one with which to close it:

The contribution which it (OSRD) has made to the winning of the war is indescribable. Without such contribution, it is safe to say that victory still would await achievement. . . . To its distinguished and internationally known head, Dr. Vannevar Bush, and the staff of great scientists he gathered around him to aid in the development of new weapons, the Nation owes much.
DURING the first six months of 1947 most of OSRD's remaining obligations were met. Consideration was given to transferring the remaining tasks of contract liquidation to the Liquidation Unit in the Treasury Department at the end of the fiscal year; but late in June the Bureau of the Budget decided that OSRD's liquidation had not reached the stage where this could be done conveniently and that it would be preferable for OSRD to remain in existence for a few months longer, so that this work could be performed by persons on its staff already familiar with the special problems involved.

The staff of the agency, which had numbered 177 on December 31, 1946, had dwindled to 74 by June 30, 1947. Then it was cut still further to 26 paid employees. At the same time, Carey G. Cruikshank, who had been Fiscal Officer, succeeded Cleveland Norcross as Executive Secretary.

The work remaining on the first of July consisted of auditing current vouchers submitted by contractors, continuing a survey of contract costs, property accounting for 45 contracts, keeping track of the security clearance of reports, supervising the publication contracts mentioned in Chapter XX (Summary Technical Reports, monographs, and histories), and completing the transfer of permanent records to the National Archives. These activities will still require some months for their completion.

The question of a successor agency, mentioned at the end of Chapter XXI, is still unsolved. An act for the creation of a National Science Foundation, which was passed by Congress on July 22, 1947, was vetoed by the President after the first session of the 80th Congress had adjourned. The Foundation, named in the Act as the successor of OSRD, was to take over its few remaining obligations. Now it appears that they will be disposed of before there is time for this subject to be considered by the next session of Congress.

The action of the 80th Congress in creating the Department of National Defense should simplify the co-ordination of research for military purposes. The Research and Development Board of the new Department, with its committees and panels, provides a means for introducing civilian scientists into military planning. There seems reason to hope that the experiences of OSRD may thus be of continuing benefit to the country in its preparation for an eventuality which we all hope may never transpire.

IRVIN G. STEWART

Morgantown, West Virginia
August, 1947
APPENDIX I

EXECUTIVE ORDER NO. 8807

ESTABLISHING THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT IN THE EXECUTIVE OFFICE OF THE PRESIDENT

By virtue of the authority vested in me by the Constitution and the statutes of the United States, and in order to define further the functions and duties of the Office for Emergency Management with respect to the unlimited national emergency as declared by the President on May 27, 1941, for the purpose of assuring adequate provision for research on scientific and medical problems relating to the national defense, it is hereby ordered:

1. There shall be within the Office for Emergency Management of the Executive Office of the President the Office of Scientific Research and Development, at the head of which shall be a Director appointed by the President. The Director shall discharge and perform his responsibilities and duties under the direction and supervision of the President. The Director shall receive compensation at such rate as the President shall determine and, in addition, shall be entitled to actual and necessary transportation, subsistence, and other expenses incidental to the performance of his duties.

2. Subject to such policies, regulations, and directions as the President may from time to time prescribe, and with such advice and assistance as may be necessary from the other departments and agencies of the Federal Government, the Office of Scientific Research and Development shall:

a. Advise the President with regard to the status of scientific and medical research relating to national defense and the measures necessary to assure continued and increasing progress in this field.

b. Serve as the center for mobilization of the scientific personnel and resources of the Nation in order to assure maximum utilization of such personnel and resources in developing and applying the results of scientific research to defense purposes.

c. Co-ordinate, aid, and, where desirable, supplement the experimental and other scientific and medical research activities relating to national defense carried on by the Departments of War and Navy and other departments and agencies of the Federal Government.

d. Develop broad and co-ordinated plans for the conduct of scientific research in the defense program, in collaboration with representatives of the War and Navy Departments; review existing scientific research programs formulated by the departments of War and Navy and other Agencies of the Government, and advise them with respect to the relationship of their proposed activities to the total research program.
e. Initiate and support scientific research on the mechanisms and devices of warfare with the objective of creating, developing, and improving instrumentalities, methods, and materials required for national defense.

f. Initiate and support scientific research on medical problems affecting the national defense.

g. Initiate and support such scientific and medical research as may be requested by the government of any country whose defense the President deems vital to the defense of the United States under the terms of the Act of March 11, 1941, entitled “An Act to Promote the Defense of the United States”; and serve as the central liaison office for the conduct of such scientific and medical research for such countries.

h. Perform such other duties relating to scientific and medical research and development as the President may from time to time assign or delegate to it.

3. The Director may provide for the internal organization and management of the Office of Scientific Research and Development and may appoint such advisory committees as he finds necessary to the performance of his duties and responsibilities. The Director shall obtain the President’s approval for the establishment of the principal subdivisions of the agency and the appointment of the heads thereof.

4. In carrying out its functions, the Office of Scientific Research and Development shall utilize the laboratories, equipment, and services of governmental agencies and institutions to the extent that such facilities are available for such purposes. Within the limits of funds appropriated or allocated for purposes encompassed by this Order, the Director may contract with and transfer funds to existing governmental agencies and institutions, and may enter into contracts and agreements with individuals, educational and scientific institutions (including the National Academy of Sciences and the National Research Council), industrial organizations, and other agencies, for studies, experimental investigations, and reports.

5. The Director is authorized to take over and carry out the provisions of any contracts which fall within the scope of this Order heretofore entered into by (1) the National Defense Research Committee, established by order of the Council of National Defense on June 27, 1940, (2) the Health and Medical Committee, established by order of the Council of National Defense on September 19, 1940, and (3) the Federal Security Administrator in his capacity of Co-ordinator of Health, Medical Welfare, Nutrition, Recreation, and other related activities as authorized by order of the Council of National Defense on November 28, 1940. The Director is further authorized to assume any obligations or responsibilities which have heretofore been undertaken by the above agencies for and on behalf of the Government of the United States and which fall within the scope of this Order.

6. There is created within the Office of Scientific Research and Development an Advisory Council consisting of the Director as Chairman, the Chairman of the National Advisory Committee for Aeronautics, the Chairman of the National Defense Research Committee (hereinafter described), the Chairman of the Com-
mittee on Medical Research (hereinafter described), one representative of the Army to be designated by the Secretary of War, and one representative of the Navy to be designated by the Secretary of the Navy. The Council shall advise and assist the Director with respect to the co-ordination of research activities carried on by private and governmental research groups and shall facilitate the interchange of information and data between such groups and agencies.

7. There shall be within the Office of Scientific Research and Development a National Defense Research Committee consisting of a Chairman and three other members appointed by the President, and in addition the President of the National Academy of Sciences, the Commissioner of Patents, one officer of the Army to be designated by the Secretary of War, one officer of the Navy to be designated by the Secretary of the Navy, and such other members as the President may subsequently appoint. The National Defense Research Committee shall advise and assist the Director in the performance of his scientific research duties with special reference to the mobilization of the scientific personnel and resources of the Nation. To this end it shall be the responsibility of the Committee to recommend to the Director the need for and character of contracts to be entered into with universities, research institutes, and industrial laboratories for research and development on instrumentalities of warfare to supplement such research and development activities of the Departments of War and the Navy. Furthermore, the Committee shall from time to time make findings, and submit recommendations to the Director with respect to the adequacy, progress, and results of research on scientific problems related to national defense.

8. There shall be within the Office of Scientific Research and Development a Committee on Medical Research consisting of a Chairman and three members to be appointed by the President, and three other members to be designated respectively by the Secretary of War, the Secretary of the Navy, and the Administrator of the Federal Security Agency. The members so designated by the Secretaries of War and the Navy and Federal Security Administrator shall be selected from the respective staffs of the Surgeons General and the Surgeon General of the Public Health Service with particular reference to their qualifications in the field of medical research. The Committee on Medical Research shall advise and assist the Director in the performance of his medical research duties with special reference to the mobilization of medical and scientific personnel of the nation. To this end it shall be the responsibility of the Committee to recommend to the Director the need for and character of contracts to be entered into with universities, hospitals, and other agencies conducting medical research activities for research and development in the field of the medical sciences. Furthermore, the Committee shall from time to time, on request by the Director, make findings and submit recommendations with respect to the adequacy, progress, and results of research on medical problems related to national defense.

9. The members of the Advisory Council, the National Defense Research Committee, the Committee on Medical Research, and such other committees and subcommittees as the Director may appoint with the approval of the President shall serve as such without compensation, but shall be entitled to necessary and actual transportation, subsistence, and other expenses incidental to the performance of their duties.
10. Within the limits of such funds as may be appropriated to the Office of Scientific Research and Development or as may be allocated to it by the President, the Director may employ necessary personnel and make provision for necessary supplies, facilities, and services. However, the Director shall use such statistical, informational, fiscal, personnel, and other general business services and facilities as may be made available to him through the Office for Emergency Management.

FRANKLIN D. ROOSEVELT

The White House
June 28, 1941
APPENDIX 2

Standard Form 1001.

MEMORANDUM OF AGREEMENT made this day of effective as of the day of between THE UNITED STATES OF AMERICA (hereinafter called “the Government”), represented by the Executive Secretary (hereinafter called “the Contracting Officer”), Office of Scientific Research and Development in the Office for Emergency Management, Executive Office of the President, and

(hereinafter called “the Contractor”).

WHEREAS, the Government desires that the Contractor conduct studies and experimental investigations as hereinafter specified requiring the services of qualified personnel; and

WHEREAS, the Contractor is willing to conduct such studies and experimental investigations on an “actual cost” basis as hereinafter specified; and

WHEREAS, the contemplated work will require that a substantial part of the materials, supplies and other articles acquired therefor be either consumed or incorporated into equipment or other articles to be constructed or assembled during the course of the work; and

WHEREAS, the Government desires that such studies and experimental investigations be conducted under the direction of of the Office of Scientific Research and Development (hereinafter called “the Scientific Officer”); and

WHEREAS, the Contracting Officer finds after careful scrutiny that payment in advance on account of actual costs will promote the national interest;

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

ARTICLE 1. (a) Subject Work. The Contractor shall, with the utmost dispatch and in accordance with instructions issued by the Scientific Officer, supply the necessary personnel and facilities for and conduct studies and experimental investigations in connection with

The Contractor shall report the progress of such studies and investigations from time to time as requested by the Scientific Officer, and shall furnish a complete final report of its findings and conclusions. Such reports shall be furnished in such quantity and form as may be required by the Scientific Officer. The Contractor’s undertakings under this paragraph are hereinafter called “the subject work.”
(b) **Termination.** The Contractor shall proceed with the subject work until or until such later date as may be authorized in writing by the Contracting Officer and agreed to by the Contractor.

(c) **Acceleration of Termination.** The Contracting Officer may at any time advance the date fixed under paragraph (b) by giving the Contractor thirty (30) days' notice in writing that the subject work shall terminate at a specified earlier date. Upon receipt of such notice the Contractor shall exercise all reasonable diligence to obtain the cancellation of its outstanding commitments hereunder running beyond such earlier date, but any reasonable cancellation charges incurred thereby by the Contractor and any reasonable loss upon outstanding commitments which it is unable to cancel shall be reimbursable hereunder.

(d) **Inspections.** The Contracting Officer or the Scientific Officer may inspect the subject work at all reasonable times.

(e) **Subcontracts.** No subcontract executed hereunder shall provide for (i) payment on a cost-plus-a-percentage-of-cost basis or (ii) the payment of a fixed fee in excess of seven per centum of the estimated cost, exclusive of the fee. The Contractor shall not enter into subcontracts involving research or development of the kind contemplated by this contract without obtaining the written approval of the Scientific Officer as to the substance and the Contracting Officer as to the form thereof. The Contractor shall refer each prospective subcontract which might involve such research or development to the Scientific Officer, who shall determine whether or not such research or development is involved.

(f) **Special Property Acquisition.** The Contractor shall obtain the approval of the Contracting Officer before (i) purchasing motor vehicles, (ii) making any building alteration at a cost of $500.00 or more, (iii) constructing buildings, or (iv) leasing, purchasing or otherwise acquiring real property, for the cost of any of which reimbursement will be claimed hereunder.

(g) **Property Furnished Directly by the Government.** The Government may furnish to the Contractor materials, supplies, apparatus, equipment or other property for use in the performance of the subject work, and such property shall be used by the Contractor only for purposes approved by the Scientific Officer.

(h) **Definitions.** "Contracting Officer" refers to the present Contracting Officer and his successors in office. "Scientific Officer" refers to the present Scientific Officer and his successors in office. Scientific assistants may act for and on behalf of the Scientific Officer in every respect under this contract except in connection with subcontracts under Article 1 (e) hereof. The Scientific Officer may designate scientific assistants in addition to, or in substitution for, those initially designated below, by naming such assistants in writing and lodging a copy of such designation with the Contractor by transmitting such copy through the Contracting Officer. The following persons are hereby initially designated as scientific assistants:

**ARTICLE 2.** (a) **Reimbursement for Costs.** The Government shall reimburse the Contractor, upon the submission of public vouchers supplied by the Government and approved by the Contracting Officer, for the "actual cost" to the Contractor of performance of its undertakings hereunder in an amount not exceeding ($ ).

The Contractor may submit such vouchers at monthly intervals for "actual cost"
incurred and not previously reimbursed. The Contracting Officer may withhold all or any part of the final reimbursement payment until receipt of the final report, the property accounting, and the patent disclosure and designation required hereunder.

(b) *Cost Escape.* Notwithstanding any other provision hereof, when and if "actual cost" in such maximum amount shall have been incurred or obligated hereunder, the Contractor shall not be required to incur or obligate further "actual cost" hereunder unless and until the Government shall first agree in writing to reimburse the Contractor therefor.

(c) *Vouchers.* All vouchers submitted shall indicate, with respect to each class of items listed by the Contractor thereon, the particular subparagraph of paragraph (d) below under which reimbursement is claimed, and shall be itemized and supported by appropriate substantiating documents as required by the Contracting Officer.

(d) *Cost Determination.* "Actual cost" as used herein includes only the following:

1. *Salaries and Wages.* Expenditures by the Contractor for the salaries and wages of its employees hereunder, plus Federal and State Social Security taxes paid by the Contractor thereon;
2. *Borrowed Personnel.* Expenditures by the Contractor to reimburse other employers for salaries and wages paid by them to their employees released for and engaged in performance of the Contractor's undertakings hereunder, plus Federal and State Social Security taxes paid thereon by such employers;
3. *Materials and Services.* Expenditures by the Contractor for such materials, supplies, apparatus, equipment and other articles (including processing and testing thereof by others, and rental of apparatus and equipment from others), and for the services of others not reimbursed under subparagraphs (1) and (2), as are necessary for performance of its undertakings hereunder; *Provided,* That, when the Contractor furnishes articles customarily produced or assembled in the regular course of its business, it shall be reimbursed therefor at fair and reasonable prices not in excess of the lower of (i) those usually charged by the trade for such articles or (ii) the lowest net prices charged by it therefor at the time to any customer;
4. *Overhead.* An allowance for overhead costs not otherwise reimbursable hereunder in an amount equal to per cent ( ) of the total salaries and wages (but not taxes) reimbursable under subparagraphs (1) and (2) hereof;
5. *Communication and Shipping.* Expenditures by the Contractor necessary for performance of its undertakings hereunder for long distance telephone calls, telegrams, cablegrams, radiograms, postage, freight, express, and drayage;
6. *Travel.* Expenditures by the Contractor necessary for performance of its undertakings hereunder for the transportation expenses of persons directly engaged therein, plus reasonable actual subsistence expenses, in an amount not exceeding ten dollars ($10.00) per person per day, of such persons
incurred during periods of travel or, at the Contractor's option, an allowance, in lieu of actual subsistence expenses of such persons, not exceeding (i) six dollars ($6.00) per person for each calendar day or major fraction thereof during the period of travel within the continental limits of the United States, and (ii) seven dollars ($7.00) per person for each calendar day or major fraction thereof during the period of foreign travel outside the continental limits of the United States; Provided, That all such foreign travel shall be limited to persons directly engaged in the performance of the subject work hereunder and shall be authorized or approved in writing by the Contracting Officer; Provided, further, That expenses for transportation hereunder by motor vehicle other than common carrier or rented automobile shall be reimbursed on a reasonable actual expense basis or, at the Contractor's option, on a mileage basis at a rate not exceeding five cents (5¢) per mile per vehicle, in lieu of the actual expenses of such transportation;

(7) Insurance. Expenditures by the Contractor hereunder for premiums on (i) insurance required by law, and (ii) insurance required or specifically approved by the Contracting Officer;

(8) Subcontracts. Expenditures by the Contractor representing payments to subcontractors performing any research or development hereunder;

(9) Real Property. Expenditures by the Contractor hereunder for leasing, purchasing, or otherwise acquiring real property or altering or constructing buildings;

(10) Termination. Expenditures by the Contractor in connection with an acceleration of termination of the subject work;

(11) Special Costs. Special expenditures by the Contractor which are specifically certified by the Contracting Officer in writing to constitute part of the "actual cost" of its undertakings hereunder.

c Advance Payments. If the Contractor requests in writing that an advance payment be made on account of reimbursable "actual cost," the Government shall advance the amount estimated by the Contractor and concurred in by the Contracting Officer as the probable "actual cost" during any calendar month for which no payment has previously been made; Provided, That the Contracting Officer may in his discretion withhold approval of any such advance payment to protect the interests of the Government; Provided, further, That in case of such advance payment, the Contractor shall submit vouchers for its "actual cost" during the month for which such advance is made and an accounting for the full amount of such advance before the end of the following month, and shall return to the Government, when and if requested by the Contracting Officer, the portion of such advance for which vouchers have not been so submitted, without prejudice to the right of the Contractor to obtain reimbursement payments for "actual cost" upon the later submission of vouchers.

ARTICLE 3. (a) Disposition of Personal Property. At any time prior or subsequent to the termination of the subject work, the Contractor shall deliver at the Government's expense, when and as directed by the Contracting Officer, all or any part of materials, supplies, apparatus, equipment or other articles of personal
APPENDIX 2

property not theretofore expended or delivered hereunder which have been furnished by the Government or for the cost of which the Contractor has been reimbursed or has the right to claim reimbursement hereunder; *Provided*, That, upon the termination of the subject work, the Contractor shall have the right to retain any such property other than (i) that furnished by the Government and (ii) articles acquired for administrative purposes, unless notified by the Contracting Officer that the further prosecution of the war renders such action inadvisable, by returning to the Government such sum of money as the Contracting Officer may determine to be fair and proper.

(b) *Disposition of Premises Altered or Constructed.* After the termination of the subject work, the Contractor shall elect, with respect to premises upon which any alteration or construction has been done hereunder, whether (i) to retain the benefit of such construction or alteration, in which case the Contractor shall return to or credit the Government with the portion of the reimbursement by the Government for its expenditure therefor determined by negotiation between the Contractor and the Contracting Officer to be fair and proper, or (ii) to have such premises restored to substantially the same condition as prior to such alteration or construction, in which case it shall retain all such reimbursement and the Government shall pay the net cost of such restoration. The Contractor shall furnish on request all information deemed relevant by the Contracting Officer.

(c) *Accountability for Property.* Within one hundred twenty (120) days after the termination of the subject work, the Contractor shall render an accounting, in accordance with the instructions of the Contracting Officer, of all property the disposition of which is governed by this Article.

ARTICLE 4. (a) *Responsibility of Contractor.* The Contractor shall be responsible to the Government for loss of or damage to materials, supplies, apparatus, equipment and any other property, real or personal, the disposition of which is governed hereby, only if and so far as attributable to the wilful misconduct or lack of good faith of an officer of the Contractor or of any other person having complete or substantially complete charge of the establishment where any undertaking hereunder by the Contractor is performed.

(b) *Insurance.* The Contractor shall maintain insurance in such forms and amounts and for such periods of time as the Contracting Officer may require or approve.

(c) *Indemnity Clause.* The Government shall indemnify the Contractor, from such funds as may be hereafter appropriated by Congress for such purpose, against loss or damage to persons or property arising from performance of its undertakings hereunder (including settlements made with the written consent of the Contracting Officer) not compensated for by insurance or otherwise, in amounts found and certified by the Contracting Officer to be just and reasonable; *Provided*, That the Contractor shall give the Contracting Officer prompt notice of the institution of, and permit the Contracting Officer at his election to control the defense of, all law suits instituted against the Contractor with respect to any such alleged loss or damage.

ARTICLE 5. *Patent Provisions.* [Long Form] (a) The Contractor hereby grants to the Government of the United States an irrevocable option to purchase a non-
exclusive license or licenses, subject to the payment of royalties, to make, have made, and use, for military, naval, and national defense purposes, and to sell in accordance with law, material, and to use processes, under all United States patents and applications for patents owned or controlled by the Contractor covering inventions heretofore developed and actually or constructively reduced to practice and concerned with the subject work. Any such license shall be granted upon reasonable terms subject to negotiation at the time the Government may desire to exercise its option hereunder.

(b) The Contractor shall and does hereby, in consideration of the premises and in consideration of payments to be made by the Government under this contract, grant unto the Government a non-exclusive, irrevocable, royalty-free license, to make, have made, and use, for military, naval, and national defense purposes, and to sell or otherwise dispose of in accordance with law, material, and to use processes, under all inventions made in carrying out the subject work, including all inventions [exclusive of inventions covered by paragraph (a)] which for the first time were actually or constructively reduced to practice as a result of the subject work, whether patented or unpatented. The Contractor shall make to the Government, prior to the final settlement under this contract, a complete disclosure of all inventions made in carrying out the subject work and shall designate in writing which of the said inventions have been or will be covered by applications for patents filed or caused to be filed by the Contractor. The Contractor shall have the right, upon notification by the Government, to elect whether it or the Government shall file applications for patents on inventions in addition to those designated by the Contractor as aforesaid.

(c) As to all such inventions that are not covered by applications for patents as specified in paragraph (b) the Government shall have the right, at the Government's expense, to file, prosecute, and act upon applications for patents thereon, and the Contractor shall secure the execution of the necessary papers and do all things requisite to protect the Government's interest in prosecuting such applications to a final issue. When an application for patent is filed by the Government as aforesaid, all right, title, and interest in and under the patent shall be assigned to the Government by the Contractor except that the Contractor may retain a non-exclusive license non-transferable except to an assignee of the entire business to which said license is appurtenant.

(d) The Contractor covenants that it has not entered into and will not enter into any arrangement to evade the intent of this Article for the Government to obtain without further payment a non-exclusive license to patents, applications for patents and inventions as called for in paragraph (b) above.

(e) The execution of this contract shall not constitute a waiver of any rights the Government may have under patents or applications for patents.

ARTICLE 5. Patent Provisions. [Short Form] Whenever any patentable discovery or invention is made by the Contractor or its employees in the course of the subject work, the Contracting Officer shall have the sole power to determine whether or not a patent application shall be filed, and to determine the disposition of the title to and the rights under any application or patent that may result. The judgment of the Contracting Officer on such matters shall be accepted as
final, and the Contractor, for itself and for its employees, agrees that the inventor or inventors will execute all documents and do all things necessary or proper to carry out the judgment of the Contracting Officer. The Contractor shall include the provisions of this Article in all contracts of employment with persons who do any part of the subject work.

ARTICLE 6. Security Provisions. (a) During the continuance of the present unlimited National Emergency, the Contractor shall not disclose any information concerning this contract or obtained as a result of the performance of its undertakings hereunder to any person, except employees assigned to such work, without the written consent of the Contracting Officer or the Scientific Officer. Subsequent to the termination of such Emergency, disclosure of such information shall be governed by the applicable laws and regulations governing the disclosure of classified information. Disclosure of information concerning this contract or such work to any person not entitled to receive it, or failure to safeguard all such classified matters within the Contractor’s control, may subject the Contractor, its employees and subcontractors to criminal liability under the laws of the United States, including (i) 50 U.S.C. Chap. 4, (ii) 50 U.S.C. 45-45d, as supplemented by Executive Order 8381, dated March 22, 1940, and (iii) 35 U.S.C., 42c.

(b) The Contractor shall immediately submit a confidential report to the Contracting Officer whenever for any cause it has reason to believe that there is an active danger of espionage or sabotage affecting any of the subject work.

(c) The Contractor shall not employ any alien on or permit any alien to have access to the subject work or any plans, specifications or records relating to its undertakings hereunder without the written consent of the Contracting Officer as to each such alien.

(d) The Contractor, whenever requested by the Contracting Officer or the Scientific Officer, shall report to the Contracting Officer the citizenship, country of birth or alien status of any or all of its employees at the site of or having access to any of the subject work.

(e) The Contractor shall not employ or continue to employ on, and shall exclude from the site of, any of the subject work any person or persons designated in writing by the Contracting Officer or the Scientific Officer for cause as undesirable to have access to such work.

ARTICLE 7. Public Policy Provisions. (a) The Contractor warrants that it has not employed any person to solicit or secure this contract upon any agreement for a commission, percentage, brokerage or contingent fee. Breach of this warranty shall give the Government the right to annul the contract or, in its discretion, to deduct from the contract price or consideration the amount of such commission, percentage, brokerage or contingent fee. This warranty shall not apply to commissions payable by the Contractor upon contracts or sales secured or made through bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business.

(b) No Member of or Delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract or any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.
(c) The Contractor shall not discriminate in any act performed hereunder against any person on the ground of race, creed, color or national origin, and shall include such provision in each subcontract.

(d) In the performance of its undertakings hereunder, the Contractor shall comply with policies, directives, and regulations prescribed under Executive Order No. 9301, "Establishing a Minimum Wartime Workweek of Forty-Eight Hours," and with the minimum workweek prescribed in said Executive Order as and when applicable under such policies, directives, and regulations; and shall include such provision in each subcontract.

ARTICLE 8. Eight Hour Law. The Contractor shall compensate laborers and mechanics for all hours worked by them hereunder in excess of eight (8) hours in any one calendar day at a rate of not less than one and one-half (1½) times the basic rate of pay of such laborers and mechanics, and shall include such provision in each subcontract. For each violation of the requirements of this Article a penalty of five dollars ($5.00) shall be imposed upon the Contractor or subcontractor for each laborer or mechanic for each calendar day in which such employee is required or permitted to work hereunder more than eight (8) hours without receiving such additional compensation, and all penalties thus imposed shall be withheld for the use and benefit of the Government.

IN WITNESS WHEREOF, the Government and the Contractor have caused this contract to be signed and sealed, intending to be legally bound thereby.

THE UNITED STATES OF AMERICA

Witnesses:

______________________________________ BY ______________________________ (SEAL)

Executive Secretary, Office of Scientific Research and Development
(Contracting Officer)

______________________________________ (Contractor)

______________________________________ BY ______________________________ (SEAL)
APPENDIX 3

Standard Form 1002.

MEMORANDUM OF PURCHASE AGREEMENT made this day of , effective as of the day of , between THE UNITED STATES OF AMERICA (hereinafter called "the Government"), represented by the Executive Secretary (hereinafter called "the Contracting Officer"), Office of Scientific Research and Development in the Office for Emergency Management, Executive Office of the President, and (hereinafter called "the Vendor").

WHEREAS, the Vendor maintains and operates manufacturing facilities, and the Government desires to purchase certain articles to be manufactured experimentally for the Office of Scientific Research and Development in performing its functions;

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

ARTICLE 1. Definitions. "Contracting Officer" refers to the present Contracting Officer and his successors in office. "An authorized representative" can act hereunder only in the limited respects and to the extent specified in provisions of this agreement wherein the term "authorized representative" is specifically used. "Authorized representative" refers to any person designated as such by the Contracting Officer, who initially so designates:

ARTICLE 2. (a) Subject Articles. The Vendor shall manufacture and sell, and the Government shall purchase, the following articles (hereinafter called "the subject articles") to be manufactured in accordance with the specifications and instructions of the Contracting Officer or an authorized representative:

(b) Delivery and Acceptance. The Vendor shall deliver the subject articles, transportation paid, as directed by the Contracting Officer or an authorized representative, on or before or such later date as may be authorized in writing by the Contracting Officer and agreed to by the Vendor. The Contracting Officer or an authorized representative shall accept each of the subject articles on behalf of the Government if he determines that it has been manufactured pursuant to the specifications and instructions therefor.

ARTICLE 3. (a) Purchase Price. After said delivery and acceptance, the Government shall pay the Vendor for manufacturing and supplying the subject articles, upon the submission of public vouchers supplied by the Government and approved by the Contracting Officer, the following price (hereinafter called "the purchase price"): 
[Alternative Purchase Price Readjustment Provisions]

I. [For use in cases wherein there is to be no profit]

(b) **Basis for Readjustment.** The Vendor represents that the purchase price (i) was computed by estimating the cost of manufacturing and supplying the subject articles and (ii) includes no profit. Subsequent to final delivery and prior to final payment hereunder, the Vendor shall submit to the Contracting Officer a statement, itemized and substantiated as required by the Contracting Officer, of its actual costs hereunder as determined by an accounting method consistent with the principles approved in the War Department-Navy Department booklet entitled "Explanation of Principles for Determination of Costs under Government Contracts." The Vendor shall also preserve its records and accounts for a period of four years from the date of final delivery for any audit deemed necessary by the Government.

(c) **Adjustment Downward.** If upon the basis of such statement or any such audit the Contracting Officer determines that said actual costs have been less than the purchase price, (i) the purchase price shall be reduced to the amount of said actual costs and (ii) the Vendor shall return to the Government any payments in excess of said actual costs.

(d) **Cost Escape.** Notwithstanding any other provision hereof, when and if said actual costs incurred or obligated in manufacturing or supplying the subject articles equal the purchase price, the Vendor shall not be required to incur or obligate further said actual costs hereunder unless and until the Government shall first agree in writing to an appropriate increase in the purchase price.

II. [For use in cases wherein a profit is to be provided]

(b) **Basis for Readjustment.** The Vendor represents that the purchase price is the sum of (i) the total estimated cost of the subject articles in the amount of dollars ($_____), plus (ii) a fixed profit of dollars ($_____), an amount equal to per cent (____)% of said total estimated cost. Subsequent to final delivery and prior to final payment hereunder, the Vendor shall submit to the Contracting Officer a statement, itemized and substantiated as required by the Contracting Officer, of its actual costs hereunder as determined by an accounting method consistent with the principles approved in the War Department-Navy Department booklet entitled "Explanation of Principles for Determination of Costs under Government Contracts." The Vendor shall also preserve its records and accounts for a period of four years from the date of final delivery for any audit deemed necessary by the Government.

(c) **Adjustment Downward.** If upon the basis of any such statement or any such audit the Contracting Officer determines that the Vendor's actual profits hereunder have exceeded said fixed profit of dollars ($_____), (i) the purchase price shall be reduced to an amount equal to the sum of said actual costs plus said fixed profit and (ii) the Vendor shall return to the Government any payment in excess of said amount.

(d) **Cost Escape.** Notwithstanding any other provision hereof, when and if

*Never to exceed seven per cent (7%) of said total estimated cost, exclusive of the fixed profit.*
said actual costs incurred or obligated in manufacturing and supplying the subject articles, plus said fixed profit, equal the purchase price, the Vendor shall not be required to incur or obligate further said actual costs hereunder unless and until the Government shall first agree in writing to an appropriate increase in the purchase price, but shall fulfill its obligations hereunder by delivering the subject articles in the degree of completion at that time.

ARTICLE 4. Accelerated Termination. At any time prior to final delivery, the Contracting Officer may terminate the work hereunder by giving to the Vendor seven (7) days' notice in writing. Upon receipt of such notice, the Vendor shall exercise all reasonable diligence to obtain the cancellation of its outstanding commitments hereunder. If such termination causes a material decrease in the amount or character of the work hereunder, or in the time required for its performance, an equitable adjustment in the amount of the purchase price shall be made, and such equitable adjustment shall include an amount reflecting all reasonable cancellation charges and all reasonable losses upon outstanding commitments which the Vendor is unable to cancel. If the parties fail to agree upon such adjustment, the dispute shall be determined as provided in Article 13; Provided, That the Government shall nevertheless pay the Vendor any undisputed balance due it hereunder.

ARTICLE 5. Subcontracts. No subcontract executed hereunder shall provide for (i) payment on a cost-plus-a-percentage-of-cost basis or (ii) the payment of a fixed fee in excess of seven per centum of the estimated cost of the subcontract, exclusive of the fee. The Vendor shall not enter into subcontracts involving any research or development in connection with the subject articles without obtaining the written approval of the Contracting Officer as to the substance and form thereof. The Vendor shall refer each prospective subcontract that might involve such research or development to the Contracting Officer or an authorized representative, who shall determine whether or not such research or development is involved.

ARTICLE 6. Default of the Vendor. In the event of the Vendor's default, the Government may procure the subject articles from other sources and charge to the Vendor any excess cost occasioned the Government thereby, except where such delay is due to unforeseeable causes beyond the control and without the fault or negligence of the Vendor. If public necessity requires the use of subject articles whose rejection would be justified, payment therefor shall be made at an equitable reduction in the purchase price.

ARTICLE 7. Purchase of Facilities. [For use only in relevant cases.]
In addition to paying the purchase price, the Government shall reimburse the Vendor, upon the submission of public vouchers supplied by the Government and approved by the Contracting Officer, for the actual cost to the Vendor in an amount not exceeding dollars ($ ) of necessary equipment or facilities especially acquired for the manufacture of the subject articles. The Vendor represents that the purchase price includes no charge for the acquisition or depreciation of any equipment or facilities for the cost of which reimburse-

** For profit contracts insert "a reasonable profit."
ment will be claimed hereunder. Title to such equipment or facilities will vest in the Government upon delivery thereof to the Vendor; Provided, That, subsequent to the delivery and acceptance of the subject articles, the Vendor shall have the right to purchase any such equipment or facilities, unless notified by the Contracting Officer that the further prosecution of the war would render such action inadvisable, by paying the Government such sum of money as the Contracting Officer may determine to be fair and proper.

ARTICLE 8. Responsibility of Vendor. The Vendor shall be responsible to the Government for loss of or damage to (i) the subject articles prior to their delivery and acceptance and (ii) equipment or facilities for the cost which reimbursement has been or will be claimed hereunder, only if and so far as attributable to the wilful misconduct or lack of good faith of an officer of the Vendor or of any other person having complete or substantially complete charge of the establishment wherein the work hereunder is performed by the Vendor. The Vendor represents that the purchase price includes no charge for any insurance on such property.

ARTICLE 9. Patent Provisions. (a) The Vendor hereby grants to the Government of the United States an irrevocable option to purchase a non-exclusive license or licenses, subject to the payment of royalties, to make, have made, and use, for military, naval, and national defense purposes, and to sell in accordance with law, material, and to use processes, under all United States patents and applications for patents owned or controlled by the Vendor covering inventions heretofore developed and actually or constructively reduced to practice and concerned with the work hereunder. Any such license shall be granted upon reasonable terms subject to negotiation at the time the Government may desire to exercise its option hereunder.

(b) The Vendor shall and does hereby, in consideration of the premises and in consideration of payments to be made by the Government under this agreement, grant unto the Government a non-exclusive, irrevocable, royalty-free license, to make, have made, and use, for military, naval, and national defense purposes, and to sell or otherwise dispose of in accordance with law, material, and to use processes, under all inventions made in carrying out the work hereunder, including all inventions [exclusive of inventions covered by paragraph (a)] which for the first time were actually or constructively reduced to practice as a result of the work hereunder, whether patented or unpatented. The Vendor shall make to the Government, prior to the final settlement under this agreement, a complete disclosure of all inventions made in carrying out the work hereunder and shall designate in writing which of the said inventions have been or will be covered by applications for patents filed or caused to be filed by the Vendor. The Vendor shall have the right, upon notification by the Government, to elect whether it or the Government shall file applications for patents on inventions in addition to those designated by the Vendor as aforesaid.

(c) As to all such inventions that are not covered by applications for patents as specified in paragraph (b) the Government shall have the right, at the Government's expense, to file, prosecute, and act upon applications for patents thereon, and the Vendor shall secure the execution of the necessary papers and do all
things requisite to protect the Government's interest in prosecuting such applications to a final issue. When an application for patent is filed by the Government as aforesaid, all right, title and interest in and under the patent shall be assigned to the Government by the Vendor except that the Vendor may retain a non-exclusive license non-transferable except to an assignee of the entire business to which said license is appurtenant.

(d) The Vendor covenants that it has not entered into and will not enter into any arrangement to evade the intent of this Article for the Government to obtain without further payment a non-exclusive license to patents, applications for patents and inventions as called for in paragraph (b) above.

(e) The execution of this agreement shall not constitute a waiver of any rights the Government may have under patents or applications for patents.

ARTICLE 10. Security Provisions. (a) During the continuance of the present unlimited National Emergency, the Vendor shall not disclose any information concerning this agreement or obtained as a result of the performance of the work hereunder to any person, except employees assigned to such work, without the written consent of the Contracting Officer or an authorized representative. Subsequent to the termination of such Emergency, disclosure of such information shall be governed by the applicable laws and regulations governing the disclosure of classified information. Disclosure of information concerning this agreement or such work to any person not entitled to receive it, or failure to safeguard all such classified matters within the Vendor's control, may subject the Vendor, its employees and subcontractors to criminal liability under the laws of the United States, including (i) 50 U.S.C. Chap. 4, (ii) 50 U.S.C. 45–45d, as supplemented by Executive Order 8381, dated March 22, 1949, and (iii) 35 U.S.C., 42c.

(b) The Vendor shall immediately submit a confidential report to the Contracting Officer whenever for any cause it has reason to believe that there is an active danger of espionage or sabotage affecting any of the work hereunder.

(c) The Vendor shall not employ any alien on or permit any alien to have access to the work hereunder or any plans, specifications or records relating to its undertakings hereunder without the written consent of the Contracting Officer as to each such alien.

(d) The Vendor, whenever requested by the Contracting Officer or an authorized representative, shall report to the Contracting Officer the citizenship, country of birth or alien status of any or all of its employees at the site of or having access to any of the work hereunder.

(e) The Vendor shall not employ or continue to employ on, and shall exclude from the site of, any of the work hereunder any person or persons designated in writing by the Contracting Officer or an authorized representative for cause as undesirable to have access to such work.

ARTICLE 11. Public Policy Provisions. (a) The Vendor warrants that it has not employed any person to solicit or secure this agreement upon any agreement for a commission, percentage, brokerage or contingent fee. Breach of this warranty shall give the Government the right to annul this agreement or, in its discretion, to deduct from the purchase price the amount of such commission, percentage, brokerage or contingent fee. This warranty shall not apply to commis-
sions payable by the Vendor upon contracts or sales secured or made through bona fide established commercial or selling agencies maintained by the Vendor for the purpose of securing business.

(b) No Member of or Delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this agreement or any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

(c) The Vendor shall not discriminate in any act performed hereunder against any person on the ground of race, creed, color or national origin, and shall include such provision in each subcontract.

(d) In the performance of its undertakings hereunder, the Vendor shall comply with policies, directives, and regulations prescribed under Executive Order No. 9301, "Establishing a Minimum Wartime Workweek of Forty-Eight Hours," and with the minimum workweek prescribed in said Executive Order as and when applicable under such policies, directives, and regulations; and shall include such provision in each subcontract.

ARTICLE 12. WALSH-HEALY ACT Provision. The representations and stipulations required by Section 1 of the Act of June 30, 1936 (Walsh-Healy Act, Public Law No. 846, 74th Congress) to be included in all contracts therein specified are hereby incorporated and made a part of this agreement with the same force and effect as if fully set forth herein.

ARTICLE 13. Disputes. All disputes concerning questions of fact arising hereunder shall be decided by the Contracting Officer, subject to written appeal by the Vendor within thirty (30) days to the Director of the Office of Scientific Research and Development or his duly authorized representative.

IN WITNESS WHEREOF, the Government and the Vendor have caused this agreement to be signed and sealed, intending to be legally bound thereby.

THE UNITED STATES OF AMERICA

Witnesses:

______________________________ BY __________________________ (SEAL)
    Executive Secretary, Office of Scientific Research and Development (Contracting Officer)

______________________________ (Vendor)

______________________________ BY __________________________ (SEAL)
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