NATIONAL SCIENCE FOUNDATION

JUSTIFICATION OF ESTIMATES ON APPROPRIATIONS

FISCAL YEAR 1952

NATIONAL SCIENCE FOUNDATION
WASHINGTON 25, D. C.

May 23, 1951

Honorable Albert Thomas, Chairman
Subcommittee on Appropriations for
Independent Offices
House of Representatives,
Washington, D. C.

My dear Mr. Chairman:

I am transmitting herewith the justification of the appropriation requested by the President for the National Science Foundation for the fiscal year 1952.

As you are aware, the Foundation was established by the National Science Foundation Act of 1950. The members of the National Science Board were appointed by the President in November, 1950. I took office as Director on April 6 of this year. Until the present time the Foundation has been, and for the remainder of this fiscal year will be, occupied with organizational matters. The budget estimate attached hereto therefore represents in financial terms the Foundation's program for its first full year of operation.

The total of the estimate is $14,000,000. In the opinion of the National Science Board and myself, this represents the minimum amount which will be necessary if the Foundation is to discharge in an adequate manner the responsibilities assigned to it in developing a national science policy with respect to basic research and education in the sciences and in implementing that policy during the first year of operation.

Respectfully submitted,

Alan T. Waterman

Alan T. Waterman
Director

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I. STATUTORY AUTHORITY AND DUTIES OF THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation was established by the enactment, on May 10, 1950, of the National Science Foundation Act of 1950 (42 U.S.C. 1861). (A brief statement of the background and legislative history of the Act is included as Appendices I & II.)

The Foundation consists of the National Science Board of twenty-four members, and the Director, both the Board and the Director being appointed by the President by and with the advice and consent of the Senate. In accordance with provisions of the Act the Board has appointed from its membership a nine-man Executive Committee. A list of the members of the Board follows: (A biographical sketch of each member is provided in Appendix III.)

*JAMES B. CONANT, Chairman, President, Harvard University
*EDWIN B. FRED, Vice Chairman, President, University of Wisconsin
*DETLEV W. BRONK, Chairman, Executive Committee, President, Johns Hopkins University
SOPHIE D. ABERLE, Special Research Director, University of New Mexico
*CHESTER I. BARNARD, President, Rockefeller Foundation
ROBERT PERCY BARNES, Head, Department of Chemistry, Howard University
GERTY T. CORI, Professor of Biological Chemistry, Washington University
JOHN WARREN DAVIS, President, West Virginia State College
CHARLES DOLLARD, President, Carnegie Corporation of New York
*LEE A. DuBRIDGE, President, California Institute of Technology
*PAUL M. GROSS, Dean, Graduate School of Arts and Sciences, Duke University
GEORGE D. HUMPHREY, President, University of Wyoming
ORREN W. HYMAN, Dean, Medical School and Vice President, University of Tennessee
*ROBERT F. LOEB, Bard Professor of Medicine, Columbia University
DONALD H. McLAUGHLIN, President, Homestake Mining Company, San Francisco, California
FREDERICK A. MIDDLEBUSH, President, University of Missouri
EDWARD L. MORELAND, Jackson & Moreland, Boston, Massachusetts
*JOSEPH C. MORRIS, Head, Physics Dept. and Vice President, Tulane University
HAROLD M. MORSE, Professor of Mathematics, Institute for Advanced Study, Princeton, N. J.
ANDREY A. POTTER, Dean of Engineering, Purdue University
JAMES A. REYNIERS, Director, Lobund Institute, University of Notre Dame
*ELVIN C. STAKMAN, Chief, Division of Plant Pathology and Botany, University of Minnesota
CHARLES E. WILSON, Director, Office of Defense Mobilization
PATRICK H. YANCEY, Professor of Biology, Spring Hill College

* Members of the Executive Committee.

The Director, who also serves as a non-voting ex officio member of the Board, is the chief executive officer of the Foundation and holds office for a term of six years unless sooner removed by the President.

Dr. Alan T. Waterman, former Deputy Chief and Chief Scientist of the Office of Naval Research, was appointed Director of the Foundation in March and assumed office on April 6, 1951. The Foundation is thus in the very early stages of organization with the majority of its principal staff yet to be named.

In the National Science Foundation Act of 1950, the Foundation is, among other things, authorized and directed -

(1) to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences;

(2) to initiate and support basic scientific research in the mathematical, physical, medical, biological, engineering, and other sciences, by making contracts or other arrangements for the conduct of such basic scientific research and to appraise the impact of research upon industrial development and upon the general welfare;

(3) at the request of the Secretary of Defense, to initiate and support specific scientific research activities in connection with matters relating to the national defense by making contracts or other arrangements for the conduct of such scientific research;

(4) to award scholarships and graduate fellowships in the mathematical, physical, medical, biological, engineering, and other sciences;

(5) to foster the interchange of scientific information among scientists in the United States and foreign countries;

(6) to evaluate scientific research programs undertaken by agencies of the Federal Government, and to correlate the Foundation's scientific research programs with those undertaken by individuals and by public and private research groups; and

(7) to maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel in the United States, including its Territories and possessions.

II. THE DEVELOPMENT OF A NATIONAL SCIENCE POLICY

The most important and fundamental function of the National Science Foundation is the development of a national policy for the promotion of basic research and education in the sciences. The importance of scientific research and the application of scientific knowledge is a matter of history. It was the application of science to practical affairs which gave rise to the industrial revolution of the nineteenth century which ushered in the present era of accomplishment and power of the western world. At first this was done largely by individuals of a practical turn of mind who happened to be in contact with scientists or their work. About the beginning of the twentieth century, industry was first to perceive the advantages to be gained from establishing research departments whose aim was to explore the possibilities of scientific research as leads to future development of the industry.

During World War I the importance of the applications of science to warfare began to be felt, and great progress was made in such fields as aeronautics, communications and chemical warfare. However, the full potentialities of science in its application to the weapons and devices of warfare were not realized until World War II where the assistance rendered by science, now common knowledge, can hardly be exaggerated. This has been fully recognized since the last war by the Department of Defense, which has carried on unprecedented programs of research and development.

Not only has the aid of science been responsible for great advances by industry and by the military, but also in medicine, a subject most important to human welfare, where continually increasing support by public and private means has led to a standard of health and physical well-being which has broken all records in the world's history. Since this field is of such obvious and important concern to the Nation, the Federal Government has taken an active interest in its support. Evidences of the same interest on the part of the Federal Government are also apparent by its support of research in the Departments of Agriculture, Commerce and, in fact, in most of the Government agencies.

At first the attention of the Government was directed toward the support of research aimed at a definite goal, related directly to the mission of the agency concerned. Thus, maximum support has, in the past, been given to applied research and to development. Gradually, and surely, the realization has come that the applications of science have their roots in fundamental or basic research and that practical accomplishments are limited by the available fund of basic scientific knowledge and this, in turn, is determined by the rate at which our basic knowledge is increased. The question then arises, in the interest of national progress: how can the accumulation of basic scientific knowledge best be increased and its significance utilized?

Fundamental or basic research, historically and traditionally, has been an activity carried on almost completely by educational institutions and institutions of higher learning. Its aims have been entirely the advancing of frontiers of human knowledge and the accumulation of basic information. Since by definition this type of research has no practical aim, from a narrow or short range point of view, it is more difficult to justify in advance from the taxpayer's viewpoint. Again, traditionally, this type of research has been supported largely by private sources and the endowments of institutions of learning. In this country, especially within the last century, however, it has been supported by state and municipal funds as a necessary part of education at their institutions. In other countries there has been an increasing tendency for the Government itself to assist in education and in research of this character.

In the legislative history leading to the establishment of the National Science Foundation it has been clearly apparent that the need for active participation by the Federal Government in the support of basic research has been recognized and its importance appreciated. At the same time, the Government has wisely seen that proper administration of this type of research is not possible without provision for review of existing research programs, both public and private, and for the development of a national policy for basic research and education which will integrate the research activities of the many separate institutions and activities in which the Government has an interest.

The encouragement and support of basic research and higher education, in spite of their importance, are more difficult to defend than the more immediately practical aims of the Government. The reasons for this are obvious: basic research is unpredictable and one can never guarantee that a particular project will yield important results nor that a particular end will be achieved. This is because basic research is an exploration into the unknown. It should therefore be regarded as an investment, an investment which, if wisely planned, will provide a safe return plus the possibility, at any time, of a really sensational return. When the latter happens it more than justifies many years of financial support. Similarly, with higher education, immediate results in terms of facts and figures are not to be expected. The benefits accrue gradually over a long term of years and become most apparent in succeeding generations. Because a program of basic research and education in the sciences has important intangible aspects, it is all the more important that its support be placed in the hands of a separate agency with the express mission of furthering these aims.

Among the considerations important in the development of a national policy in basic research and education in the sciences are the following:

1. What portion of the total national income should be devoted to basic research and education in the sciences?

2. What are the broad needs of the country with respect to the applications of science? Specifically, what are the needs of the public, national defense, industry, agriculture and civil government?

3. What is the degree of effort currently placed on basic research by educational, industrial and governmental institutions? Is this distribution satisfactory or does it require modification?

4. What are the relative degrees of interest of the Governmental agencies in research? Are these interests over- or under-emphasized?

5. To what extent should Government agencies support research in their own laboratories and to what extent research in non-Governmental facilities?

6. What means of coordination in research exist between universities, industry and Government? What means of coordination exist within each of these three areas?

7. In terms of progress in pure science alone, what are the important lines along which maximum progress in each science may be gained?

8. To what extent is the optimum encouragement and support of research limited by the total number of trained scientists available? To what extent should support be given to especially gifted or competent scientists and to their identification and training? At what point in our educational system should the encouragement and training of scientists begin?

9. What is the proper distribution of support between the different fields of science?

10. What are the probable effects of Government support of scientific research and education on (a) educational institutions (b) industry and (c) the Government?

11. What fields or areas of science require additional emphasis and support? In what areas may there be over-emphasis?

12. What special fields of research are there where progress is of critical importance to the national welfare or security?

13. What is the proper balance between the encouragement and promotion of vital basic research in the hands of the most competent investigators available, and areas in which general research and education in the sciences should be enlarged and increased?

14. To what degree should a given Government agency or a given industry conduct its own basic research? To what extent may basic research be supported and conducted by one agency for the general benefit of all?

15. By what means can the transition period between basic scientific discovery and its practical application be shortened?

16. What are the relative advantages and disadvantages of research effort in large centers as compared with conduct of research by individuals and small groups with a wide geographic distribution?

17. What is our supply of scientific manpower in relation to our needs, both for basic research and education and for applied research and development? What is the demand for men and women with scientific training for positions outside the field of scientific research?

18. What degree of financial support for basic research and education in the sciences may be expected in the future aside from that supplied by the Federal Government?

These and other questions require careful and considerable study in the evolution of a national policy for basic research and education. The National Science Foundation expects to study these matters by a number of different approaches; by staff studies; by the use of consultants and advisory committees in special fields; by visits and discussions at colleges, universities, industrial concerns and Government agencies. It is expected that some of these questions may require the appointment of commissions to make special investigations.

It is expected that the development and formulation of a national policy will take considerable time. It must be approached with care and thoroughness at the very outset. Furthermore, it is recognized that this policy should be maintained current and take into account such matters as trends in science and changing national needs. Only in this way will the National Science Foundation best serve to promote the progress of science, to advance the national health, prosperity and welfare and to secure the national defense.

III. COMPARATIVE SUMMARY OF FUNDS BY FUNCTIONS

Function	1951 Amount	1952 Amount	Difference	Page No
1. Research Policy Development & Services	$	$	$	
Development of National Science Policy.....	-o-	50,000	+ 50,000	12
Dissemination of Scientific Information.....	-o-	285,000	+ 285,000	13
Maintenance of National Roster of Scientific Personnel.............	-o-	156,000	+ 156,000	15
Support of Interdepartmental Committee on Sci. Res. & Dev.......	25,000	26,000	+ 1,000	16
Operating Costs........	37,400	268,000	+ 230,600	28
Subtotal.....	62,400	785,000	+ 722,600	
2. Research Support				
Medical Sciences.......	-o-	1,300,000	+ 1,300,000	18
Biological Sciences....	-o-	2,600,000	+ 2,600,000	18
Mathematical, Physical & Engineering Sciences	-o-	3,913,000	+ 3,913,000	18
Operating Costs........	71,300	342,000	+ 270,700	28
Subtotal.....	71,300	8,155,000	+ 8,083,700	
3. Training of Scientific Personnel				
Fellowship Programs....	-o-	4,970,000	+ 4,970,000	23
Operating Costs........	16,300	90,000	+ 73,700	28
Subtotal.....	16,300	5,060,000	+ 5,043,700	
Grand Total.......	150,000	14,000,000	+ 13,850,000	
Estimated Savings......	75,000	-o-	- 75,000	
Total Appropriated or Requested	$225,000	$14,000,000	$ + 13,775,000	

IV. COMPARATIVE SUMMARY OF FUNDS BY OBJECTS

	Object	1951 Estimate	1952 Estimate	Difference
01	Personal services..........	$ 37,000	$ 536,000	$ + 499,000
02	Travel....................	12,000	135,000	+ 123,000
04	Communication services......	1,000	5,000	+ 4,000
05	Rents and utilities.........	1,300	5,000	+ 3,700
06	Printing and reproduction...	600	15,000	+ 14,400
07	Other contractual services..	28,000	865,500	+ 837,500
08	Supplies and materials......	10,000	15,000	+ 5,000
09	Equipment..................	60,000	40,000	- 20,000
11	Grants.....................	-0-	12,383,000	+ 12,383,000
15	Taxes and assessments.......	100	500	+ 400
	Total......................	$150,000	14,000,000	13,850,000
	Estimated savings...........	75,000	-0-	- 75,000
	Total appropriated or requested	$225,000	$14,000,000	$13,775,000

V. ANALYSIS OF BUDGET FUNCTIONS

1. Research Policy Development, and Services

Summary of Financial Requirements. The funds requested for this activity are for the following purposes:

Development of a national science policy	$ 50,000
Dissemination of scientific information	285,000
Maintenance of the National Scientific Register	156,000
Support of the Interdepartmental Committee on Scientific Research and Development	26,000
Operating costs of the Foundation	268,000
Total	$ 785,000

Development of a National Science Policy. The National Science Foundation Act, in section 3(a) (1), authorizes and directs the National Science Foundation "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences." As already indicated, the Foundation regards this function as a primary responsibility. Such a policy must be compounded of many ingredients. It must draw on the thinking of a wide variety of leaders in the scientific disciplines and of outstanding laymen whose experience has given them knowledge and understanding of scientific research. Much of the planning of a national science policy will be done by the members of the National Science Board and the staff of the Foundation. To supplement the Board and the staff, the Foundation is authorized to establish special commissions to make comprehensive surveys of research, both public and private, recommending to the Foundation an over-all research program in the field of the survey. It is expected that at least two such commissions will be appointed and commence deliberations in the coming fiscal year. Finally, the advice and comment of organized scientific groups including professional societies and conferences and the published thinking of individuals must be considered and utilized where pertinent.

Although a national science policy must stem from many sources and embody the contributions of diverse groups and individuals, the policy must, if it is to be sound, rest on a firm foundation of fact. Developing such a body of fact is one of the chief responsibilities of the Foundation. Much of the fact-gathering and fact-analysis can be supplied by the Foundation's own staff. But it is practically certain that the Foundation's staff, because of its limited numbers, will be unable to provide all the information and analysis which will be required. Its efforts will need to be supplemented by studies conducted by groups outside the Foundation having specialized staffs or skills. It is estimated that $50,000 will be required for this purpose in fiscal year 1952.

Dissemination of scientific information. By section 3(a)(5) of the National Science Foundation Act, the Foundation is authorized and directed "to foster the interchange of scientific information among scientists in the United States and foreign countries" and in section 13(a) to "defray the expenses of representatives of Government agencies and other organizations and of individual scientists to accredited international scientific congresses and meetings." The nerve system of a healthy and vigorous scientific effort lies in ready exchange of information. Scientific progress is cumulative. One individual builds on the findings of other individuals or groups; in turn his work becomes modified or augmented by still other individuals. The faster and more easily information passes from scientist to scientist, the faster science progresses. When this intellectual exchange is hampered or slowed, science as a whole declines.

Serious problems exist in the dissemination of scientific information both internally in the United States and in obtaining for scientists in the United States the benefit of scientific information developed in foreign countries. Publication of scientific papers in the recognized journals is now subject to delays of as much as several years. Technical difficulties in abstracting published articles and in distributing abstracts among scientists further delay the proper correlation of research activities throughout the world.

Efficient dissemination of scientific information not only stimulates scientific progress, it is also a guarantee against wasted effort. A scientist will not knowingly undertake an investigation which has previously been adequately covered. The professional standing of a scientist depends upon his capacity for sound and original work. He jeopardizes that standing whenever he undertakes research which has previously been adequately covered. Thus, by all odds the most effective insurance against undesirable duplication and overlap in research effort is a free flow of information among working scientists.

Information is exchanged among scientists largely by two means, publication of scientific findings and by personal exchange of information, especially at scientific meetings. As a part of its program for 1952, the Foundation proposes to take modest steps toward improving the functioning of both of these means.

With respect to the publication of information, the need is two-fold, (1) to insure that all worthwhile findings are published in an economical manner and (2) to develop techniques by which published materials can readily be made available in usable form to scientists as needed.

In 1952 the Foundation's efforts toward insuring comprehensive publication will consist largely of studies by the Foundation's staff. In these studies, an analysis will be made of the broad phases of scientific literature in the United States to determine (1) in which areas publication facilities are lacking or inadequate, (2) where gaps exist in the major collections of scientific literature and what can be done to close these gaps, and (3) the factors which contribute to a lag in publication of research results.

To develop new techniques for the quick and economical dissemination of scientific information, the Foundation also will sponsor research in this field. This research will be designed to produce improvements in (1) existing methods of abstracting information, (2) the use of mechanical means for compiling bibliographies and other reference materials, (3) more rapid ways of preparing and processing units of scientific literature, and (4) methods for indicating the availability of these units of scientific literature. For these purposes the amount of $225,000 is included in this estimate.

The second principal means by which scientific information is exchanged is through meetings. U. S. scientists must have access not only to the published findings of scientists abroad but also on occasion to these scientists themselves. Personal contacts stimulate thinking in a way which printed publications cannot. The attendance of American scientists at such recent meetings as those of the International Physiological Congress at Copenhagen, the International Biochemical Congress at Cambridge, the International Nuclear Physics Symposium in Zurich has resulted in bringing back to the United States information which has saved American scientific research many times the actual cost of travel. The Foundation's estimate includes $60,000 for this purpose; this will provide for the attendance of 60-80 scientists.

Maintenance of the National Scientific Register. In section 3(a)(8), the National Science Foundation Act authorizes and directs the Foundation "to maintain a register of scientific and technical personnel and in other ways provide a clearinghouse for information covering all scientific and technical personnel in the United States, including its territories and possessions."

Trained technical manpower is one of our national resources. In formulating a national policy for science and in planning for mobilization of scientific effort in time of war, comprehensive information on scientific manpower is essential. The need for information of this kind became apparent early in the last war and was met by the establishment of a national roster of scientific personnel. The usefulness of this roster during the war in locating scarce skills and providing other information on scientific personnel was demonstrated. After the war, its continuation on a limited basis was undertaken by the National Research Council with the support of the Office of Naval Research, the Veterans Administration, and other Federal agencies.

In 1949, the National Security Resources Board concluded that the establishment of the roster on a broad basis was essential to our mobilization readiness. Legislation then being considered by the Congress would have assigned this function to the proposed National Science Foundation. Pending the passage of the National Science Foundation Act, the Office of Education undertook, beginning in the spring of 1950, to activate and administer a National Scientific Register on an interim basis with funds transferred by the National Security Resources Board. In accordance with section 14(i) of the National Science Foundation Act, the Foundation will assume direct operation of the Register sometime in fiscal 1952. It plans to provide financial support by a transfer of funds to the Office of Education for the period during which it will remain under that Office's administration.

The activities of the Register fall into three groups: (1) initial compilation, (2) maintenance, and (3) research studies of the "registered" population and on techniques of quickly disseminating information concerning registrants to potential users.

The Register to date has concentrated almost wholly on the first activity, compilation. This consists of circularization of a questionnaire to scientists, coding of returned questionnaires, reduction of the coded information to machine tabulating cards, and abstracting experience for use in dissemination of information about registrants.

Compilation is now one-third completed. The Register is expected to total approximately 300,000 names when completed.

During fiscal year 1952, the Register's work plans are: (1) to continue the registration of scientists and analysis of their experience, (2) to establish procedures for maintenance of the Register after completion, (3) to prepare and publish statistical studies of the personnel included in the Register, and (4) to develop and maintain a clearinghouse of information on scientific personnel for use of agencies of the Government and other activities.

The financial history of the Register and its requirements for fiscal year 1952 are as follows:

Funds originally transferred to the Office of Education by NSRB in fiscal year 1950		$279,400
Less amount obligated in fiscal year 1950		10,600
Amount available as of July 1, 1950		$268,800
Estimated obligations in fiscal year 1951:		
Staff costs	$ 93,800	
Contractual costs (for mailing, coding and tabulating questionnaires)	160,000	253,800
Estimated unobligated balance as of July 1, 1951		15,000
Funds included in this estimate:		
For transfer to Office of Education	156,000	
Included in operating costs of the Foundation	14,000	170,000
Funds available for fiscal year 1952		185,000
Estimated obligations for fiscal year 1952:		
Staff costs	95,000	
Contractual costs:		
For completion of Register	70,000	
Research studies	20,000	185,000
Estimated unobligated balance as of June 30, 1951		-0-

<u>Support of the Interdepartmental Committee on Scientific Research and Development.</u> By Executive Order 9912 of December 24, 1947, the President, acting on a recommendation of the

President's Scientific Research Board, established an Interdepartmental Committee on Scientific Research and Development. The Committee is composed of representatives of the agencies of the Government directly concerned with research activities: the Departments of Agriculture, Commerce, Defense, Interior and State; the Army, Navy, and Air Force; the Federal Security Agency; the Atomic Energy Commission, the National Advisory Committee on Aeronautics; the Veterans Administration; and the Smithsonian Institution. It is expected that the President will shortly authorize membership by the National Science Foundation. The principal functions of the Committee are continuing review of administrative policies and techniques to increase the efficiency of scientific operations within the Government and encouraging cooperation among the scientists of the Government agencies.

Members of the Committee and of its subcommittees and panels serve on a part-time basis. The Committee also has a full-time secretariat. Following the pattern established in the 1951 budget, the Foundation's estimate for fiscal year 1952 includes $26,000 to cover the salaries of this secretariat. These funds will be transferred to the agency which provides physical housing for the Committee's secretariat and whose representative is Chairman of the Committee. In fiscal year 1952 this will be the National Advisory Committee on Aeronautics.

Although the Foundation will provide financial support for the Committee, it is not anticipated that the Committee's present function or relationships with Federal research activities will be altered as a result.

2. Research Support

Summary. Funds requested for this function are for the purpose of providing support in the form of grants, contracts and other arrangements for basic research in the sciences distributed among the major classifications as follows:

Medical sciences................	$1,300,000
Biological sciences..............	2,600,000
Mathematical, physical and engineering sciences...........	3,913,000
Operating costs..................	342,000
Total	$8,155,000

Importance of Basic Research. The National Science Foundation Act of 1950, in Section 3(a)(2), authorizes and directs the Foundation "to initiate and support basic scientific research in the mathematical, physical, medical, biological, engineering and other sciences ... and to appraise the impact of research upon industrial development and upon the general welfare."

The leading economic, industrial, and military position of the United States is due in large part to the technological ability of the American people. Our real genius as a Nation has been the power to convert scientific knowledge into practical utility. Evidence of this is found on every hand, in industry, in business, in public health, and, during two World Wars, in our military power. It is fundamental to our high standard of living.

By and large, however, it is only recently that the country has come to recognize that technological advances are made possible only through the application of fundamental scientific knowledge already known. This fundamental knowledge has been a heritage available to us from the accumulated findings of science all over the world. We drew heavily upon this stockpile during the war, very seriously depleting it. Since research has very nearly come to a standstill in most other countries, the replenishment of this stockpile now rests chiefly in our own hands. Certainly, among the Western nations the responsibility is ours, and it is indeed a grave one.

Until comparatively recently and except in a few outstanding cases, we have not in the past led other nations in fundamental research. We have now come to realize that, if we are to maintain the leadership in technology necessary to our welfare and security, we must ourselves produce the major portion of the necessary knowledge basic to scientific progress. Indeed, during the present emergency this may be the price of survival.

The importance of basic research is demonstrated by the fact that many of the major original discoveries in science, for example, the electric current, the X-ray, and vaccination, had their origin in the research of gifted individuals whose only aim was to learn the secrets of nature. Yet major discoveries like these have made world-shaking changes in our civilization and their dollar value is beyond estimation. They represent a reservoir of power and wealth. Atomic energy technology, with all of its implications for our military and economic life, had its origin in basic research fifty-five years ago with the discovery of radioactivity. For the first forty-four years its study was confined entirely to scholars and basic research investigators and it provided no practical applications except for the use of radium in cancer treatment and in luminous watch dials. Ultimately, the accumulated background of experimental and theoretical investigation, and improvement in laboratory techniques, made possible the discovery of atomic fission. This led directly within the next six years to a development so important and far-reaching that we have hardly as yet been able to see its potentialities.

In its relation to the present emergency the problem of planning and supporting basic research and science should be viewed as follows: Since both the degree and the duration of this emergency are uncertain, it is clear that we must (a) with all dispatch, put ourselves into what the military call "operational readiness" and (b) take the necessary steps to maintain ourselves in this state of readiness for an extended period, perhaps for many years. This we should do with the realization that at any time the emergency may turn into a crisis. In its application to science, this means that scientists should play their part immediately in seeing that urgent military applications of science should be expedited, where these are capable of being put to practice in a short period, say two or three years. Obviously this should be done with all the care that can be spent on an emergency problem. We know that the country certainly cannot undertake all possible scientific applications in a limited period and hope to complete them in time for operational use. Therefore, there must be careful selection as to the practical developments which are both feasible and of high priority.

In order to maintain our scientific readiness over a long period of years, we must also do our utmost to strengthen our scientific progress and maintain that strength at the highest possible level. In this second phase, to maintain scientific progress at a maximum level, it is essential that we keep the initiative, scientifically speaking, in as direct a sense as we keep the initiative with respect to the effectiveness of our military forces. It is especially here that a comprehensive and balanced program of basic research can make its most effective contribution.

Basic research is also a tool of economy. Wisely used it can render completely unnecessary costly lines of applied research and development, the construction of prototypes, extensive testing, and in some cases useless manufacture. By suggesting alternatives and new lines of attack, it can shorten, sometimes by years, the time necessary to reach an important technological or medical objective. In brief, basic research is the pacemaker for applied research and development, and, moreover, it is the least expensive variety.

Yet there is in fact not enough basic scientific research being done. This has been stressed repeatedly since World War II by virtually every authority which has examined the facts. Notable among formal statements to this effect are those in Science, the Endless Frontier by Dr. Vannevar Bush; Science and Public Policy by the Chairman of the President's Scientific Research Board; Survival in the Air Age by the President's Air Policy Commission; Report of the Surgeon General's Committee on Medical School Grants and Finances; Telecommunications, a Program for Progress by the President's Communications Policy Board; by the Naval Research Advisory Committee and the Research and Development Board of the Department of Defense. Some of the estimates of the annual dollar shortage in basic research run into hundreds of millions.

Need for Government Support of Basic Research. The case for an integrated program of Federal support of basic research is based on the following considerations:

1. The major research efforts of industry have generally been in applied research directed toward immediate or short-term utility in the interest of profit to the company or utility to the public. Some highly technical industries conduct basic research and furnish special support to universities but the fields of science thus supported are usually chosen with special reference to the aims and future development of the industry.

2. Similarly, the major research efforts of governmental agencies have been in background research, applied research and development rather than basic research. Again this is because research must conform to the aims and functions of the agency in order to justify the support by the agency.

3. Under prevailing conditions and in the foreseeable future, the traditional sponsors of basic research--non-profit institutions, and particularly the colleges and universities--have only limited resources. Yet it is in these institutions where the search for new knowledge goes ahead most vigorously and imaginatively in the spirit of free inquiry, where the majority of basic research scientists are to be found, and where the entire basic training of young scientists is carried on. With additional financing from the Government they can markedly increase their output of basic research and their facilities for the training of advanced students in science.

4. A comprehensive and balanced program of basic research in the national interest can be achieved with economy only if there is central evaluation and policy development. This is necessarily a job for the Federal Government.

<u>The Foundation's Research Program</u>. An immediate and pressing task to which the Foundation will address itself is a careful survey which will permit an accurate evaluation of the need for support of basic research. In its approach to the problem in its initial year, the Foundation has not been able to consider development of a program adequate to the need, but has limited its plans to a program which will:

1. By establishing a limited comprehensive program of support in the basic sciences, bring the Foundation into close touch, in a working level relationship, with each of the major fields of basic scientific research;

2. In the light of existing programs in basic research place special emphasis on fields and areas where needed in the national interest.

3. Keep the organization well within its first-year capabilities for adequate assessment and administration of its program.

4. Utilize the information and experience gained in this program in the initial formulation of national policy on basic research.

While recognizing the urgent need for maximum support of basic research at the present time, the Foundation considers its recommended program the optimum approach, in view of current limitations on organization, available information and feasible activity in the first year. This is the basis for the Foundation's estimate of $8,155,000 for support of basic research in Fiscal Year 1952.

It should be noted that the program of basic research which the Foundation plans to support cannot be considered by itself a well-rounded or comprehensive basic research endeavor. Actually, it can accomplish little more than provide emergency support in the directions of greatest need.

3. Training of Scientific Manpower

Summary. The funds requested for this function are for the purpose of establishing a fellowship program which will augment scientific manpower essential for the progress of science, the national welfare and the national defense. The total estimate is as follows:

Fellowship program............................	$4,970,000
Operating costs of the Foundation............	90,000
Total..........................	$5,060,000

The Need for a Fellowship Program. The Foundation is authorized (Section 3(a)(4) of the National Science Foundation Act of 1950) "to award,...., scholarships and graduate fellowships in the mathematical, physical, medical, biological, engineering and other sciences."

The present need for a graduate fellowship program arises from the following facts:

(1) The continued industrial progress of the Nation is dependent on an adequate supply of trained scientists and technicians.

(2) In time of national emergency, the need for trained scientists and technicians is greater than usual. Industry must continue its normal research and development program at a reasonable level; scientists in academic institutions must to a large extent continue teaching and research; yet the Nation must enormously expand its efforts in research and development in support of the military program.

(3) Training of graduate students to the doctorate level is necessary to provide scientists who will be most productive in terms of ideas and additions to our store of basic knowledge in the sciences. The three years of post-graduate study necessary for a doctorate permit the student to attain a level of proficiency which enables him to engage in original and independent research. Generally speaking, it is here that our leaders in research are trained.

(4) A graduate fellowship program will increase the total capacity of science for all purposes including industrial progress and national defense. This increase will occur

to some extent almost at once and, over a period of years, in direct proportion to the numbers trained.

The need for trained scientists is exemplified in the following recent statement of the Scientific Manpower Advisory Committee of the National Security Resources Board, of which C. A. Thomas, President of the Monsanto Chemical Company, is Chairman:

> It is of paramount importance to the security of the United States that the nation maintain in peace and in war an adequate supply of scientifically and technically trained manpower to carry on progressive research in basic science; to design and develop devices and equipment for both military and civilian use; to sustain, broaden, and increase mass production by scientific and engineering methods; and to serve the armed forces in applied science research, technical maintenance, and the use of modern weapons.

The depletion of our national resources of highly trained manpower during the years of World War II has been pointed out in Manpower for Research, Volume III of Science and Public Policy. This indicates that the total number of persons in this class who were lost to the Nation during the war years, as a result of a lack of training due to the War, is estimated to be over 8,400. This is an important factor in the present shortage.

One of the most important considerations in the need for support of a fellowship program is the number of graduates in science adjudged competent to go on to graduate study who do not do so because of lack of finances. This is shown in a careful survey made by the National Research Council in 1948. This survey indicated that one-fourth of the college graduates receiving bachelor's degrees in that year, and judged competent by the heads of their departments to proceed to the doctorate in the natural sciences, were unable to enter graduate training because of inadequate financial support. It is estimated that, in the three-year period 1947 to 1950, over 14,000 potential Ph. D.'s in the sciences were prevented from entering graduate schools because of lack of funds.

In the immediate future, the financial factor will loom even larger as G. I. training declines. G. I. benefits were received by approximately one-half of the total number of graduate students in the sciences in the years 1948-50. This number is now decreasing and will continue to decrease rapidly. Students who have been unable for financial reasons to receive further training in the sciences represent a net loss to the Nation in trained scientific manpower.

Advantages of Fellowship Program. A number of advantages will accrue as a result of the fellowship program: competent students, at present unable to pursue graduate studies for financial reasons, will be enabled to do so; post-doctoral fellowships will make it possible for mature scientists who have already received their doctorate or advanced engineering degree to spend one, and in some cases two years on specific problems in fundamental research; an increase in the number of highly trained scientists will contribute directly and in some cases immediately to the effectiveness of research activities; and the capacity of the country for all forms of research will be increased on a long range basis.

Another direct result of a fellowship program is a saving of time in training scientists. While studying on a fellowship the student can devote his entire attention to his primary work, free from commitments for teaching and other distractions. The quality of the training is also enhanced.

It is through fellowship opportunities that some of the most important pioneering work in science will be done. Especially in the case of the post-doctoral fellowships, which will be relatively few in number, will there be an opportunity to develop future leaders in research and education. Proof may be found in the experience of the National Research Council in administering its own limited program of post-doctoral fellowships over the last thirty years. From the scientists who held National Research Council fellowships have come many of today's eminent scientists, educators, and leaders in industrial and government research. During the war former National Research Council fellows played leading roles in the development of the atomic bomb, radar and radar counter-measures, and the proximity fuse.

The fellowship program represents a relatively small investment with the near certainty of great gains in the future.

Distribution of Fellowships. In arriving at the optimum number and distribution of the proposed science fellowships, account has been taken of existing sources of support as well as the local opportunities for such aid in the hands of private institutions (the latter being available mainly during the last years of graduate study). The table below sets forth the estimated number of fellowships to be provided under funds made available by the National Science Foundation program, principally for use in the academic year 1952-53:

Graduate Level	Number
First year	1,400
Second year	400
Third year	200
Post-doctoral	100
Total	2,100

Of the total number of graduate students in the fields of science and engineering in 1950, the proposed number of graduate fellowships in this estimate amounts to 3.6 percent. The number of fellowships recommended for the first year of graduate study comprises 4.5 percent of the total number of first-year graduate students, and the number of fellowships recommended for the second year comprises 2.2 percent of the total number of second-year graduate students. The fellowship program will thus provide assistance to a small but highly select fraction of the total graduate student body.

The largest number of fellowships is provided for the first year of graduate study. This is the critical time in the selection of graduate fellows since a delay means a loss in continuity of training and increases the possibility that the students will be permanently lost as scientists. Other fellowship programs, for example, the Guggenheim and NRC fellowships, aim at graduate students in later years, the third or post-doctoral years.

Selection of Fellows. Fellows under the proposed program will be selected solely upon the basis of ability, as required by the National Science Foundation Act, with appropriate consideration being given to wide distribution throughout the Nation in the case of applicants deemed to be of substantially equal ability. Fellowships will be granted on a one-year basis with the possibility of a renewal.

The National Research Council, because of its experience in fellowship program administration, is the logical agency to administer the Foundation's fellowship program in the opening year. Accordingly, the Foundation plans to arrange with the NRC for the initial selection of candidates for these fellowships and for a substantial amount of the administrative work involved in carrying it out. Final appointments, as required by law, will be made by the Foundation.

Estimate of Cost. In developing estimates, the Foundation must necessarily rely in the beginning for information from other fellowship programs. Based on the experience of the National Research Council, the Atomic Energy Commission, and the Public Health Service, an average cost of slightly less than $2300 per fellowship is a reasonable estimate. This would include on the average a stipend of about $1600, tuition of $500, an allowance for dependents of $100 and an allowance for procurement of technical equipment and materials of $100. In addition, experience shows that a competent job of testing and selection for a program of this size should run somewhat less than 10 percent of the total amount distributed to recipients. A tentative distribution of the cost required for the program in 1952 is as follows:

Level	Number	Average Cost	Total Cost
First year	1400	$2,000	$2,800,000
Second year	400	2,300	920,000
Third year	200	2,500	500,000
Post-doctoral	100	3,500	350,000
	2100	$2,176	$4,570,000
Cost of testing and selection......................			400,000
Total cost of program......................			$4,970,000

VI. SUMMARY OF OPERATING COSTS OF THE FOUNDATION

The estimated operating costs of the Foundation by object and function for fiscal year 1952 are summarized in the table on page 29. The table on page 30 shows the distribution by object between program and operating costs. The chart following page 30 sets forth the proposed organization of the Foundation. A brief discussion of each object is given below.

01 - Personal Services	Amount
Permanent Staff, Office of the Director	
The attached organization chart shows the number and proposed distribution of positions among the various organizational units. The number of positions proposed for fiscal year 1952 is 140, with an average employment of approximately 82 for the entire year. In arriving at this number, consideration has been given to the experience of other activities, both private and governmental, administering comparable programs. On the basis of this experience, the number proposed is the minimum necessary to discharge the responsibilities of the Foundation on developing a national science policy and in managing wisely the Foundation's program in support of that policy..............................$	506,000
W.A.E. Employment	
Compensation of members of the National Science Board. The National Science Foundation Act provides that members of the Board shall be compensated at the rate of $25 per diem while engaged in the business of the Foundation. During 1952 it is anticipated:	
(a) That the Board will meet in full session at least 10 times at an average cost of $1300 per meeting based on present year experience, for a total of....................	13,000
(b) That Board members will have 50 days of additional business for the Foundation in the form of executive and other committee meetings, consultation, etc., which at the prescribed rate of $25 per day amounts to..............................	1,250

OPERATING COSTS OF THE FOUNDATION BY FUNCTION AND OBJECT
FISCAL YEAR 1952

	Object	Research Policy, etc.	Research Support	Training Scientific Personnel	Total
01	Personal services.........	$205,000	$261,000	$70,000	$536,000
02	Travel....................	28,000	37,000	10,000	75,000
04	Communication services....	1,800	2,500	700	5,000
05	Rents and utilities.......	1,800	2,500	700	5,000
06	Printing and reproduction.	6,000	7,500	1,500	15,000
07	Other contractual services	3,200	4,200	1,100	8,500
08	Supplies and materials....	5,800	7,500	1,700	15,000
09	Equipment.................	16,200	19,600	4,200	40,000
15	Taxes and assessments.....	200	200	100	500
	Total	$268,000	$342,000	$90,000	$700,000

Distribution of Total Costs by Object
Between Program and Operating Costs
Fiscal Year 1952

Object	Research Policy, etc	Research Support	Training Scientific Personnel	Operating Costs	Total
01 Personal serv.	$	$	$	$ 536,000	$,536,000
02 Travel	60,000			75,000	135,000
04 Com. services				5,000	5,000
05 Rents & utilities				5,000	5,000
06 Print. & repr.				15,000	15,000
07 Other cont. serv.	457,000		400,000	8,500	865,500
08 Sups. & mat.				15,000	15,000
09 Equipment				40,000	40,000
11 Grants		7,813,000	4,570,000		12,383,000
15 Taxes & assess.				500	500
Total	$ 517,000	$ 7,813,000	$ 4,970,000	$ 700,000	$ 14,000,000

24 P

Divisional Committees

General Counsel

1 General Counsel		12,600
1 Asst. General Counsel	GS - 13	7,600
1 GS - 6		4,200
3		24,400

1 Dir
1 Dep
1 Exe
1 GS
1 GS
1 GS
1 GS
7

Medical Research Division

1 Asst. Dir.	13,000
2 GS - 15	20,000
3 GS - 14	26,400
2 GS - 13	15,200
2 GS - 12	12,800
1 GS - 6	3,825
2 GS - 5	6,200
1 GS - 4	2,955
1 GS - 3	2,650
15	103,030

Biological Science Division

1 Asst. Dir.	13,000
2 GS - 15	20,000
3 GS - 14	26,400
2 GS - 13	15,200
1 GS - 12	6,400
1 GS - 11	5,400
1 GS - 9	4,600
1 GS - 6	3,450
2 GS - 5	6,200
1 GS - 4	2,875
1 GS - 3	2,650
15	106,175

Math., Physical & Eng. Sciences Division

1 Asst. Dir.	13,000
3 GS - 15	30,000
5 GS - 14	44,000
4 GS - 13	30,400
3 GS - 12	19,200
3 GS - 11	16,200
1 GS - 6	3,450
3 GS - 5	9,300
1 GS - 4	2,875
2 GS - 3	5,300
27	173,725

National Science Board

24 Part-Time Members - Appointed by President

Committees

Executive Committee

9 Board Members

Special Commissions

Office of the Director

1	Director - Appointed by President	15,000
1	Deputy Director	14,000
1	Executive Sec'y. to Board GS - 13	7,600
1	GS - 9	4,850
1	GS - 7	3,825
1	GS - 6	3,450
1	GS - 5	3,100
7		51,825

Assistant Director for Administration

1	Assistant Director.	10,000
1	GS - 7	3,825
2		13,825

...al & Eng. ...sion

13,000
30,000
44,000
30,400
19,200
16,200
3,450
9,300
2,875
5,300
173,725

Scientific Personnel and Education Division

1	Asst. Dir.	13,000
2	GS - 15	20,750
1	GS - 14	8,800
4	GS - 13	30,400
3	GS - 12	19,600
2	GS - 11	10,800
2	GS - 9	9,950
1	GS - 6	3,450
6	GS - 5	19,475
1	GS - 4	2,875
23		139,100

Scientific Information Office

1	Scientific Info. Officer GS-15	10,000
1	Scientific Info. Specialist GS-13	7,600
1	GS - 12	6,400
1	GS - 11	5,400
1	GS - 9	4,600
1	GS - 5	3,100
1	GS - 4	2,875
1	GS - 3	2,650
8		42,625

Finance Office

1	Comptroller GS - 14	8
1	Grants Negotiator GS - 14	8
2	GS - 13	15
2	GS - 12	12
7	GS - 11	37
2	GS - 9	9
1	GS - 7	3
1	GS - 6	3
4	GS - 5	12
2	GS - 4	5
3	GS - 3	7
26		125

NATIONAL SCIENCE FOUNDATION
POSITION ORGANIZATION PLAN
FOR FISCAL YEAR 1952

Director

ation

ctor. 10,000
3,825
13,825

Finance Office

1 Comptroller GS - 14	8,800
1 Grants Negotiator GS - 14	8,800
2 GS - 13	15,200
2 GS - 12	12,800
7 GS - 11	37,800
2 GS - 9	9,200
1 GS - 7	3,825
1 GS - 6	3,450
4 GS - 5	12,400
2 GS - 4	5,765
3 GS - 3	7,950
26	125,990

Administrative Office

1 Admn. Off. GS-13	7,600
1 Personnel Officer GS-12	6,400
1 GS - 11	5,400
1 GS - 7	3,950
1 GS - 6	3,450
1 GS - 5	3,100
4 GS - 4	11,580
1 GS - 3	2,650
1 GS - 2	2,930
2 CPC - 3	4,504
14	51,564

01 - Personal Services (continued)	Amount
Special Commission. The National Science Foundation Act provides that special commissions of 11 members may be appointed to assist in the formulation of a national science policy. In 1952 it is anticipated that two such commissions will be appointed and commence deliberations.	
Two commissions of 11 members each.....22,	
Estimated number of meeting days...... 4,	
Estimated number of compensable days for each meeting day................ 2,	
Total estimated compensable days......176,	
At $25 per day....................................$	4,400
Divisional Committees. The National Science Foundation requires that there be divisional committees of 5 members each to advise the Foundation in the conduct of its program. In 1952, it is anticipated that 4 of these Committees will be constituted.	
Four committees of 5 members each..... 20,	
Estimated number of meeting days...... 10,	
Estimated number of compensable days for each meeting day................ 2,	
Total estimated compensable days......400,	
At $25 per day....................................	10,000
Consultants to the Office of the Director. It is anticipated that the Foundation will require approximately 45 additional days of consultant services under section 5 of Act of August 2, 1946 (5 U.S.C. 73 b-2) at average cost of $30 per day..	1,350
Total, personal services.....................$	536,000

02 - Travel	Amount
Attendance of Scientists at International Meetings. The Foundation is authorized under Section 13 of the Act to ... "defray the expenses of representatives of Government agencies and other organizations and of individual scientists to accredited international scientific congresses and meetings..." The estimate provides for 70 scientists to attend such meetings at an average of approximately $850 per attendance (see also pages 13 and 14)..$	60,000
Travel by members of the National Science Board. Based on the experience of the present year it is expected that the travel costs of the Board in 1952 will be:	
Ten meetings at $1650 per meeting..................	16,500
Additional business, 50 trips at approximately $85 each................................	4,250
Travel by members of special commissions and divisional committees.	
Special commissions: 22 members for 4 meetings, requiring 88 trips at approximately $85 each................................	7,480
Divisional committees: 20 members for 3 meetings requiring 60 trips at approximately $85 each................................	5,100
Travel by the staff of the Office of the Director and consultants	
The estimate allows approximately 417 trips by staff members of the Director's Office and of consultants at approximately $100 each...................................	41,670
Total, travel.......................$	135,000

04 - Communication Services

For telephone installation and termination costs, long distance services, etc., based on a per capita cost of $61 for an average employment of 82.................................$	5,000
Total, communication services...........	5,000

05 - Rents and Utilities

For rental of equipment, and of other services necessary in the operation of the Foundation......................................	5,000
Total, rental and utilities.............	5,000

06 - Printing and Reproduction

For printing of the annual report of the Foundation required by Section 3(c) of the basic Act....................................	2,500
For printing technical reports arising from research projects sponsored by the Foundation and other program activities of the Foundation................................	11,000
For printing and contractual reproduction of administrative materials required in the operation of the Foundation (letterheads, informational material, etc.)..............	1,500
Total, printing and reproduction.......	15,000

07 - Other Contractual Services

For contracts with groups outside the Foundation to provide statistical and other services in connection with the development of a national science policy (see also pages 12 & 13)...........	50,000
For contracts with groups outside the Foundation for research in the techniques of disseminating scientific information (see also pages 13 & 14)...	225,000

07 - Other Contractual Services (continued)	Amount
For transfer to the Office of Education for support of the National Scientific Register prior to assumption by the Foundation of the Register's operation (see also pages 15 & 16)..........................$	156,000
For transfer to the National Advisory Committee on Aeronautics for support of the Interdepartmental Committee on Scientific Research and Development (see also pages 16 & 17).........................	26,000
For administration of the Foundation's fellowship program by the National Research Council (see page 26)....................	400,000
For miscellaneous contractual services in connection with the operation of the Foundation, e.g., office moves, building maintenance, etc......................................	8,500
Total, contractual services..............	865,500

08 - Supplies and Materials

For office and other supplies required in the operation of the Foundation..................	15,000
Total, supplies and materials............	15,000

09 - Equipment

The equipping of the Foundation with office and incidental equipment will extend over a two-year period. The total cost is estimated to be $100,000, of which $60,000 will be defrayed from the 1951 appropriation. The total cost has been computed as follows:

Office equipment: 140 positions at an average cost of $600 per position...............$	84,000	
Miscellaneous equipment....................	16,000	
Total cost, 1951 & 1952...........	100,000	
Defrayed from 1951 appropriation..........	60,000	
Required from 1952 appropriation.................		40,000
Total, equipment........................		40,000

	Amount
11 - Grants	
For grants and other arrangements to research activities in support of basic research (see also pages 18-22)................................	$ 7,813,000
For grants to graduate students in the form of fellowships (see also pages 23-27).............	4,570,000
Total, grants............................	12,383,000
15 - Taxes and Assessments	
For the foundation's contributions under the Federal Employees' Insurance Contribution Act...	500
Total, taxes and assessments............	500
Grand total, all objects.....................	$ 14,000,000

Appendix I

HISTORICAL BACKGROUND OF THE NATIONAL SCIENCE FOUNDATION

The establishment of the National Science Foundation on May 10, 1950 represents the culmination of a long series of efforts to provide for an appropriate recognition and support of science by the Federal Government. It may therefore be of interest to note some of the steps in the evolution of the National Science Foundation.

Smithsonian Institution

The Smithsonian was created by act of Congress approved August 10, 1846 under the terms of the will of James Smithson, of London, England, who in 1829 bequeathed his fortune to the United States to found, at Washington, an establishment for the "increase and diffusion of knowledge among men." This was the first significant step taken by the Federal Government to support fundamental research.

National Academy of Science and the National Research Council

On March 3, 1863, President Lincoln approved an act passed by the Congress for the incorporation of the National Academy of Sciences. The Act stipulated that

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

During World War I, President Wilson requested the Academy to establish the National Research Council as the active agent of the Academy to assist the Government in organizing the scientific resources of the country. The Council so fully demonstrated its value that it seemed desirable that its life be extended after the war. President Wilson accordingly signed, on May 11, 1918, Executive Order No. 2859 requesting the Academy to perpetuate the National Research Council.

The distinguished members of the Academy and of the Council, render their services without compensation on a part time basis. Neither body is directly financed with Federal funds, although the Academy has contracts with the Federal Government.

Science Advisory Board

In order that the various scientific services of the Government might enjoy the cooperation of non-governmental scientists, President Roosevelt named a Science Advisory Board to the National Research Council on July 31, 1933. The Board, which was established on a short-term basis, was authorized to appoint committees to deal with specific problems in various Government departments. Under the operating principles which the Board set for itself, advice was given only when requested, and the functions, standards and programs of the scientific bureaus were its principal concern. In its first report, however, the Board stated: "The attempt has been made to look beyond details of program, procedure and personnel, toward the great social objectives of science, to see which of them are the necessary part of government and how each bureau can contribute toward them."

Dr. Karl T. Compton, then President of the Massachusetts Institute of Technology, was Chairman of the Board, and its membership represented an impressive cross section of the scientists of the country.

In its first report the Board commented as follows:

> In the evolution of our national life we have reached a place where science, and the research which has discovered and released its powers, cannot be regarded as matters of accidental growth and application, but must be consciously related to our social life and well-being. What these relations are or may become is now a matter of general or public concern. This leads at once to the question as to how far Government itself should go in conducting or supporting research or guiding the applications of scientific discoveries, and how its responsibilities in these lines can best be handled.

These were the depression years and one recommendation of far-reaching importance was for a recovery program of science progress. In it, the Board had this vigorous comment to make regarding research in the basic sciences:

> It should not be forgotten that back of applied science must be continual progress in pure science. Consequently any well balanced program of research should provide for continued productive activity in the fundamental sciences. It is suggested, therefore, that some portion of the funds here discussed be made available for such research, with particular consideration of important programs already in progress in institutions, which have had to be dropped or curtailed in the present financial emergency.

"Relation of the Federal Government to Research"

Another major inquiry into the relationships of the Federal Government to research and development was instituted in 1937 by the National Resources Committee, with the approval of the President. A Science Committee, under the chairmanship of Ross G. Harrison, issued a series of reports from 1938 to 1941. The first of these "Relation of the Federal Government to Research," the work of Charles H. Judd, William F. Ogburn and E. B. Wilson, is of particular significance.

In submitting and indorsing to the President of the United States the findings of the Science Committee, the National Resources Committee commented:

> Research constitutes one of our most important national resources. The Federal Government has always played an important role in relation to scientific research, and in the last decade has expanded its activities, particularly in the social sciences. If we are to make more effective use of all the resources of the Nation for the benefit of all our citizens, our research resources must be conserved and developed.

Office of Scientific Research and Development

The following year war broke out in Europe, and the activities of scientists loomed in new perspective. Rumors of the technological superiority of the Wehrmacht spurred a group of American scientists to action. Spokesman of a group which included Conant of Harvard, Compton of M.I.T., and Jewett of Bell Telephone Laboratories, Dr. Vannevar Bush, President of the Carnegie Institution of Washington, presented a plan for the President's consideration. It envisioned the immediate mobilization of American scientists and resources for the development of weapons and devices of warfare which would offset anything a potential enemy might bring against this country. The President gave the plan almost immediate approval, and the National Defense Research Committee, headed by Dr. Bush, was created by Order of the Council of Defense on June 27, 1940. A year later, the National Defense Research Committee had so far proved its value to the Military Services that the organization was reconstituted by the President into the Office of Scientific Research and Development by Executive Order of June 28, 1941. Out of its activities grew the United States radar program, the proximity fuse, and the atomic bomb, to name but a few of the weapons for which it was wholly or in part responsible. The OSRD through its Committee on Medical Research also sponsored an effective program of medical research which made significant contributions to the development of penicillin, blood fractionation, anti-malarials, insecticides, and other important contributions to the health of our fighting forces.

The OSRD demonstrated that an independent agency could operate effectively in the area of scientific research and development. It avoided the construction of elaborate new facilities and instead chose to contract with existing academic, industrial and governmental research institutions. This policy enabled the Government to make full use of the best brains and facilities in the country. The OSRD was, however, a purely wartime agency, predestined to go out of existence at the end of the war. Long before the war was over it became apparent to members of Congress, to scientists, and to others, that an important need existed for a permanent agency of the OSRD type to support and foster scientific research for applications over and above military needs.

Senate Committee on Military Affairs, Subcommittee on Technological Mobilization

An early wartime effort to mobilize as fully as possible technically trained manpower, technical facilities, inventions and knowledge of the country was made by a Senate Committee on Military Affairs Subcommittee on Technological Information under the chairmanship of Senator Harley M. Kilgore. The hearings which extended through 1942, 1943, 1944, and 1945 were antecedent to the National Science Foundation legislation.

"Science--The Endless Frontier"

Further thinking as to the need for continuing Federal financing of scientific activities was stimulated by Presidential inquiry. In a letter of November 17, 1944 the President asked the Director of the Office of Scientific Research and Development four important questions:

(1) 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 possible the contributions which have been made during our war effort to scientific knowledge?

(2) 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?

(3) What can the Government do now and in the future to aid research activities by public and private organizations?

(4) 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?

Dr. Bush appointed a series of committees representative of American science to assist him in the preparation of a reply to the President. That reply is the now well-known "Science--the Endless Frontier." A major recommendation of the report was for the establishment of a National Research Foundation, the purposes of which would be to:

> ...develop and promote a national policy for scientific research and scientific education, ...support basic research in non-profit organizations, ...develop scientific talent in American youth by means of scholarships and fellowships, and ...by contract and otherwise support long range research on military matters.

The Committee on Postwar Research

At about the same time the Secretaries of War and Navy were experiencing some concern regarding the hiatus which would be created in the program of military research and development when the OSRD was terminated. Together they named a Committee on Postwar Research which was requested "to study the various aspects of the postwar research and development needs of the War and Navy Departments and to recommend a plan for carrying on such work after the war." The Committee, which was headed by Mr. Charles E. Wilson, Vice President of General Electric Company and now Director of Defense Mobilization, was composed equally of civilian scientists, and Army and Navy representatives. The Committee's report, submitted September 18, 1944, recommended the establishment of an independent agency which should be charged with the responsibility of a long term program for national security. Recommended legislation to accomplish the purpose accompanied the report. As an interim measure, until such legislation might be enacted, the Committee recommended that a Research Board for National Security should be established within the National Academy of Sciences. In a letter of November 9, 1944, addressed to the president of the National Academy of Sciences, the Secretaries of War and Navy requested that a Research Board for National Security be constituted, and commented in part:

> To insure continued preparedness along far sighted technical lines, the research scientists of the country must be called upon to continue in peacetime some substantial portion of those types of contribution to national security which they have made so effectively during the stress of the present war. By such peacetime service, moreover, there will be maintained at all times a substantial body of scientists acquainted with military personnel, establishments, procedures and problems who can be immediately mobilized for effective service in event of another war emergency.

The Research Board for National Security was never activated, but efforts for a permanent Federal agency for the support and encouragement of research and development continued along other lines.

The President's Scientific Research Board

By Executive Order of October 17, 1946, the President's Scientific Research Board was established and directed

> to investigate and report upon the entire scientific program of the Federal Government, to make recommendations concerning its content and balance, to report upon its administration and to recommend administrative improvements, to examine the conditions under which scientists are employed by the Government, to analyze the policies of the several agencies in respect to research contracts, to survey our national scientific resources in terms of men, money, and facilities, and to examine into the training of scientific personnel.

A report to the President on Science and Public Policy by the Chairman of the President's Scientific Research Board was issued in five volumes on successive dates following the appearance of the first volume on August 27, 1947.

The report recommended that by 1957 we should be devoting at least one percent of our national income to research and development in the universities, industry and the Government; that heavier emphasis should be placed on basic research and upon medical research in our national research and development budget; that the Federal Government should support basic research in the universities and non-profit research institutions at a progressively increasing rate reaching an annual expenditure of at least $250,000,000 by 1957; and that a National Science Foundation should be established to make grants in support of basic research. The Board made other recommendations pointing toward the purposes for the accomplishment of which the National Science Foundation has now been established.

The Office of Naval Research

Of particular note is legislation passed in August 1946 creating the Office of Naval Research to coordinate research activities of the Navy and to support basic research of interest to the Navy through contracts with universities and other research institutions. This Office is generally regarded as having sustained basic research through the crucial post-war period in which there was no other Federal median for its support.

Other Military and Atomic Energy Research and Development

This summary does not attempt to take into account the chronological evolution of Military and Atomic Energy research and development.

The Departments of the Army, the Navy, and the Air Force support their own programs of research and development. A separate agency at the Department of Defense level, the Research and Development Board, was created by the National Security Act of 1947 to coordinate the programs of the three military departments and to formulate an over-all program at the national level.

The Atomic Energy Commission, established by the Atomic Energy Act of 1946, administers the Government's research and development program in that field, and funds are appropriated expressly for that purpose.

Conclusion

For over a hundred years the Federal Government has recognized that scientific research is a matter of national concern. It has further recognized the need for governmental support and encouragement of research. This need has now culminated in the establishment of the National Science Foundation, an agency created by Congress in 1950:

> To promote the progress of science; to advance the national health, prosperity, and welfare; [and] to secure the national defense.

APPENDIX II

LEGISLATIVE HISTORY OF THE NATIONAL SCIENCE FOUNDATION ACT OF 1950

The report made on June 14, 1949 by the Committee on Interstate and Foreign Commerce of the House of Representatives, accompanying H.R. 4846 (Report No. 796, 81st Congress, 1st Session) summarizes the legislative history of the National Science Foundation Act as follows:

> "The history of the Science Foundation legislation begins on November 17, 1944 when President Roosevelt wrote a letter to Dr. Vannevar Bush, Director of the wartime Office of Scientific Research and Development, asking him to prepare for him a report on a postwar science program.
>
> "President Roosevelt had passed away when Dr. Bush submitted his report in July 1945. His report was entitled Science, the Endless Frontier. It became the basis for the Science Foundation legislation which is being considered today.
>
> "Shortly after the submission of the report and essentially based on its recommendations, identical Science Foundation bills were introduced in the Seventy-ninth Congress by Senator Magnuson and Representative Mills. Other measures were introduced by Senators Kilgore and Fulbright.
>
> "When, in September of 1945, President Truman called Congress into special session to enact a 21-point postwar domestic program, one of the points urged the establishment of a single Federal Research agency. Following the President's request, hearings were begun in the Senate on the various Science Foundation bills which continued through October of 1945.
>
> "Several points were in dispute. Among them were the type of organization of the Foundation and what kind of patent provisions should be included in the bill.

"In the following year, the Senate Committee reported out S. 1850, which would have made extensive changes in the patent laws of the United States with respect to inventions made with the financial support of the Federal Government. The bill also would have placed considerable control in the President of the United States.

"This committee, late in 1946, held hearings on H.R. 6448, introduced by Representative Mills. This bill was a revised version of his original Science Foundation bill.

"In July 1946 the Senate passed S. 1850 by a vote of 48 to 18. The House took no action and all bills died with the close of the Seventy-ninth Congress.

"During the Eightieth Congress S. 526 was sponsored by a bipartisan group of six Senators and the House had also before it a number of Science Foundation bills. The Senate bill was passed by the Senate in May by a vote of 79 to 8.

"In the House this committee held extensive hearings and, as a result of the hearings, H.R. 4102 was introduced, reported favorably by the comittee, and passed by the House, its text being substituted for that of S. 526.

"S. 526 then went to conference and both Houses approved the conference report. The bill died by pocket veto. President Truman stated in a memorandum of August 6, 1947, that he had vetoed the bill with great reluctance for he was convinced of the urgent need for the establishment of a National Science Foundation, but he felt that the bill passed by Congress vested the determination of vital national policies and the expenditure of large public funds in a group of individuals who would be essentially private citizens. This, the President stated, was a marked departure from the sound principles for the administration of public affairs to which he could not give his approval.

"In 1948, during the second session of the Eightieth Congress, new bills were introduced both in the Senate and in the House - S. 2385 and H.R. 6007. These bills were identical and constituted a compromise worked out following conferences between some Members of Congress and presidential advisers. In May 1948 the Senate passed the new measure by a voice vote. In the House this committee held brief hearings and reported favorably H.R. 6007, which differed in a few respects from S. 2385, passed earlier by the Senate. The bill failed to reach the House floor and, therefore, the Science Foundation legislation did not materialize during the Eightieth Congress.

"In the Eighty-first Congress, in the Senate, there was introduced S. 247 which is identical with S. 2385, the last Science Foundation bill passed by the Senate during the second session of the Eightieth Congress. This bill passed the Senate without amendment and in the House was referred to this committee. In the House seven bills were introduced which fall into three categories. Four of these bills were identical with H.R. 6007, reported favorably by this committee during the Eightieth Congress, which differ in some respects from S. 247. These bills are H.R. 12, H.R. 185, H.R. 311, and H.R. 2751.

"The second category consists of H.R. 1845 and H.R. 2308 which are in all respects identical with S. 247.

"The third category consists of a single bill, H.R. 359, which differs substantially from the bills in the first two categories with respect to the organization of the Foundation and patent provisions.

"Although the 4-year history of proposed legislation on this subject encompasses over 1,200 pages of testimony by 150 of the Nation's leading authorities in science, education, and medicine, the committee further reviewed the legislation in public hearing, on March 31 and April 1, 4, 5, and 26, 1949. In the light of this additional information the committee has rewritten the Science Foundation bill that it reported favorably during the Eightieth Congress, primarily to clarify the bill still further. As a result, a new bill, H.R. 4846, has been introduced by Mr. Priest, whose subcommittee on Public Health, Science, and Commerce held hearings on this subject. The committee believes that H.R. 4846, as amended, is a better bill with respect to form, as well as content, than any bill on the subject heretofore proposed, and that it meets the objections expressed by the President in his memorandum of August 6, 1947, with respect to S. 526."

Concurrently with the consideration of H.R. 4846 in the House, the Senate considered and passed a similar although not identical bill, S. 247. Following adoption of H.R. 4846, the House, by amendment, substituted the provisions of H.R. 4846 for those of S. 247. Following a conference a revised version of S. 247 was reported out in both houses and passed, receiving the approval of the President on May 10, 1950 as Public Law 507, 81st Congress, the National Science Foundation Act of 1950.

APPENDIX III

BIOGRAPHICAL SKETCHES

MEMBERS OF THE NATIONAL SCIENCE BOARD

ABERLE, Sophie B. D. Ph.D., Stanford NEW MEXICO
Physician and anthropologist. Special Research Director, Univ. of New Mexico. Supt., Pueblo Indians, Bureau of Indian Affairs, and Secretary of the Southwest Supervising Council, U.S. Indian Services, 1935-44. Chief, Emergency Medical Services, State Council of National Defense, New Mexico, 1942-44. Member, Div. of Medical Sciences, National Research Council, since 1944. Former research associate, Carnegie Institution of Washington.

BARNES, Robert P. Ph.D., Harvard WASHINGTON, D.C.
Chemist and educator; now Associate Professor of Chemistry at Howard Univ., with which associated since 1922. Formerly in chemistry department at Amherst.

BARNARD, Chester I. D.Sc.,Rutgers; Univ. of Penn. NEW YORK
President, Rockefeller Foundation and General Education Board. Associated with American Telephone and Telegraph Company and subsidiaries until 1927. First president, New Jersey Telephone Co., 1927-1948. President, United Services Organization, 1942-45. Chairman, Executive Committee since 1945. Meritorious Civilian Service award, U.S. Navy, 1944; the President's Medal for Merit, 1946. Member, Board of Consultants to the State Department on Atomic Energy Control in 1946. Member, Presidential Special Committee on Integration of Medical Services in the Government, 1946.

BRONK, Detlev W. Ph.D., Univ. of Michigan MARYLAND
President, Johns Hopkins Univ. President, National Academy of Sciences. Coordinator of Research, Air Surgeon's Office, Headquarters Army Air Force, 1942-46. Chief, Div. of Aviation Medicine, Committee on Medical Research (OSRD), 1944-47. Vice Chairman, National Advisory Committee on Aeronautics. Member, Advisory Committee on Biology and Medicine, Atomic Energy Commission. Award for Exceptional Civilian Service, 1946.

CONANT, James Bryant. Ph.D., Harvard Univ. MASSACHUSETTS
President, Harvard University since 1933. Chairman, National Defense Research Committee (OSRD), 1941-46. Member, Educational Policies Commission, 1941-46. Member, Board of Scientific Directors, Rockefeller Inst. since 1930. Medal for Merit.

CORI, Gerty Theresa M.D., Prague Medical School MISSOURI
Biochemist, winner of Nobel Prize in medicine and physiology, 1947. Naturalized citizen of the United States since 1928. Professor of Biological Chemistry, Washington University Medical School.

DAVIS, John W. LL.D., Wilberforce U.; Howard U., WEST VIRGINIA
President, West Virginia State College since 1919. Member, President, Hoover's Organization on Unemployment Relief. Member, National Advisory Committee on Education of Negroes. Member, Commission on Institutions of Higher Education of North Central Ass'n. of Colleges, 1936-48. Member, U.S. Office of Education Wartime Commission.

DOLLARD, Charles LL.D., University of Denver. NEW YORK
President, Carnegie Corporation of New York, with which associated since 1938. Deputy Director for Operations Information and Educational Division, G.S.C. U. S. Army, 1944-46. Consultant to Research and Development Board, Department of Defense. Director, American Council on Race Relations.

DuBRIDGE, Lee A. Ph.D., Univ. of Wisconsin. CALIFORNIA
President, California Institute of Technology since 1946. Physicist, educator, science administrator. Board of Trustees, Rand Corp. since 1948. Member, General Advisory Committee, U.S. Atomic Energy Commission. Member, Advisory Board, Naval Research; Advisory Board, Air Force Science. Director, Radiation Laboratory, M.I.T. (OSRD Radar Program) 1940-45. Medal for Merit, 1948.

FRED, Edwin B. Ph.D., University of Gottingen WISCONSIN
President, Univ. of Wisconsin since 1945. Bacteriologist. Chairman, Advisory Committee on Biological Warfare, National Academy of Sciences, 1941-43. Member, National Advisory Health Council since 1945. Medal for Merit.

GROSS, Paul Magnus Ph.D., Columbia Univ. NORTH CAROLINA
Vice Pres., Duke Univ. since January 1949. Dean, Graduate School, Duke Univ. since 1947. Director, tobacco research since 1921. Member, Board of Directors, Oak Ridge Institute of Nuclear Studies. Medal for Merit, 1948.

HUMPHREY, George Duke Ph.D., Ohio State Univ. WYOMING
President, Univ. of Wyoming. Teacher and official, Mississippi School System, 1923-35. President, Mississippi State College, 1934-35. Consultant to Advisory Panel on Regional Materials of Instruction for TVA, 1941-44. Public member, Regional War Labor Board, 1943-45. President, Southern Ass'n. of Colleges and Secondary Schools, 1942-45. Chairman, Postwar Educational Committee, 1944-45. Member, Executive Committee, Ass'n. of Land Grant Colleges and Universities since 1944.

HYMAN, Orren Williams Ph.D., Princeton TENNESSEE
Dean, College of Medicine, Univ. of Tennessee since 1925. Dean of Administration, Memphis Division.

LOEB, Robert F. M.D., Harvard Medical School NEW YORK
Director of Medical Services, Presbyterian Hospital, New York, since 1947. Asso. Medical Director, Neurological Institute, 1938-41. Prof. of Medicine, Columbia Univ. since 1938. Trustee, Rockefeller Foundation. Special Consultant, Committee on Medical Research (OSRD). Chairman, Board of Coordination of Malarial Study, 1943-46. Chairman, Medical Board of Review, U.S.Atomic Energy Commission.

McLAUGHLIN, Donald H. Ph.D., Harvard CALIFORNIA
Mining Geologist and engineer. President of Homestake Mining Company. Chief Geologist, Cerro de Pasco Copper Corporation, Peru, 1919-25; Director since 1943. Professor, Mining Engineering, Harvard, 1925-35. Chairman, Div. of Geological Sciences, Harvard, 1930-41. Dean, College of Engineering, Univ. of California, 1942-43. Chairman, Advisory Committee on Raw Materials, Atomic Energy Commission, since 1947. Chairman, National Minerals Advisory Committee (Dept. of Interior) since 1947. Member, Committee on Natural Resources, Hoover Commission, 1947-48.

MIDDLEBUSH, Frederick A. Ph.D., University of Mich. MISSOURI
President, University of Missouri. Vice Chairman, Naval Civilian Advisory Committee, 1946. Member, Executive Committee, Association of Land Grant Colleges and Universities. Member, Citizens Committee on Reorganization of Federal Government. Chairman, Academic Advisory Board, U.S. Merchant Marine Academy, 1948-49. Member, Committee on Organization, Executive Branch of the Government, 1948. Member, Commission to Study Financing of Higher Education and Research, Service Academy Board.

MORELAND, Edward L. M.S., Mass. Inst. of Tech. MASSACHUSETTS
Executive Vice President, M.I.T., since 1946. Member of firm, Jackson & Moreland since 1919. Regional Advisor on Engineering, U.S. Office of Education, Defense Training in Region I, 1940-42. Member, Advisory Committee for Coordinating Available Facilities for Defense Production (OPM) in Region I, 1941-42; also member, Labor Supply Committee (OPM) 1941-42. Executive Officer, National Defense Research Committee (OSRD) 1942-45. Expert consultant to Secretary of War, assigned GHQ Armed Forces in Pacific. Chief, Scientific Survey in Japan in 1945.

MORRIS, J. C. Ph.D., Princeton LOUISIANA
Vice President, Tulane University. Director, Office of Scientific Personnel, National Research Council, 1941-43. Ass't Director, San Diego Laboratory and Associate Director, Training Program, Division of War Research, University of California, 1943-45. Personnel Procurement Officer, Applied Physics Laboratory, Johns Hopkins University, 1945.

MORSE, Harold M. Ph.D., Harvard NEW JERSEY
Mathematician. Professor, Institute for Advanced Study, Princeton, N.J., since 1935. Consultant, Office of Chief of Ordnance, U.S. Army. Consultant, Coast and Geodetic Survey. Consultant, National Defense Research Committee (OSRD). Chairman, War Preparedness Committee, 1940-42. Meritorious Service award, U.S. Army Ordnance.

POTTER, Andrey A.   D.Eng., Kansas State College   INDIANA
Dean of Engineering School and Director, Engineering Experiment Station, Purdue Univ., since 1920; Acting President, 1945-46. Consultant, U.S. Navy, since 1948. Chairman, Advisory Committee on Engineering, Science and Management Defense Training, 1940-46. Expert consultant to U.S. Office of Education, 1928-31. Executive Director, National Patent Planning Commission, 1942-45. Member, Science Advisory Board of Coordinator of Transportation, 1934-35. Member, Research Advisory Board, American Ass'n. of Railroads, since 1935.

REYNIERS, James A.   M.S., Notre Dame   INDIANA
Director of Bacteriology Laboratory, University of Notre Dame. Consultant to Chemical Warfare Service; Office of Naval Research; Federal Security Agency; U.S. Public Health Service.

STAKMAN, Elvin C.   Ph.D., Univ. of Minnesota   MINNESOTA
Chief, Div. of Plant Pathology and Botany, Univ. of Minnesota. Pathologist and agent, U.S. Dept. of Agriculture, since 1919. U.S. Dept. of Agriculture, National Defense, leader of rubber expedition to S. America, 1940. Member, Committee on Biology and Medicine, U.S. Atomic Energy Commission, since 1947. Vice Chairman, Div. of Biology and Agriculture, National Research Council, 1937-38, and since 1948.

WILSON, Charles E.   NEW YORK
President, General Electric Company. Director, Office of Defense Mobilization. Executive Vice President, War Production Board, 1942-44.

YANCEY, Rev. P. H., S.J.   Ph.D., St. Louis   ALABAMA
Chairman, Dept. of Biology, Spring Hill College. Instructor, biology, Spring Hill College, 1919-23; St. Louis, 1930-31; Professor and Chairman of Department, Spring Hill College, since 1931.

Member Ex Officio

WATERMAN, Alan T.   Ph.D., Princeton   WASHINGTON, D.C.
Director, National Science Foundation. Deputy Director and Chief Scientist, Office of Naval Research, 1946-51. Deputy Chief, Office of Field Service (OSRD), 1943-45; Chief, 1945. Associate Professor of Physics, Yale University, 1931-43.

21 May 1951