The Second Annual Report

of the

NATIONAL SCIENCE FOUNDATION

Fiscal Year 1952

Dorothy P. Jon

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LETTER OF TRANSMITTAL

WASHINGTON 25, D. C.,
November 1, 1952.

MY DEAR MR. PRESIDENT: I have the honor to transmit herewith the Annual Report for Fiscal Year 1952 of the National Science Foundation for submission to the Congress as required by the National Science Foundation Act of 1950.

Respectfully,

ALAN T. WATERMAN,
Director, National Science Foundation.

The Honorable
The President of the United States

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FOREWORD

The following report of the National Science Foundation records such matters of fact as should formally be made available in a public document. It shows what the Director and his staff, with the approval and the cooperation of the Board, and with the advice of many scientists, have accomplished despite two annual appropriations inadequate except to begin to perform the functions contemplated in the act establishing the Foundation. Insofar as this reflects the general need for economy in a huge national budget, it is not appropriate to comment here. But insofar as the financial limitations upon the Foundation's program reflect lack of understanding of the purposes for which the agency was created and of their importance to the Nation, I shall discuss these matters below.

First, however, a few remarks on the general organization of the Foundation are in order. The National Science Foundation consists of a Board of 24 members, appointed by the President with the consent of the Senate, and of a Director, who is *ex officio* a member of the Board, also appointed by the President with the consent of the Senate. The Board may meet as frequently as it deems necessary, but must meet at least once a year. It is composed of men and women eminent in various fields of science, education, and general affairs, so selected that all geographic sections of the country are represented to the extent possible in a Board of this size. Since December 1950, when the Board was organized, it has held 16 meetings. In view of the fact that all Board members are actively busy with professional and administrative duties and in most cases serve on other boards and committees, and that absence from the country and illness have interfered, the attendance has been remarkably good. It has averaged 83.7 percent.

Eight members of the Board were originally appointed for a 2-year term, eight for a 4-year term, and eight for a 6-year term. During the past year, President Truman reappointed all members whose terms expired in 1952 and all were willing to accept. Although change in the membership of a Board of this kind is desirable, I think it has been helpful in this initial period, when many problems of policy and procedure require consideration, for the President to reappoint these members. This action has had a stabilizing effect.

A Board of as many as 24 members still fails to represent many special branches of the sciences. The Congress recognized this fact by providing for Divisional Committees and other advisory groups to the Foundation. With great satisfaction I note here that the Foundation has been highly successful in enlisting competent men and women from all over the country to serve on its committees and panels. This evidence of the support of the scientific community over the difficult initial period has greatly encouraged the Board and the Director and his staff and deserves to be widely recognized. Its importance cannot be overemphasized, for the tasks required of the National Science Foundation cannot be effectively accomplished without the support of these men and women and of their institutions.

Nor is this all. An ever-present danger inherent in any governmental organization for promotion of basic science lies in its propensity to exercise the kind and degree of control which is appropriate to research and development more closely related to immediate practical ends. The chief safeguard against this danger, outside the integrity and understanding of the Director and members of the Board, is the extensive, active cooperation of scientists who are not part of the regular staff of the Foundation. For wise judgment of the merits of specific research proposals the Foundation depends upon those most competent and respected in their various fields. Such advice is a personal thing, relating not only to subject matter, but to character, scientific competence, and integrity of those to whom support is to be given.

The collaboration of scientists is also indispensable in the discharge of the functions of the Foundation in evaluating scientific progress and scientific needs. The term "evaluation" suggests to many the idea of direction or control—factors thought to be inimical to effective basic scientific research. It has been widely held that creative and imaginative research in science as in certain other fields is necessarily individualistic and unorganizable except for informal or more or less spontaneous collaboration. In large degree this may always be true, but it may well be that we have reached the stage of social development where deliberate collaboration of specialists and concerted development of ideas is possible and necessary. It has already become so in the ascertainment of facts and tests of hypotheses in a few important fields. In any event the act requires the Foundation to evaluate scientific progress and to locate fields that need scientific development, and it is difficult to see how the Foundation could carry out its functions otherwise. In so doing, however, the Foundation should guard against the danger of indirect control and avoid too strict adherence to scientific "orthodoxy" as well as the danger of discouraging independent research in fields of great potential importance. Clearly, in embarking upon the problem of evaluation—an undertaking of great delicacy and intricacy in which our society now must pioneer—the collaboration of the scientific community is indispensable.

Before concluding these remarks, I return to a subject mentioned in the first paragraph concerning basic research and support for this Foundation in solving problems relating to basic research. The significance of basic science for our national life, indeed for our international interests, is not well understood. This partly results from confusion with respect to the spectacular technological results of certain *ad hoc* researches which indeed have been almost glamorous—a fact not improperly exploited by industrial organizations which have had much to do with them.

It may also in a deeper sense be related to the fact that until comparatively recently, it has been generally impossible to look for practical results from application of science except to very specific problems and quite sporadically. This is still true, of course, in many branches of science, where the density of knowledge is low and the comprehensiveness and utility of theory is restricted, but we have now reached the stage of social organization and scientific development where these earlier limitations are being much reduced. This justifies the expenditure to a degree not possible earlier of manpower, resources, and money solely to extend our knowledge and develop fundamental scientific ideas for their potential, if not immediately apparent, practical significance. Thus, we have reached the stage where the maintenance of an expanding pool of tested scientific knowledge is good economics as well as indispensable in the effective utilization of the world's natural resources for the needs of an increasing and largely half-starved population and necessary for maintaining the competitive position of this Nation for military or economic purposes.

Whether such competition is desirable or merely unavoidable depends on the point of view. In any event the bottleneck in the future will be men. The proportion of our population potentially capable of assimilating the training required of scientists, or having the curiosity, interest, and ambition to pursue effective scientific careers, is narrowly limited compared with the need for such trained individuals in the development of basic science. Thus, the proportionately limited amounts of funds now required, even with the most liberal estimates, are of small consequence in the economy that we are here concerned with.

Our national interest requires full development of our potential scientific manpower resources and sufficient funds for this have not been available. Indeed, the present restriction in the National Science Foundation Act holding appropriations to a maximum of $15,000,000 in any year seriously limits the capacity of the Foundation to carry out effectively its statutory directives.

CHESTER I. BARNARD,
Chairman, National Science Board.

THE YEAR IN REVIEW

Publication of this report marks the end of the second year of operations of the National Science Foundation.

At the end of these 2 years the Foundation has made progress toward the fulfillment of its statutory responsibilities to the Nation and to science. In part these responsibilities are of an operational nature—supporting basic research in the sciences, encouraging young scientific talent through award of graduate fellowships, improving science teaching, broadening the flow of scientific information. In these cases the Foundation has had to devise suitable and effective operating techniques.

The second broad area of responsibility lies in the field of policy development. Here the goals are long range and must wait upon the gathering and analysis of facts—facts about the quantity and quality of present day scientific research, about the availability of and shortages in the supply of trained scientists and engineers, and about the many and complex ways in which science affects the national welfare. Once the basic information is in hand, the Foundation must develop methods for bringing informed opinion to bear on its analysis. Again definite progress can be reported in both the fact-gathering and analytical phases of policy development.

POLICY DEVELOPMENT

During the past year, the Foundation has started the first of a continuing series of fact-gathering studies under a newly established Program Analysis Office. Statistical information is being compiled on Federal obligations for research and development at nonprofit institutions. Other studies will be concerned with the organization of Federal agencies for research administration and with their budgets for research and development, the content of their research programs and the impact of Federal support of research upon industrial development and upon colleges and universities in the United States.

For certain types of information about the present state of science other study techniques are called for. In fiscal 1952 the American Physiological Society with Foundation support has begun to investigate the content and scope of the physiological sciences, the role of physiology in the realm of education, the professional personnel in the field, the scientific contribution which may be expected of physiology over the next few years and present plans to achieve it. Similar studies are planned in the fields of psychology and applied mathematics.

SHORT RANGE STUDIES

During the year the Foundation has undertaken a number of short-range studies on scientific topics having immediate urgency from the standpoint of national defense, the national welfare, or scientific promise. Here the aim is to determine the extent and kind of Federal research support and the outline of basic research needed to make the most progress in the shortest possible time. For example, attention has been focused upon ascertaining the status, the need and the potentialities of basic research in high temperature physics, chemistry, and metallurgy, a field critically related to jet engines, rockets, and guided missiles. A study is under way on the utilization of solar energy from the point of view of both the biological and the physical sciences.

The Foundation is making a full inventory of existing scientific and technical knowledge and research on techniques and instruments for the exploration for minerals. This is being done in cooperation with the National Security Resources Board in implementing the recommendation of the President's Materials Policy Commission.

RESEARCH GRANTS, FELLOWSHIPS AND SCIENTIFIC MANPOWER

In the past 12 months good progress has been made in filling out the scientific staff of the Foundation. Working procedures for review, evaluation and selection of high quality research projects were developed and the research support program in the biological, medical, mathematical, physical and engineering sciences became a fact. The first National Science Foundation graduate fellowships were awarded under a procedure by which young Americans with scientific talent are encouraged to undertake or continue careers in scientific research. A broad program to encourage and facilitate dissemination of scientific information was begun. Initial steps were taken toward the development of a program for research education in the sciences aimed primarily at raising the level of science training for teaching and research.

During the year a careful review and study of the scientific manpower clearinghouse function of the Foundation was undertaken. Plans were made to utilize the personnel records and other facilities of the professional societies in making continuing statistical analyses of the number and location of scientific and technical personnel in the United States.

ORGANIZATIONAL CHANGES

During fiscal year 1952, eight members of the National Science Board were reappointed by the President for 6-year terms, ending May 10, 1958. Chester I. Barnard, formerly President of the Rockefeller Foundation, was elected chairman of the board to succeed James B. Conant. Lists of members of the board, members of divisional committees and program panels, and principal members of the director's staff are given in Appendix 1, p. 36.

The following sections of this report will describe in detail the major programs of the Foundation, the progress that has been made during the current year and the major plans and policies that have been developed in connection with them. These will be discussed under the headings, Development of National Science Policy, Scientific Research Support, Scientific Manpower and Education, and Dissemination of Scientific Information. Supporting statistical and documentary material is provided in the Appendices.

DEVELOPMENT OF NATIONAL SCIENCE POLICY

In his Budget Message to the Congress, January 1952, the President of the United States outlined the broad policy-making functions of the National Science Foundation. He wrote:

> During the last decade we have seen how basic scientific research can alter the foundations of world power. We have seen that this research yields a stream of new knowledge which fortifies our economic welfare as well as our national strength. We have learned that a strong, steady, and wide-ranging effort in science is as essential to our sustained national security as the production of weapons and the training of military personnel.
>
> The National Science Foundation has been established as the Government agency responsible for a continuing analysis of the whole national endeavor in basic research, including the evaluation of the research programs of other Federal agencies. On the basis of studies now under way, the Foundation will formulate a broad national policy designed to assure that the scope and the quality of basic research in this country are adequate for national security and technological progress.

Earlier, the President had indicated that the Foundation "was conceived as a much-needed keystone in the structure of the national research program. Its principal task is to appraise the rapid growth of research activity, both public and private, and to recommend the broad goals toward which this massive effort should be channeled."

This concept of a Federal agency devoted to the formulation of national science policy followed the recommendations of the Hoover Commission. In its report the Commission itemized the major functions of such an agency as follows:

1. To examine the total scientific research effort of the Nation.
2. To assess the proper role of the Federal Government in this effort.
3. To evaluate the division of research effort among the scientific disciplines and among fields of applied research.
4. To evaluate the key factors that impede the development of an effective national research effort.

METHOD OF ATTACK

The necessary first step in policy development is the assembly of an adequate body of fact about the current status of science in the United States, including an inventory of our present resources of trained men and facilities. During 1952 steps were taken along three different lines to supply such information. These are:

1. Studies of existing Federal, university, and industrial research support.
2. Analysis of the current status of science and research by fields of science.
3. Special studies on urgent topics.

To assist in the collection of facts necessary to policy formulation and evaluation the Foundation has established a Program Analysis Office and has assigned it the responsibility for:

1. Planning and scheduling, with the cooperation of interested divisions of the Foundation and other Federal agencies, the studies necessary to discharge the Foundation's policy formulating functions.
2. Acting as a focal point within the Foundation for coordination of such activities, and serving as a repository of reports, data, and other material relating to program analysis.
3. Carrying out such studies, primarily those of a fact-finding nature, which because of their over-all character cannot logically be carried out by another division of the Foundation or another agency.

The Program Analysis Office is supported by the entire staff of the Foundation. The Foundation, in turn, draws upon all Federal agencies engaged in research or manpower studies, and the scientific societies. In certain areas the Foundation intends to establish special scientific investigating committees composed of industrialists, representatives of Government, economists, scientists, and teachers.

THE NATIONAL RESEARCH EFFORT

For the past 3 years the Bureau of the Budget has compiled statistical information on the amount of funds obligated by Federal agencies for research and development at colleges and universities. This information has been used in arriving at broad conclusions concerning the effect of this support on the educational system of the country, and as an aid in fiscal analysis of the Federal Government's budgetary programs. The Foundation has assumed responsibility for the annual compilation of this information and expects to complete its first report for fiscal years 1951 and 1952 early in fiscal year 1953. In order to obtain comparable information the Foundation provided each of the reporting agencies with working definitions of the classes of research and of the content of the various fields of science. See Appendix V, p. 72.

Preliminary figures from this survey show that Federal agencies made available a total of $297 million in fiscal year 1951 and $341 million in fiscal year 1952 for scientific research and development through grants and contracts at nonprofit institutions. Funds administered by the Department of Defense made up over 50 percent of the total in each year, compared with about 35 percent for the Atomic Energy Commission, almost 6 percent for the Federal Security Agency, and slightly less than 5 percent for the Department of Agriculture. The remaining agencies accounted for less than 3 percent of the total.

Obligations for basic research for the 2-year period totaled $147 million, compared with $317 million for applied research, $131 million for development, and $43 million for increase in research and development plant. See Appendix V, page 72.

In 1952 the total national expenditure for scientific research and development was estimated at approximately $3 billion. Nearly two-thirds of this amount, $2 billion, was provided by the Federal Government, one-third from industry and 3 percent from universities. A score of Federal agencies and bureaus now carry out scientific research and development programs in government-owned laboratories or administer research under contract with non-Federal groups. Normally the scientific activity supported by a particular agency relates to the operating responsibilities of that agency.

Nongovernment industrial research and development are aimed primarily at new products for wider markets or cheaper, more efficient processes. Here, likewise, research is closely tied to specific operating goals or missions. The vast bulk, then, of the total national expenditure for research and development, and as a corollary, the major part of available research facilities and specialized manpower are committed to the furtherance of specific program goals.

Therein lies a serious threat to the security and future well-being of the United States, for the great forward advances in science have seldom come primarily from applied or programmatic research. In the opinion of the Foundation and its advisory groups the cornerstone of national science policy is to assure adequate support—not only in terms of funds but in terms of qualified scientists and research facilities—for basic research in the sciences.

STUDIES BY FIELDS OF SCIENCE

Consideration of the current status of each domain of science will enable the Foundation to make realistic estimates as to the amount of support that can be effectively utilized in each field, what can best be accomplished in Government laboratories, what research can more efficiently be accomplished by nongovernment research institutions, the resources of manpower and facilities which are available, and the current status of development of the field.

Studies of the type described will supplement information obtained by other means. They can be successfully completed only with the full cooperation of scientists who are working in the field under review. A general survey of an entire field of science, including its research, training, and educational aspects, will require from 1 to 3 years to complete. Other survey methods include the employment of standing committees to consider progress in research only and the holding of conferences or symposia on special topics at appropriate intervals.

The first study started in fiscal year 1952 has to do with the physiological sciences. The American Physiological Society, under contract with the Foundation, is investigating the content and scope of the physiological sciences, the role of physiology in American education, the professional personnel now engaged in the field, the scientific contribution which may be expected of physiology in the future and the plans that have been made or are in the making to achieve it. This study which was proposed by the Society will be carried out by a central committee of physiologists. Working subcommittees have been established for personnel, research, communications, applications and consequences, and control and trend.

It is expected that the physiological survey will be completed during fiscal year 1954.

A similar study in the field of psychology as a science has been planned with the American Psychological Association. The Foundation jointly with the Army, Navy, and the Air Force also will support a survey of applied mathematics. In this case an appropriate committee of the National Academy of Sciences will undertake the investigation.

SYMPOSIA AND CONFERENCES

A closely related method for organizing information about a field of science is the assembling of experts for scientific symposia and conferences. The Foundation, with the assistance of several other Federal agencies, is supporting a committee of experts to survey current work and research potentialities in the low-temperature field. At the invitation of the General Electric Company a symposium was held at the Knolls Laboratory, Schenectady, N. Y., in October 1952, with joint sponsorship of the Foundation and the Office of Naval Research.

A conference on high-energy particles at the University of Rochester will also be sponsored by the Foundation in December 1952 to appraise recent progress in the physics of the elementary particles—one of the most important fundamental problems in physics at the present time.

Another conference at the University of Chicago will be sponsored by the Foundation in November 1952. This meeting on the abundance of the elements will bring together an outstanding group of astronomers, physicists, geologists, and chemists to consider recent findings in a subject of great interest and importance in many fields of science.

SPECIAL STUDIES ON URGENT TOPICS

In view of the nature of basic research it is ordinarily impossible to outline specific areas for investigation which promise short-term results of a practical nature. From time to time, however, it is possible to isolate certain areas in which the need for basic research is clearly urgent from the standpoint of the national defense, the general welfare, or promise in science itself.

Here again basic research is the pacemaker for applied work. Basic research aimed at producing more adequate data and at times new fundamental scientific discoveries hastens the progress of applied research. It serves to clarify the practical problems to be solved and enables the applied research scientist to lay out the course of his work in the most direct and economical manner.

The Foundation has made plans during the year to undertake short-range studies in three such areas, to determine the extent of research now being conducted, the extent of present Federal support, the need for expanding such support, and the specific areas where basic research may be necessary to make maximum progress.

High temperature physics, chemistry, and metallurgy comprise such a general area at the present time. Research problems in this field are critically related to the development of jet motors, rockets, and guided missiles. Here, the Foundation is following closely the work of the Minerals and Metals Advisory Board of the National Research Council and will expect to contribute to the work of this group.

Utilization of solar energy is a second field in which it seems clear that additional basic research will yield information of great potential value. In this case, the Foundation has attempted to coordinate the interests of other cooperating Federal agencies. One result of this cooperative effort is the scheduling of a series of National Research Council conferences on photobiology to review and evaluate current research. A counterpart study in the physical sciences will be concerned with the utilization of solar energy by physical and chemical rather than biological methods.

MATERIALS POLICY STUDIES

The Foundation is cooperating with the National Security Resources Board in undertaking activities recommended by the President's Materials Policy Commission. Four subjects in the Report of the Commission, *Resources for Freedom,* are of direct interest to the Foundation. These are:

1. Research to improve methods of exploration for hidden minerals.
2. Research bearing on the more effective utilization and conservation of scarce metals and other materials.
3. Research to make possible a future technology for the utilization of renewable sources of energy.
4. The training of qualified persons to do research in the sciences and engineering.

The first area of interest is defined in Recommendation 3 of the Report (Vol. I, p. 29), which reads as follows:

> That an intensive program of basic scientific research and technical development be undertaken on techniques and instruments of exploration for minerals. The first step should be the appointment of a special committee under the National Science Foundation, made up of outstanding experts from Government, private industry, and universities, to make a full inventory of existing scientific and technical knowledge and research projects in the field, to determine the areas of greatest need for further research and development, to devise a coordinated program to be carried out by private groups and such Federal agencies as the Bureau of Mines, Geological Survey, Bureau of Standards, and Office of Naval Research, and to estimate the cost of the program and the extent to which it will require supporting funds from the Government. The National Science Foundation could call upon the National Academy of Sciences (National Research Council) for assistance in laying the groundwork of a program.

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This recommendation is based on the recognition that technical developments almost invariably rest on a foundation of research and that there is small hope of significant advances in the exploration for hidden minerals unless there is a solid foundation of knowledge which has been developed through basic research.

Systematic search for ore bodies in the rocks of the earth's crust can be directed intelligently only if accurate and reliable knowledge is available concerning the mineralogy, the physical and chemical properties, and all aspects of the geologic character and history of such deposits. Much is of course known, as an inventory of existing data will reveal, but there is still a vast amount of additional work of fundamental nature to be done to provide an adequate scientific understanding of the many varieties of these unusual and complicated concentrations of metals or other valuable elements. The National Science Foundation recognizes that programs of research to advance such ends may very properly be considered one of its major concerns.

A special committee of the National Science Board of the Foundation has been appointed and the Foundation will support a group of experts from Government, industry and the universities to review the recommendation of the Commission and to plan appropriate steps by which the Foundation can carry out its part in this important enterprise.

GENERAL POLICY CONSIDERATIONS

The third paragraph of the section of the President's Budget Message devoted to the National Science Foundation calls attention to the responsibility of the Foundation to stimulate or sponsor basic research. He wrote:

> The Foundation also will stimulate or sponsor basic research in subjects which otherwise might receive inadequate attention. While the research program of the Foundation is not intended to supersede the basic research programs of other agencies, the Foundation should ultimately become the principal agency through which the Federal Government gives support to basic research that is not directly related to the statutory functions of other Federal agencies.

In carrying out these objectives, the general goal of the Foundation is to make certain that the scope and quality of basic research in the United States meet the requirements of national security, national welfare and continuing progress in science and technology. In particular, the Foundation lays stress upon the fact that adequate general support of basic research and training in the sciences is indispensable to the emergency effort. It constitutes a *defense in depth* which is essential to establishment and maintenance of technological supremacy.

At the close of fiscal year 1952, the Foundation was in position to take the lead with respect to Federal support of basic research. It was able to consider support of basic research in fields now receiving inadequate attention. Also, it was prepared to stimulate or sponsor basic research in scientific subjects of general importance to the interests of other Federal agencies. In so doing, however, the Foundation recognizes the desirability and importance of support by other agencies of an appropriate amount of basic research directly related to their statutory functions.

In attempting to lay the groundwork for national science policy the Foundation realizes the necessity of achieving full cooperation on the part of scientists in educational institutions, industry, and the Federal government. There can be no monopoly on the constructive thinking which must be brought to bear upon the problems facing science or created by it in the United States.

The Foundation, however, can do much to speed the process and to buttress scientific progress, particularly to meet the unique requirements of the United States. This country has achieved its present agricultural, economic, industrial and military position because of its ability to turn scientific knowledge to practical account. Over a century ago, Alexis de Tocqueville, shrewdly detected and remarked upon this American trait. He wrote:

> In America the purely practical part of science is admirably understood, and careful attention is paid to the theoretical portion which is immediately requisite to application. On this head the Americans always display a clear, free, original, and inventive power of mind. But scarcely anyone in the United States devotes himself to the essentially theoretical and abstract portion of human knowledge.

Although the last statement is no longer true, as a nation we do not yet fully appreciate the importance of basic research to technology. The technological sequence consists of basic research, applied research, and development. Historically, this Nation has placed emphasis upon these stages in reverse order. In times of crisis the pressure of events tends to throw the balance still farther away from support for basic research on the one hand and toward applied research and development on the other.

This tendency must be resisted, for as Vannevar Bush has maintained, "basic research is the pacemaker of technology." Basic research charts the course for practical application, eliminates dead ends, and enables the applied scientist and engineer to reach their goal with maximum speed, directness, and economy.

Basic research, directed simply toward more complete understanding of nature and its laws, embarks upon the unknown. Clearly, that which has never been known cannot be foretold, and herein lies the great promise of basic research. It extends beyond the fringes of knowledge, beyond existing limitations and preconceptions. Basic research enlarges the realm of the possible.

Applied research concerns itself with the elaboration and application of the known. Its aim is to convert the possible into the actual, to demonstrate the feasibility of scientific or engineering development, to explore alternative routes and methods for achieving practical ends.

Development, the final stage in the technological sequence, is the systematic adaptation of research findings into useful materials, devices, systems, methods, and processes. From engineering development come the models, the prototypes, the demonstration methods, and the experimental clinical procedures. Development leads to production of finished products, built in quantity and to definite specifications.

From these definitions it is clear that each of the successive stages depends upon the preceding. Unlimited expansion of effort toward applied research and development, without corresponding support for basic research, will defeat the entire effort by limiting technological progress to minor improvements and refinements of obsolete processes and equipment.

Moreover, of the three stages, basic research is the least, and development the most, expensive. For maximum economy as well as maximum rate of advancement, development should follow only upon an adequate foundation of basic and applied research. By eliminating guesswork, waste effort, and aimless trial-and-error methods, every dollar spent for basic research returns tens of dollars in developmental savings.

Study and analysis of the three components of technological progress, of the expenditure of trained manpower, resources and funds that can be appropriately utilized by each, and of the proper balance among them will continue to be of major concern to the Foundation.

Finally, basic research in the sciences, largely carried on in educational institutions, is of vital importance in training scientific manpower. Analysis of the technological components will of necessity include evaluation of the impact of research and development activities upon science education and the institutions for advanced training in the United States.

SUPPORT OF BASIC RESEARCH IN THE SCIENCES

During the year ending June 30, 1952, 96 grants totalling $1,073,975 were made for the support of basic research. These funds were distributed for research in the biological, medical, mathematical, physical, and engineering sciences at 59 institutions in 33 states, the District of Columbia, and Hawaii. The average grant was for $11,156 to run for 1.9 years, or about $5,800 per year. A list of the grants, showing institution, principal scientist, title of the project, duration, and amount is given in Appendix II, p. 44.

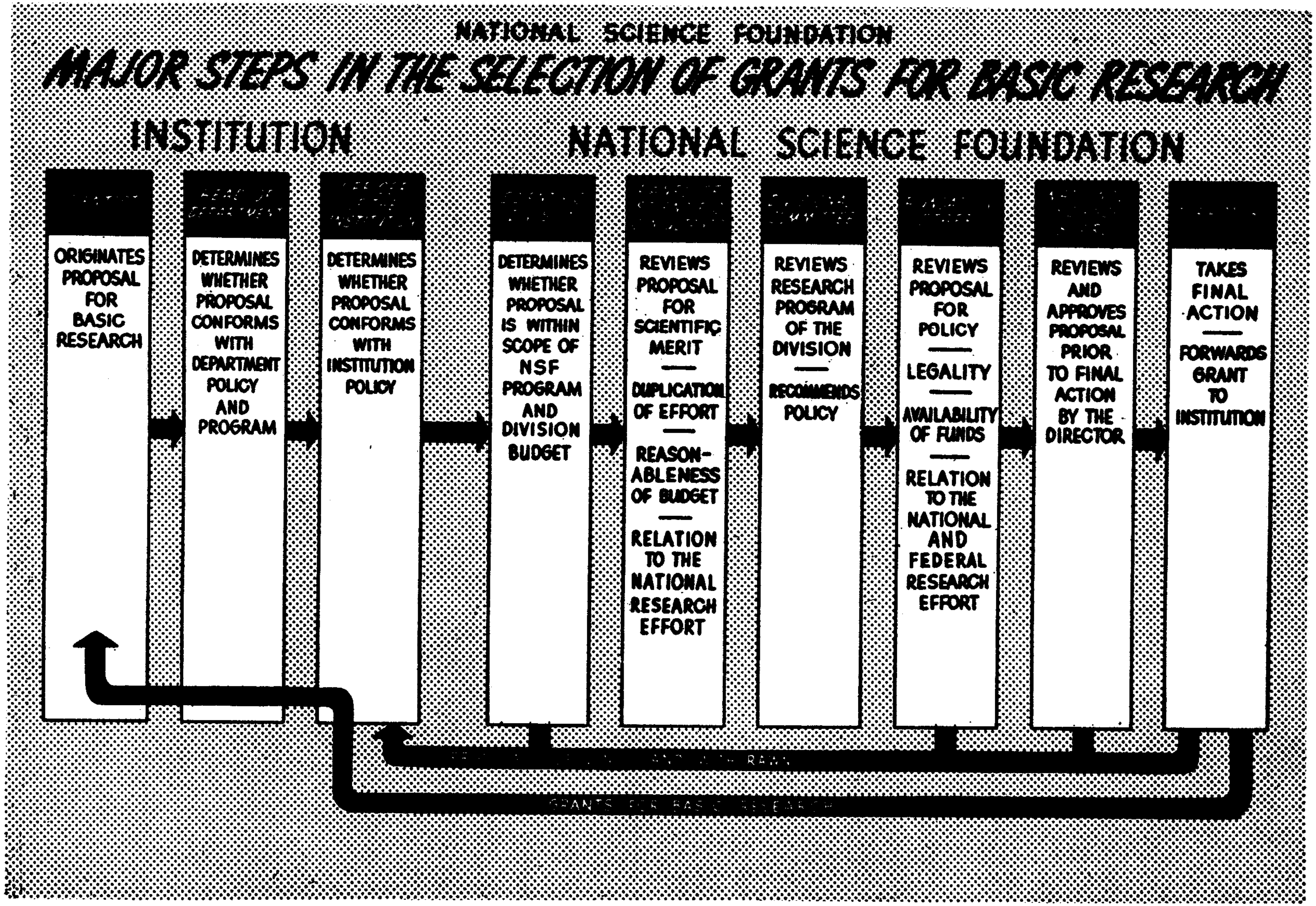
The direct grant has been adopted by the Foundation as the most appropriate type of instrument for supporting basic research. The administration of grants has proved to be comparatively simple, both for the grantor and the grantee. Basic research cannot be bought by the gross or the pound, and not only is it extremely difficult or impossible to establish specifications for its performance as is done for procurement of most goods and services but owing to the nature of the subject it is inadvisable to make the attempt.

The research grant is normally made to the institution for use by the principal scientist for the project proposed. If he requires the assistance of additional scientists, the grant may be used to pay their salaries on a part- or full-time basis. Funds may be made available for purchase of scientific equipment. The institution is permitted to include in the project budget up to 15 per cent of direct costs for indirect costs.

ANALYSIS OF PROPOSALS

A total of $13.3 million in basic research proposals was received during the year ending June 30 of which $1.1 million (8 percent) was approved, $5.1 million (38 per cent) was declined, withdrawn, or represented reductions in budgets of approved proposals, and $7.1 million (54 per cent) was pending. New proposals submitted in 1953 will total more than in 1952. It is clear, however, that limited Foundation funds for research support has discouraged many competent investigators from submitting proposals.

The proportion of declined and withdrawn proposals is high compared with the experience of other Federal agencies and private foundations


NATIONAL SCIENCE FOUNDATION
MAJOR STEPS IN THE SELECTION OF GRANTS FOR BASIC RESEARCH
INSTITUTION
NATIONAL SCIENCE FOUNDATION
ORIGINATES PROPOSAL FOR BASIC RESEARCH
DETERMINES WHETHER PROPOSAL CONFORMS WITH DEPARTMENT POLICY AND PROGRAM
DETERMINES WHETHER PROPOSAL CONFORMS WITH INSTITUTION POLICY
DETERMINES WHETHER PROPOSAL IS WITHIN SCOPE OF NSF PROGRAM AND DIVISION BUDGET
REVIEWS PROPOSAL FOR SCIENTIFIC MERIT — DUPLICATION OF EFFORT — REASON-ABLENESS OF BUDGET — RELATION TO THE NATIONAL RESEARCH EFFORT
REVIEWS RESEARCH PROGRAM OF THE DIVISION — RECOMMENDS POLICY
REVIEWS PROPOSAL FOR POLICY — LEGALITY — AVAILABILITY OF FUNDS — RELATION TO THE NATIONAL AND FEDERAL RESEARCH EFFORT
REVIEWS AND APPROVES PROPOSAL PRIOR TO FINAL ACTION BY THE DIRECTOR
TAKES FINAL ACTION — FORWARDS GRANT TO INSTITUTION

supporting research. This does not reflect upon the average quality of research proposals submitted to the National Science Foundation but rather upon the exceedingly stringent criteria for approval that were necessarily established by the Foundation in view of its limited funds for research support. Research proposals submitted to date have to an unusual extent shown originality in concept, boldness in design, and a desire on the part of the scientists to explore important but relatively neglected fields.

NEW RESEARCH RESOURCES REVEALED

Experience during the first year of the program has shown that there are large untapped research resources in the colleges, universities, and other nonprofit institutions in the United States. It is also apparent that other public and private research programs—often tied to specific goals and operating missions—have not provided adequate support for many areas of scientific research. As was anticipated in its legislative charter, the Foundation has discovered that many areas of great scientific interest are in need of additional support.

The distribution of National Science Foundation funds for support of basic research offers an interesting contrast to the usual pattern of Federal research and development programs. For fiscal 1950, the Bureau of the Budget reports that Federal research support at colleges and universities totaled $90,000,000. Fully half of this expenditure, $45,000,000, was spent in only 12 institutions, while the remaining 50 percent was distributed among 180 other institutions. Although the total program of the National Science Foundation in 1952 was relatively small compared with the over-all Federal program, it is worth noting that nearly 75 per cent of the dollar value of Foundation grants went to institutions that have participated least in previous Federal research support.

RESEARCH SUPPORT STRENGTHENS TEACHING

The wider distribution of research support among institutions of higher education has the additional advantage of strengthening the teaching of science in these institutions. Research, particularly basic reseach, is a normal function of the colleges and universities. In offering greater opportunities to perform research, such institutions are able to retain more competent faculty members and more and abler students. At the same time, the research grants provide added funds for research assistantships and for materials and equipment for research.

Approximately 52 cents out of each dollar approved by the Foundation for research support is spent for direct assistance to graduate students and other research assistants. Part-time salary for the principal investigator accounted for 6 cents, indirect costs including overhead for approximately 11 cents, and the remaining 26 cents for other direct costs including nonscientific labor, travel, expendable supplies, costs of publication and such items. It should also be noted that for every dollar provided by the Foundation the grantee institution adds an additional contribution in the form of salaries of principal scientists and indirect costs not reimbursed.

The regional distribution of National Science Foundation research grants for Fiscal Year 1952 is in line with the distribution of the graduate student population as is shown on the table below and the chart on p. 17.

Regional Distribution of National Science Foundation Research Grants and Graduate Student Population

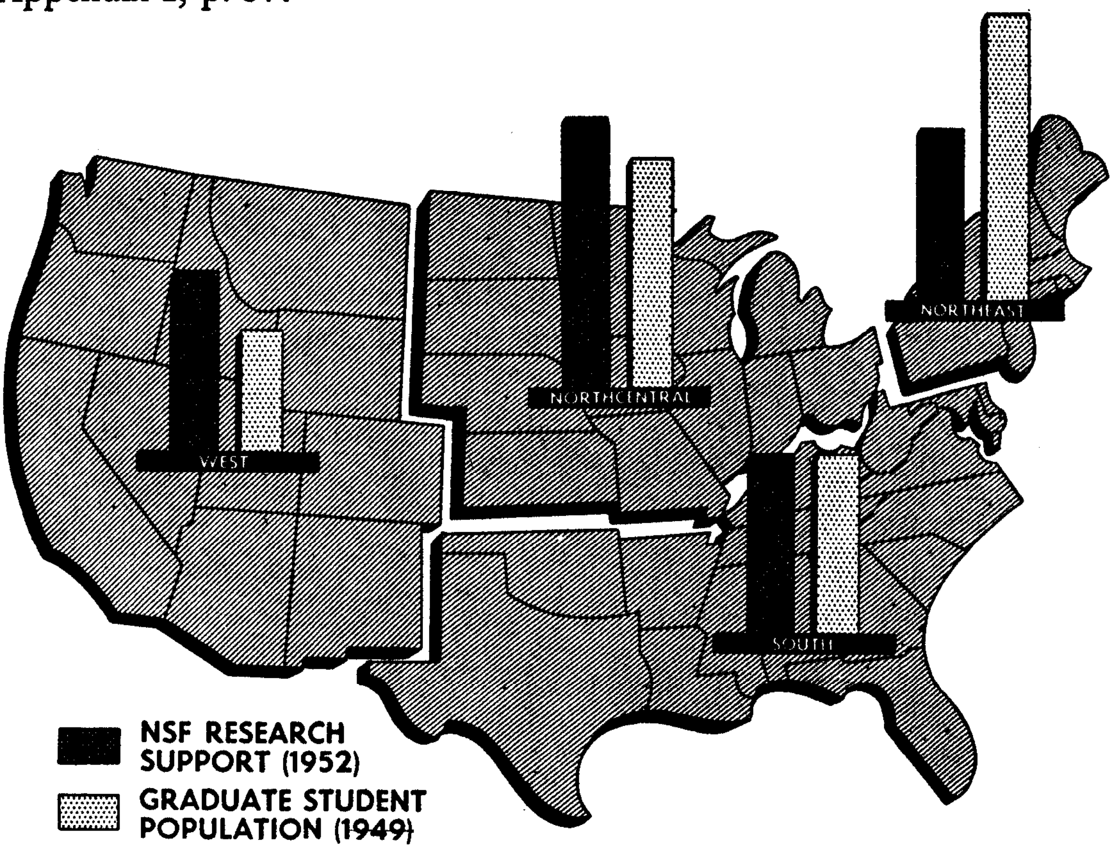
Region	National Science Foundation grants, fiscal year 1952			U. S. graduate student population	
	Number	Amount	Percent	Number	Percent
Northeast	22	$227, 500	21	75, 400	35
North Central	37	365, 715	34	61, 000	28
South	22	241, 860	23	47, 300	22
West	15	238, 900	22	32, 100	15
Total	96	1, 073, 975	100	215, 800	100

REVIEW AND EVALUATION PROCEDURE

The review and evaluation procedure developed by the Foundation for research proposals is described in graphic form on page 14. Research proposals normally originate with the scientist who intends to carry out the work. The Foundation has prepared A Guide for Submission of Research Proposals (see Appendix II, p. 50) to assist him in preparing a proposal.

When a proposal is received by the Foundation, the staff of the appropriate research division appraises its relation to the entire research support program in that area. It is then reviewed by selected scientific consultants and advisory panels for scientific merit, relation to and degree of undesirable duplication with other current research in the field, competence of personnel, facilities and resources of the institution, and budget. The program staffs of the Foundation review each proposal in terms of its contribution to the over-all Federal research program and the extent to which other agencies are supporting research in the field. Consideration is also given to the geographic and institutional pattern of distribution of research support.

The National Science Board has appointed Divisional Committees in the Mathematical, Physical and Engineering Sciences, Biological Sciences and Medical Research to advise the research divisions in formulation of their programs and the relation of Foundation policy to the activities of the division. The membership of the Divisional Committees is listed in Appendix I, p. 37.



REGIONAL DISTRIBUTION OF NATIONAL SCIENCE FOUNDATION RESEARCH GRANTS AND GRADUATE STUDENT POPULATION

Success or failure of a review procedure embracing so many elements depends upon the level of competence of the individuals making the review. Among its consultants the Foundation numbers highly competent scientists from all sections of the United States.

Panel ratings are reviewed by the staff of the Foundation and superior proposals are considered in light of the current administrative and budget situation. Recommended proposals are then submitted to the National Science Board for review and approval.

Experience to date indicates that the selection process adopted by the Foundation enables it to exert a positive and forward-looking influence upon research. The fact that the Foundation is not tied to specific program goals permits investigators free rein to use imagination and initiative in submitting research proposals. At the same time, the selection process is protected from administrative rigidity and bureaucratic control of research by the use of review panels, made up of research scientists representing widely divergent interests and schools of thought.

RESEARCH SUPPORT FOR MEDICAL AND BIOLOGICAL SCIENCES

During fiscal 1952 the programs of the Division of Biological Sciences and the Division of Medical Research were combined on an experimental basis to permit an integrated program covering all the life sciences. Specific program areas include developmental biology, environmental biology, genetic biology, microbiology, molecular biology, regulatory biology, psychobiology, and systematic biology. The 68 grants totaling $762,675 in biology and medicine are grouped according to these classifications in Appendix II, p. 44.

Research in molecular biology received the most support during 1952. This important program deals with the physical chemistry of important biological molecules, particularly the proteins and related substances found in living tissue. It is at present one of the most active areas of research in the entire field of biology. Of special interest in this program is research on photosynthesis, the mechanism by which plants convert sunlight into chemical energy. All plants and animals depend for nourishment upon this basic life process and it is the ultimate source of all organic fuels, including coal, oil, and natural gas. At present photobiological processes appear to offer the most promising route toward utilization of sunlight either as an additional source of food or as an energy source to augment our limited or diminishing resources of fossil fuels, water power and uranium.

Before progress can be made along practical lines, far more detailed knowledge of their functioning in nature must be accumulated through basic research. To this end, the Foundation along with other agencies is supporting photobiological research in institutions in various sections of the country.

Regulatory biology also received a proportionately large share of Foundation funds for research support. As the name implies research in regulatory biology is directed toward the better understanding of how life processes are controlled and regulated. This includes the actions of enzymes and hormones, the mechanism by which the nervous system affects body functions, the relation of visible light to sexual periodicity of animals, and similar studies.

Although knowledge of regulatory mechanisms is of recent origin, and very incomplete, the practical benefits have already been highly important. The use of the pancreatic hormone, insulin, has extended the useful lives of millions of diabetics who would otherwise have been destined to early death. Knowledge of the relation of certain vitamins to red cell production has made possible successful treatment of an otherwise lethal disease, pernicious anemia. Knowledge of plant growth hormones has led directly to the production of chemical weed killers which save farmers in the United States millions of dollars each year.

Despite the obvious and fundamental importance of regulatory biology in medicine, agriculture, animal husbandry, and certain types of organic industrial processing such as brewing and production of antibiotics, the amount of basic research carried on in these fields is far too small. Within the limits of its resources, the Foundation will continue to make grants for basic research in this vital area.

Systematic biology is a third area for which the Foundation has provided a relatively large amount of support. This is one of the oldest biological research fields. It is concerned with identification, description, and classification of the countless plant and animal species inhabiting the earth. The current interest in systematic biology stems from new techniques—genetic, chemical, immunological, and others—which have recently been made available to the biologist.

During and since World War II many rich collections of plants and animals from previously little explored areas of the world are now housed in American museums, awaiting identification and integration with existing collections. The Foundation has emphasized support of such research in museums and universities. Information on new entities and on the distribution of unknown forms will serve as the basis for the assessment of available natural resources and hasten the introduction of new and economically important groups.

MATHEMATICAL, PHYSICAL AND ENGINEERING SCIENCES

During fiscal 1952 the Foundation awarded 29 grants totaling $311,300 in the physical sciences. A detailed listing of these grants is given in Appendix II, p. 44, under chemistry, physics, earth sciences, astronomy, mathematics, and engineering.

The over-all objectives of basic research are the same in the physical sciences and engineering as for other scientific fields. An additional objective, however, has become increasingly evident in the development of physical sciences during recent years. As research has extended the frontiers of knowledge the boundaries between fields have become less and less marked. The complete solution of many research problems today requires the correlation of many individual viewpoints approaching the problem from several directions. The Foundation is acutely aware of its obligation to support integrated attacks upon borderline and interdisciplinary problems.

An example may serve to illustrate the point. The improvement of radio reception requires knowledge of the electrified layers of the upper atmosphere which are concerned with long range transmission of radio waves but which are subject to unexplained fading and interference. Physical conditions in the upper atmosphere depend upon the "weather" at high altitudes and upon energy radiated from the sun. The actual mechanism of transfer of solar energy into heat and electricity in the atmosphere involves physical and chemical processes. Thus, the radio engineer in trying to solve an everyday problem finds himself joining the physicist, the chemist, the meteorologist, and the astronomer. Each of these individuals is a valuable member of the team because he can contribute something out of his own specialized stock of information. The modern strategy for the rapidly expanding physical sciences is to increase intercommunication among scientists.

The relationship of technological progress to basic research in chemistry, physics and mathematics is well-known. Less familiar, perhaps, but of no less importance are basic studies in the engineering and earth sciences, and a brief description of the Foundation's interests in these areas is therefore given.

In considering the program of the Foundation in the engineering sciences, the traditional categories, such as aeronautical, civil, chemical, electrical, and mechanical engineering, do not always provide a framework. The emphasis is rather on research fields common to these disciplines, such as fluid mechanics, strength of materials, corrosion, heat transfer, or thermodynamics, because the basic engineering sciences are concerned primarily with the utilization of scientific principles for the general welfare rather than the design aspects of professional engineering.

Moreover, the Foundation's program in the engineering sciences and its research support budget is being used to encourage research to fill gaps in the basic information now available to the engineer. Special attention is centered on those research projects which are basic to the extension of the use of strategic materials, the replacement of strategic materials with new, hitherto unknown materials, and the better understanding of energy conversion.

In the earth sciences, the Foundation's program for basic research is expected eventually to be spread more or less equally over studies involving the atmosphere, the waters of the earth, its surface and its interior—including all their inter-relations. The less frequently investigated microphysical processes, which are basic to the discovery and understanding of underlying geophysical and geochemical principles, are emphasized, in contrast to the gross physical processes which are currently being surveyed by many government and some private agencies.

SCIENTIFIC MANPOWER AND GRADUATE FELLOWSHIP PROGRAM

In April 1952, the Foundation awarded 624 graduate fellowships in the sciences for the academic year 1952–53. Of the total 569 awards were made to predoctoral graduate students, while 55 were made to postdoctoral applicants. A complete list of the awards is given in Appendix IV, p. 56. The fellows were selected from about 3,000 applicants from all parts of the United States, its territories and possessions, and from American citizens abroad. Fellows were selected solely on the basis of ability, with awards made in cases of substantially equal ability so as to result in a wide geographical distribution.

Of the predoctoral fellowships 169 (27 percent) were awarded to graduating college seniors entering their first year of graduate study. A total of 170 awards were made to second year graduate students, and the remaining 230 to advanced predoctoral students. This pattern of distribution by year of study is in contrast with that of previous Federal fellowship programs in its emphasis upon first year awards. By encouraging graduating seniors to begin and continue advanced studies the Foundation hopes to increase the supply of trained scientists and engineers in the shortest possible time during a period when there is great need for more individuals with advanced training.

The largest group of fellowships, 158, was awarded to graduates in the biological sciences, which compares with 140 in chemistry, 137 in physics, 75 in engineering, 62 in mathematics, 36 in earth sciences, 7 in agriculture, 6 in astronomy, and 3 in anthropology.

All regions of the United States were represented among the selected fellows. Both applications and awards were roughly proportional to the total population, and the population attending colleges in the various regions. Tables showing breakdown of awards by subject and year of study and geographical origin are given in Appendix IV, p. 55. Analysis of the institutions at which fellows received their undergraduate training confirms previous studies of the importance of small, liberal arts colleges as a source of scientific talent.

As was anticipated the successful fellows, free to attend graduate institutions of their own choosing, showed a tendency to seek training at a highly selected group of institutions. (See Appendix IV, p. 67). The extent to which this tendency is undesirable requires further study. The Foundation and its advisory groups are giving serious consideration to the question. One obvious corrective measure is to strengthen teaching and research faculties of a greater number of graduate schools. The Foundation is helping to do this through its research support program.

SELECTION PROCESS

Predoctoral applicants were screened on the basis of:

1. Test scores on scientific aptitude and achievement examinations.
2. Previous academic record.
3. Recommendations from faculty advisors and others in a position to know the candidate and his scientific abilities.

This part of the selection procedure was administered for the Foundation by the National Research Council of the National Academy of Sciences. The predoctoral examination for scientific aptitude and achievement was conducted by the Educational Testing Service, Princeton, New Jersey. Panels of outstanding scientists in each scientific field were established by the Council to review and rate the applications. During the preliminary screening the total list of applicants was reduced by about one-half. A final screening by a second group of panels established a list of superior candidates which was submitted to the Foundation for the final selection of fellows.

Postdoctoral fellows were screened in a similar manner except that no examination was required. During the review it was clear that there were two broad classes of postdoctoral applicants, namely: recent recipients of doctorate degrees who desired to proceed with an additional year of specialized training, and senior scientists who received their doctorates some years ago and desired and needed additional training at this time. In the final selection 5 awards were made to senior scientists, while 50 awards were made to younger scientists.

TERMS AND STIPENDS

National Science Foundation fellows are expected to devote full time to advanced scientific study for the full tenure of the fellowship. The results of research carried out by a fellow during his training may be made available to the public without restriction, except as is required in the interests of national security, in accepting a Foundation graduate fellowship, the recipient is not committed to accepting future Federal employment nor is the Federal government committed to offering employment to any fellow.

Stipends for the National Science Foundation fellowships vary with the academic status of the fellows. First year fellows receive a basic stipend of $1,400; second year, $1,600; advanced predoctoral, $1,700; and postdoctoral, $3,000 per year. Second year, advanced predoctoral and postdoctoral fellows receive an additional allowance for wives and children. Normal tuition and laboratory fees are paid by the Foundation, and limited travel allowances are provided. Slight adjustments in the schedule of stipends will be made for the academic year 1953–54 in accordance with interagency agreement on standard stipends. Under the new schedule the basic stipend for terminal year fellows will be $1,800 per year and the postdoctoral stipend will be increased to $3,400. Stipends for first year fellows will continue at $1,400 per year with $1,600 for intermediate years.

RELATION TO NEED

While the graduate fellowship program has an immediate effect upon the shortage in scientists, it by no means can solve the whole problem. The Foundation clearly recognizes that the scientific and technical manpower shortage stems from deep roots in our educational, social and economic structure and that its eventual correction will require long-range attack on these underlying problem areas.

Accurate estimates of the extent of the current shortage of scientific manpower are difficult to obtain. All of the evidence indicates, however, that shortages of varying severity exist in most of the scientific disciplines, and in engineering shortages appear to be especially critical. Headlines such as these from the *New York Times* are typical:

Government Seeks Scientists

Engineers Scarce in Plane Industry

Skilled Scientific Manpower
One of Nation's Great Needs

Lack of Scientists in Defense Feared

Such headlines are eloquently supported by columns of classified advertising devoted to recruitment of engineers and physicists. Appeals for persons of these qualifications are frequently broadcast, and the United States Employment Service reports an increased number of listings in these categories.

One informed estimate places the annual need for engineering graduates at 30,000 and another fixes the present shortage at about 96,000 engineers. In the chemical field, J. H. Lux and L. S. Moody predict an average deficit in the number of chemists increasing from 3,000 in 1951 to 8,000 by 1953. The average deficit in the number of chemical engineers is expected to increase from 9,000 in 1951 to 41,000 by 1955. The placement bureau of the American Institute of Physics reports the number of listed jobs had increased 420 percent in 1951 over 1950, while the number of registrants decreased 16 percent.

The United States is currently falling behind on the production of new scientists at the rate of 10 percent or more a year. M. H. Trytten, director, Office of Scientific Personnel, National Research Council, reports that at one meeting in 1951, representatives of 16 major industrial employers of scientific personnel announced that "after scouting the Nation's graduating classes they were able to obtain on the average only 36 percent of the new employees needed." The Department of Defense, its laboratories, and contractors experience considerable difficulty in staffing projects under way. The Atomic Energy Commission reports similar problems. Planning for future expansion is seriously modified in these agencies by the knowledge that scientific and technical manpower is so limited.

The number of engineers who have graduated from our schools has declined in recent years and is expected to reach a low of about 15,000 graduates by 1955. On the basis of present and foreseeable college enrollments it seems unlikely that the desired level of 30,000 engineering graduates a year can be reached before 1965.

It is of interest to note that the Soviet Union plans for a constantly increasing number of engineering graduates. Goals for 1955 call for nearly 50,000 engineering graduates, which represents a steady rise from a low point of 9,000 graduates in 1943. The chart on page 26 compares the trends in production of engineering graduates in the United States and the Soviet Union for the 16-year period, 1940–55.

Some 34,000 Ph. D. and D. Sc. scientists plus about 6,000 additional scientists having equivalent training represent a crucial element in the scientific manpower situation. These 40,000 men and women make up

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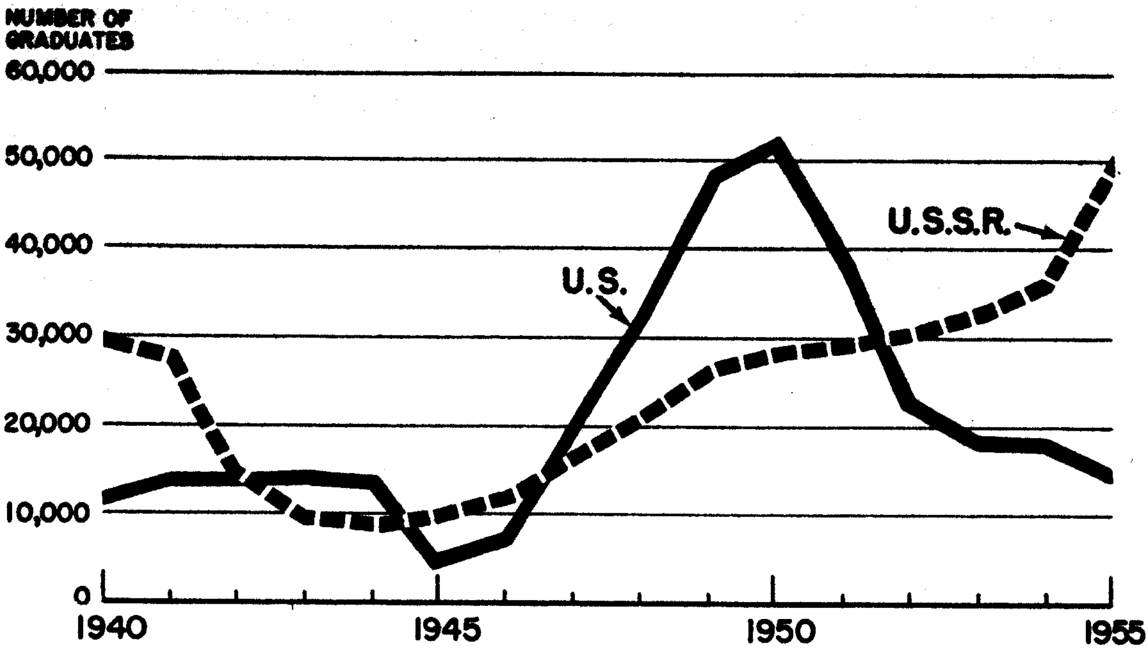

ENGINEERING GRADUATES IN THE UNITED STATES AND THE SOVIET UNION, 1940–55

Source: U. S. figures from Hollister, S. C., from U. S. Bureau of Labor Statistics, U. S. Office of Education, American Society for Engineering Education, and Engineering Manpower Commission of Engineers Joint Council (August 21, 1951). U. S. S. R. figures from Bartosek, Milan, *Vysoke Skolstvi S. S. S. R.*, Prague, 1947.

the research core of the Nation. These are the ones who, as a result of their training, carry on advanced research for their country. Upon this group we also depend for most of the advanced teaching in science.

The rate at which new Ph. D.'s and D. Sc.'s are being produced is therefore a matter of considerable importance. At present the rate of production is about 3,600 new doctorates in the sciences every year, or something less than 10 percent of the total. This rate is too low to keep up with the normal growth of technology, the expanded current needs. In addition there are signs that the present rate is near a peak unless extraordinary action is taken. According to Dean George R. Harrison of the Massachusetts Institute of Technology we may expect not only the number of scientists to decrease but the number of research scientists to decline even more radically. Dean Harrison points to the declining enrollment in undergraduate science courses and the effect of the low birth rate during the depression years.

The current deficit in scientists may be traced in part to the effect of World War II upon the number of science students. The American Council on Education in 1951 stated "that the loss occasioned by World War II in the number of doctorates produced in science was in the neighborhood of 10,000, possibly much higher."

It is worth noting that the deficits produced by World War II have not been offset by the veterans training program under the G. I. Bill of Rights. The postwar upsurge in the production of baccalaureate degrees in science and engineering reached a peak of 125,600 in 1950. The graduating classes of 1951 and 1952 decreased markedly from this record number. The downward trend will continue at least into 1954. The number of students expected to receive baccalaureate degrees in June 1954 will be much lower than the number awarded in 1950, yet the number of Ph. D. awards to be made in 1954, representing members of the 1950 college graduating classes, will clearly be too few to make any appreciable impact on the accumulated shortage of scientists. Thus, we can expect the problem to grow more critical.

LONG-TERM NATURE OF THE PROBLEM

During the first half of the twentieth century, the various fields of science underwent periods of expansion at different times in response to specific economic or military stimuli. For example, the American chemical industry, which began to grow during World War I when the products of the German industry were cut off, stimulated a great demand for chemists. The rise of the atomic-energy program and a wide variety of other weapons involving the physical sciences, created, during World War II, a demand for physicists. The growth of the electronics industry and the magnitude of the defense program have maintained and even increased this demand since the war.

Dean Harrison points out that the number of chemists, now about 80,000, has been doubling every 10 years; while the number of physicists, now about 20,000, has been doubling every 8 years. The number of biologists, now about 30,000, is increasing at a slower rate. The rate of increase in the number of persons trained in a field is some indication of the amount of activity in that field. These figures suggest that physics is at present in its greatest period of development, while biology has still to reach its peak activity level.

There are dangers, of course, in using empirically derived estimates as definite program goals for planning purposes. On the other hand such estimates reflect long-term trends which tend to change slowly. For this reason they have some validity in indicating the general order of magnitude of the problems which will have to be dealt with.

The President's Materials Policy Commission's emphasis upon our diminishing natural resources in the face of an expanding economy suggests cogent reasons why increasing dependence will be placed upon scientists and technologists. World War II, to be sure, and the tensions of the postwar world have emphasized shortages in certain skills, but it seems certain that whatever the political situation, our technology will continue to expand at an increasing rate, either to create the machines of war, or, more happily, for peacetime purposes. In any event, future needs for scientific and technical manpower are almost certain to be far greater than those we now find difficult to meet.

LOSS OF STUDENTS AT THE BACCALAUREATE AND UNDERGRADUATE LEVELS

A large portion of the most capable graduating college-seniors in science never enter upon graduate study. Part of the reason is economic. The student weighs the costs of three or four years of graduate study against the attractive salaries he finds he can command upon graduation. Engineers and physicists with 4 years of undergraduate training are now offered salaries of from $3,000 to $6,000 a year. College graduating classes are besieged with personnel representatives, so that most students have a choice of jobs upon graduation.

As the number of baccalaureate graduates in science decreases, it is important to consider what fraction of these graduates are capable of pursuing graduate study and becoming research scientists. Studies supported by the Foundation and conducted by the Office of Scientific Personnel of the National Research Council and by the National Scientific Register clearly show that despite unprecedented amounts of financial support for graduate students in the postwar period, many capable students desirous of continuing their training have been unable to do so because of lack of finances.

The National Research Council reports that of approximately 70,000 graduating college seniors who majored in science in 1952, about 14,400 (20 percent) were judged capable of continuing graduate work toward the doctorate degree. Of these 6,400 (44 percent) will receive full support from family or personal sources, fellowships, assistantships, or G. I. benefits. Another 3,400 (24 percent) have partial support which may be sufficient to enable them to begin graduate training. Some 1,200 seniors, although judged capable of pursuing graduate studies, apparently have no desire to continue. The remaining 3,400 desire to continue advanced scientific training but have no support.

As was pointed out previously the National Science Foundation is emphasizing first-year awards of graduate fellowships to help as many students as possible across the bridge between undergraduate and graduate study.

RESEARCH EDUCATION IN THE SCIENCES

The number of students entering the colleges in all fields is estimated at 40 percent of those capable of doing college work. The anticipated rate of attrition during the 4-year undergraduate period is about 50 percent. Under these conditions, the role of the college teacher in developing, as fully as possible, those who remain takes on added significance.

A preliminary inquiry by the National Science Foundation has uncovered very few analyses of the problems associated with college-level teaching of science. Many educators agree, however, that no single factor is so important in influencing the choice of a science career as the student-teacher relationship. A joint study conducted by the Bureau of Labor Statistics and the Office of Naval Research of occupational mobility of scientists bears out this point. The histories of holders of Ph. D.'s in chemistry, physics, and biology, show that interest in the branch of science in which these men later specialized began most often in the junior year in college. It was also found, that four out of five had majored as undergraduates in the branch of science in which they are currently competent.

If a teacher is to inspire and stimulate his students with the desire to pursue research careers, it seems clear that he himself must appreciate research. He must be aware of significant developments in his field and be able to communicate to his students the excitement and interest in new developments as they occur. This in turn means that he must keep in touch with research progress and enjoy at intervals a chance to do research or to form fresh associations with other research scientists, preferably away from his home campus. The Foundation is, therefore, assisting in developing methods for increasing the effectiveness of teaching at institutions of higher learning and increasing the quality of training in the sciences.

The Office of Scientific Personnel, National Research Council, has shown that 46 percent of all graduate students receiving doctorates in science during the decade 1936–45 did their undergraduate work at institutions which did not award scientific doctorates during that period. This demonstrates that small colleges are an effective factor in production of scientists. Moreover, over half of this group received their training from only 118 of the eleven hundred smaller institutions of higher learning in the United States. It is apparent from these figures that only one out of ten of these small institutions is effectively turning out potential scientists.

Under its program of research education in the sciences the Foundation will assist selected teachers of science to spend their summers or a year of absence at research and training centers. During this interval the recipients will be able to associate closely with leading scientists and accomplished teachers of science. In addition, plans are under way for establishing a limited number of summer research centers or colloquia to aid teachers of science in keeping informed of new developments in their fields through research or training.

INFORMATION ON SCIENTIFIC MANPOWER

Concurrently with the passage of the National Science Foundation Act of 1950 a register of scientific and technical personnel was established and supported initially by the National Security Resources Board. Shortly thereafter, the Foundation assumed financial responsibility for the National Scientific Register. At the same time it undertook a study under the direction of Dr. Dael Wolfle, of the Commission on Human Resources and Advanced Training, Conference Board of Associated Research Councils, as to how best to carry out its statutory directives to provide a central clearinghouse for information covering scientific and technical personnel. The study was completed in June 1952.

The report listed four primary purposes for collecting information on scientific and technical manpower:

1. To provide the basis for statistical studies of the supply of and national demand for scientists and specialists.
2. To aid in administrative planning.
3. To serve as a basis for compilation and publication of scientific biographical directories.
4. For employment and placement purposes.

The National Scientific Register served primarily as a means for compiling data on personnel, and by the end of 1952 it will have completed the initial registration and analysis of data on scientists in chemistry, chemical engineering, physics, psychology, agricultural and biological sciences, geosciences, and veterinary medicine. The Register was not used for employment and placement purposes, and statistical studies were limited in nature. On the other hand, the report indicated that a number of scientific societies had for years maintained registers of scientists in their respective fields, and many societies conducted placement services.

In these areas there appeared to be no justification for the Federal government to set up competing facilities beyond those necessary for the coordination of the efforts of private groups. This has been the basic policy adopted by the Foundation in carrying out its manpower clearing-house functions.

In line with this policy, the operation of the present National Scientific Register will be discontinued after December 31, 1952. An office has been established by the Foundation to assist the professional scientific societies in compiling information on the scientists in various fields on a uniform basis. The individual societies will be encouraged to maintain placement and employment services. For special studies and general planning purposes extensive use will be made of sampling techniques.

In undertaking the register and clearing-house function the Foundation will be greatly aided by the wartime experience with the National Roster of Scientific and Specialized Personnel and by the experience of the Office of Education and Bureau of Labor Statistics in conducting surveys of scientific manpower. The Foundation is also cooperating with other Federal agencies in this program and is giving careful attention to their needs.

DISSEMINATION OF SCIENTIFIC INFORMATION

Since World War II, with the great expansion of government and industrial support of research in the United States, the volume of publication has risen sharply. *The Physical Review,* for example, has increased from about 2,000 pages to 5,000 pages a year, and the *Journal of the American Chemical Society* has likewise shown an increase. The costs of production and publication have gone up appreciably. These facts have created severe financial problems for the journals and the societies which support them. Subscription rates and society dues have generally increased, articles have been trimmed to bare essentials and more words have been printed on every page.

A few journals sought relief by charging authors or their institutions a levy based upon the number of pages printed. This so-called page charge created additional problems since many individuals, notably those working for certain government agencies, found it difficult to pay these charges. Other journals looked to industry, the private foundations or Federal agencies for additional support.

PUBLICATION SURVEY

In view of these problems, the National Science Foundation has compiled information on the present status of journal publication. After checking with other interested agencies it sent out a questionnaire to selected journals to determine to what extent financial difficulties might be interfering with the scientific usefulness of the journals. The questionnaires were designed to obtain facts concerning circulation, backlog of unpublished papers, sources of financial support and distribution of expenses, and opinions of editors and business managers on various editorial and management policies. The answers to these questionnaires indicated that despite financial problems most journals appear to be doing their primary function well. There are, of course, exceptions, but on the basis of the returns the Foundation believes that these cases must be handled individually.

As a result of this analysis the Foundation does not believe that continuing Federal support of scientific journals is desirable at this time.

In critical cases emergency support of a temporary nature may be appropriately provided.

OTHER PROBLEM AREAS

The Foundation also has under study various other potential problem areas including abstracting services, translation services, and the function and organization of scientific libraries. One study will attempt to analyze and evaluate present library methods for assisting scientists engaged in research and development. Such studies are expected to provide insight into how scientific reference services, particularly for industrial laboratories, can be made more effective. The results will undoubtedly be of interest to research administrators.

The National Science Foundation is following the development of improved methods for compiling scientific information and for its rapid handling, economical storage, and efficient retrieval and distribution.

INTERNATIONAL EXCHANGE OF SCIENTIFIC INFORMATION

The availability of foreign scientific literature is important to scientists in the United States. This problem is currently acute in the case of literature originating in the Soviet Union and other Eastern European countries. Language barriers have imposed serious obstacles in the way of general access to the results of Russian research. Even where translation services are available, problems in distribution of Russian scientific periodicals within the United States increase the magnitude of the question. The Foundation considers this one of the important problem areas in the scientific information field. The first step is a complete survey of the present pattern of distribution and processing of Russian scientific literature in the United States. This is under way. Next will come a constructive program in which many Federal and private agencies have expressed a desire to cooperate.

During the year, the Foundation encouraged the formation of a Russian science group at Columbia University which is laying out plans for extending the availability of information about science progress in Eastern European countries. The first specific task undertaken by the group with the support of the Foundation was preliminary planning for the compilation of an improved and up-to-date Russian-English scientific and technical dictionary. A better tool for translating recent Soviet scientific papers is seriously needed by English-speaking scientists.

The Foundation has supported publication by the American Association for the Advancement of Science of several important papers on

Russian science read at a symposium in December 1951. The volume presents an appraisal by informed American scientists on the present status of Russian research in the fields of genetics, physiology, pathology, soil science, psychology and psychiatry, mathematics, physics and chemistry, and social sciences.

Attendance of American scientists at international meetings is closely related to scientific information since this is an important channel for exchange of views on new scientific developments. During the year 23 American scientists were enabled to travel to Paris, Rome, and Israel through Foundation support. Four mathematicians received travel grants to attend the First General Assembly of the International Mathematical Union in Rome. Eighteen biochemists received travel grants to attend the Second International Congress of Biochemistry in Paris. A list of individuals receiving travel grants during the year is given in Appendix III, p. 53.

APPENDIX I

National Science Board, Staff, Divisional Committees and Advisory Panels

NATIONAL SCIENCE BOARD

Terms Expire May 10, 1954

Lee A. DuBridge,[1] President, California Institute of Technology, Pasadena, Calif.

Donald H. McLaughlin, President, Homestake Mining Co., San Francisco, Calif.

George W. Merck, President, Merck & Co., New York, N. Y.

Joseph C. Morris,[1] Head of Physics Department and Vice President, Tulane University, New Orleans, La.

Harold Marston Morse, Professor of Mathematics, The Institute for Advanced Study, Princeton, N. J.

James A. Reyniers, Director, LOBUND Institute, University of Notre Dame, South Bend, Ind.

Elvin C. Stakman,[1] Chief, Division of Plant Pathology and Botany, University of Minnesota, St. Paul, Minn.

Patrick H. Yancey, S. J., Professor of Biology, Spring Hill College, Spring Hill, Ala.

Terms Expire May 10, 1956

James B. Conant,[1] President, Harvard University, Cambridge, Mass.

John W. Davis, President, West Virginia State College, Institute, W. Va.

Edwin B. Fred,[1] Vice Chairman of the Board, President, University of Wisconsin, Madison, Wis.

Paul M. Gross,[1] Vice President and Dean of the Graduate School of Arts and Sciences, Duke University, Durham, N. C.

George D. Humphrey, President, The University of Wyoming, Laramie, Wyo.

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APPENDIX II

RESEARCH SUPPORT PROGRAM

Research Grants by Fields of Science

	Number	Amount
Biological and Medical Sciences:		
Developmental biology	9	$66,975
Environmental biology	4	25,060
Genetic biology	5	86,800
Microbiology	9	93,000
Molecular biology	9	114,500
Psychobiology	2	23,300
Regulatory biology	15	173,800
Systematic biology	11	106,480
General	4	72,760
Total	68	762,675
Mathematical, physical and engineering sciences:		
Astronomy	1	8,000
Chemistry	13	146,800
Earth sciences	3	23,700
Engineering	3	41,900
Mathematics	1	19,300
Physics	8	71,600
Total	29	311,300
Total Research Grants	97	1,073,975

BASIC RESEARCH GRANTS AWARDED IN FISCAL YEAR 1952

Astronomy

UNIVERSITY OF MINNESOTA, Minneapolis, Minn.; Dr. Willem J. Luyten, Department of Astronomy; *Astronomical Research: Motions of the Stars;* 2 years; $8,000.

Chemistry

CARNEGIE INSTITUTE OF TECHNOLOGY, Pittsburgh, Pa.; Dr. Frederick D. Rossini, Department of Chemistry; *Heats of Formation of Chemical Compounds;* 2 years; $21,500.

GEORGIA INSTITUTE OF TECHNOLOGY, Atlanta, Ga.; Dr. Jack Hine, School of Chemistry; *The Effect of Halogen Atoms on the Reactivity of Other Halogen Atoms in the Same Molecule;* 1 year; $5,500.

THE UNIVERSITY OF KANSAS, Lawrence, Kans.; Dr. William E. McEwen, Department of Chemistry; *Relative Rates of Migration of Aryl-Groups in the Schmidt Reaction;* 2 years; $5,500.

UNIVERSITY OF LOUISVILLE, Louisville, Ky.; Dr. Richard H. Wiley, Department of Chemistry; *Chemistry of 2-Pyrones;* 3 years; $14,400.

UNIVERSITY OF MINNESOTA, Minneapolis, Minn.; Dr. Bryce L. Crawford, Jr., Department of Physical Chemistry; *A Study of Force Constants in Unsaturated Molecules;* 1 year; $6,900.

UNIVERSITY OF NEBRASKA, Lincoln, Nebr.; Dr. Norman H. Cromwell, Department of Chemistry; *Stereochemistry and Hyperconjugation of Three-Ring Carbonyl Compounds;* 2 years; $13,700.

UNIVERSITY OF NORTH DAKOTA, Grand Forks, N. Dak.; Morton E. Milberg, Department of Chemistry; *The Properties of Vanadium Tetrachloride and Its Solutions;* 1 year; $3,000.

NORTHWESTERN UNIVERSITY, Evanston, Ill.; Dr. Fred Basolo, Department of Chemistry; *Preparation and Properties of Complex Compounds Containing Coordinated Fluoride Ions;* 2 years; $6,100.

PURDUE RESEARCH FOUNDATION, Lafayette, Ind.; Dr. Herbert C. Brown, Department of Chemistry; *Investigation of Effect of Structure on Chemical Reactivity Using Molecular Addition Compounds;* 2 years; $25,300.

TENNESSEE AGRICULTURAL AND INDUSTRIAL STATE UNIVERSITY, Nashville, Tenn.; Dr. Carl M. Hill, Department of Chemistry; *Reaction of Alpha, Beta-Unsaturated Ethers with Grignard Reagents;* 1 year; $6,600.

UNIVERSITY OF TEXAS, Austin, Tex.; Dr. Kenneth A. Kobe, Department of Chemical Engineering; *Critical Properties of Some Organic Compounds;* 2 years; $15,400.

UNIVERSITY OF UTAH, Salt Lake City, Utah; Dr. Randall E. Hamm, Department of Chemistry; *Solution Chemistry of Complex Ions;* 2 years; $14,700.

YALE UNIVERSITY, New Haven, Conn.; Dr. Benton B. Owen, Department of Chemistry; *Dielectric Constant of Water at High Pressures;* 1 year; $8,200.

Developmental Biology

CATHOLIC UNIVERSITY OF AMERICA, Washington, D. C.; Dr. W. Gardner Lynn, Department of Biology; *Control of Metamorphosis in Hyla Brunnea;* 4 months; $1,000.

UNIVERSITY OF COLORADO SCHOOL OF MEDICINE, Boulder, Colo.; Heinz Herrmann, Department of Pediatrics; *Embryonic Development and Maturation of Muscle Tissue;* 2 years; $20,000.

UNIVERSITY OF ILLINOIS, Urbana, Ill.; Dr. S. Meryl Rose, Department of Zoology; *Growth and Cellular Transformation During Regeneration in Amphibia;* 1 year; $4,600.

INDIANA UNIVERSITY, Bloomington, Ind.; Dr. James D. Ebert, Department of Zoology; *Origin of Tissue-Specific Proteins in the Chick Embryo;* 3 years; $16,500.

STATE UNIVERSITY OF IOWA, Iowa City, Iowa; Dr. J. Davies, Department of Anatomy, College of Medicine; *Anatomy and Physiology of the Kidneys and Placentae of the Mammalian Embryo;* 1 year; $600.

MIAMI UNIVERSITY, Oxford, Ohio; Dr. John R. Harrison, Department of Zoology; *Growth and Differentiation of the Pigment Layer of the Retina;* 2 years; $3,675.

UNIVERSITY OF MISSISSIPPI, University, Miss.; Dr. I. C. Kitchin, Department of Biology; *Culture of the Intact Amphibian Neural System as an Isolated Explant;* 2 years; $10,300.

TEXAS AGRICULTURAL EXPERIMENT STATION, College Station, Tex.; Dr. James Nevin Weaver, Department of Entomology; *Nutritional Factors in Differentiation of the Honeybee;* 5 years; $7,100.

WABASH COLLEGE, Crawfordsville, Ind.; Dr. Louis E. DeLanney, Department of Zoology; *Causative Factors in the Development of the Spleen;* 2 years; $3,200.

Earth Sciences

UNIVERSITY OF MIAMI, Coral Gables, Fla.; Robert N. Ginsberg, Marine Laboratory; *Geological Role of Certain Blue-Green Algae;* 1 year; $4,700.

OBERLIN COLLEGE, Oberlin, Ohio; Dr. Paul B. Sears et al.; *Continuous History of Forest and Climate Extending Into the Pleistocene;* 1 year; $12,000.

WEST VIRGINIA UNIVERSITY, Morgantown, W. Va.; Dr. Milton T. Heald, Department of Geology; *Determination of Factors Which Govern Mineral Changes in Sandstone;* 2 years; $7,000.

Engineering

BROWN UNIVERSITY, Providence, R. I.; Dr. Daniel C. Drucker, Graduate Division of Applied Mathematics; *Research in Three Dimensional Photoelastic Techniques;* 2 years; $10,000.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, Mass.; Dr. John G. Trump, Department of Electrical Engineering; *Fundamental Processes in High Voltage Breakdown in Vacuum;* 2 years; $16,400.

PENNSYLVANIA STATE COLLEGE, State College, Pa.; Dr. J. A. Sauer, Department of Engineering Mechanics; *Mechanical Behavior and Structure of Linear High Polymers;* 1 year; $15,500.

Environmental Biology

MICHIGAN STATE COLLEGE, East Lansing, Mich.; Dr. G. W. Prescott, Department of Botany; *Ecological Survey of Alpine and Arctic Algae in Relation to Glaciation and the Disjunctive Distribution of Phenarogams;* 1 year; $3,900.

UNIVERSITY OF MINNESOTA, Minneapolis, Minn.; Dr. Ernst C. Abbe, Department of Botany; *Phytogeography of the American Arctic and Subarctic;* 2 years; $9,700.

UNIVERSITY OF NEW MEXICO, Albuquerque, N. Mex.; Dr. C. Clayton Hoff, Department of Biology; *Effect of Elevation on Distribution of Insect and Arachnid Groups;* 3 years; $7,500.

ST. LOUIS UNIVERSITY, St. Louis, Mo.; Dr. Basile J. Luyet, Institute of Biophysics; *Survival of Vitrified and Dried Tissues and Organisms;* 1 year; $3,960.

Genetic Biology

CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, Calif.; Dr. Max Delbruck, Division of Biology; *Mechanisms Underlying Genetic Recombination in Bacteria;* 1 year; $5,500.

CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, Calif.; Dr. Frits W. Went, Division of Biology; Earhart Plant Research Laboratory; *Differences among Races and Varieties of Higher Plants;* 3 years; $21,700.

UNIVERSITY OF CALIFORNIA, Berkeley, Calif.; Dr. I. M. Lerner and E. R. Dempster, Division of Poultry Husbandry and Genetics, respectively; *Polygenic Variability;* 5 years; $50,000.

INDIANA UNIVERSITY, Bloomington, Ind.; Dr. Charles B. Heiser, Jr., Department of Botany; *Variation and Speciation in Sunflowers;* 3 years; $5,300.

UNIVERSITY OF PENNSYLVANIA, Philadelphia, Pa.; Dr. John R. Preer, Jr., Department of Zoology; *Genetic Cytoplasmic Factor in Protozoa;* 1 year; $4,300.

Mathematics

PURDUE RESEARCH FOUNDATION, Lafayette, Ind.; Dr. Lamberto Cesari, Department of Mathematics; *Asymptotic Behavior and Stability Problems;* 2 years; $19,300.

Microbiology

BROOKLYN COLLEGE, Brooklyn, N. Y.; Dr. George S. Tulloch, Department of Biology; *The Nature of Certain Ultramicroscopic Bodies Associated with Insects;* 1 year; $3,600.

BRYN MAWR COLLEGE, Bryn Mawr, Pa.; Dr. Rosalie C. Hoyt, Physics Department; *Bioelectric Behavior in Filamentous Algae, Investigated With the Aid of a New Analogue Computer;* 1 year; $3,400.

UNIVERSITY OF ILLINOIS, Urbana, Ill.; Dr. Robert Emerson, Department of Botany; *Carbon Dioxide Exchange During the Induction Period of Photosynthesis;* 3 years; $18,600.

UNIVERSITY OF ILLINOIS, Urbana, Ill.; Dr. Elliot Juni, Department of Bacteriology; *Mode of Action of Cocarboxylase in Carbohydrate Metabolism;* 3 years; $17,200.

INDIANA UNIVERSITY, Bloomington, Ind.; Dr. J. L. Stokes, Department of Bacteriology; *Investigations of the Iron Bacteria and of Chemoautotrophy;* 3 years; $17,400.

UNIVERSITY OF MARYLAND, College Park, Md.; Dr. Michael J. Pelczar, Jr., Department of Bacteriology; *Microbiological Degradation of Lignin;* 1 year; $5,500.

WABASH COLLEGE, Crawfordsville, Ind.; Dr. Willis H. Johnson, Department of Biology; *Nutritive Requirements of Paramecium Multimicronucleata;* 2 years; $3,100.

YALE UNIVERSITY, New Haven, Conn.; Dr. Paul R. Burkholder, Department of Plant Science; *Development of National Culture Collection of Algae;* 3 years; $10,000.

YALE UNIVERSITY, New Haven, Conn.; Dr. Victor M. Cutter, Jr., Department of Plant Science; *Isolation and Culture of Plant Rusts;* 3 years; $9,900.

YALE UNIVERSITY, New Haven, Conn.; Dr. Wolf Vishniac, Department of Microbiology; *Enzymatic Reactions in Photosynthesis and Chemosynthesis;* 1 year; $7,700.

Molecular Biology

UNIVERSITY OF LOUISVILLE, Louisville, Ky.; Dr. John Fuller Taylor, School of Medicine, Department of Biochemistry; *Enzymes Associated With Phospholipids and Nucleic Acids;* 2 years; $17,500.

MOUNT SINAI HOSPITAL, New York, N. Y.; Dr. J. D. Chanley, Department of Chemistry; *Reaction Mechanism of Aromatic Phosphoric Ester Hydrolysis;* 3 years; $12,200.

UNIVERSITY OF PENNSYLVANIA, Philadelphia, Pa.; Dr. Britton Chance, Johnson Foundation for Medical Physics; *Components of Blood;* 3 years; $37,100.

TEXAS A. & M. RESEARCH FOUNDATION, College Station, Tex.; Dr. Raymond Reiser, Department of Biochemistry and Nutrition, Texas Agricultural Experiment Station; *Tracer Studies on Glyceride Absorption and Transport;* 3 years; $16,000.

TULANE UNIVERSITY OF LOUISIANA, New Orleans, La.; Dr. Robert T. Nieset, Biophysics Laboratory; *Isotopic Studies on Nitrogen and Sulphur Metabolism;* 2 years; $11,500.

UNIVERSITY OF VERMONT, Burlington, Vt.; Dr. Thomas Sproston, Jr; Department of Botany; *The Role of Naturally Occurring 1,4–Naphthoquinones in Disease Resistance and Metabolism of Impatiens Balsamina L.;* 3 years; $6,500.

UNIVERSITY OF WISCONSIN, Madison, Wis.; Dr. Robert A. Alberty, Department of Chemistry; *Molecular Kinetics and Chemical Kinetics of Fumarase;* 1 year; $9,000.

YALE UNIVERSITY, New Haven, Conn.; Dr. G. Evelyn Hutchinson, Department of Zoology; *Amino Acid Analyses of the Water, Mud, and Organisms of Lakes;* 1 year; $1,400.

Physics

HAVERFORD COLLEGE, Haverford, Pa.; Louis C. Green, Strawbridge Observatory; *Transition Probabilities in the X-Ray Continua of Singly Ionized Potassium;* 4 months; $2,800.

UNIVERSITY OF MISSOURI, Columbia, Mo.; Dr. Arthur R. Laufer, Department of Physics; *Acoustic Cavitation Research;* 2 years; $31,700.

UNIVERSITY OF NEW MEXICO, Albuquerque, N. Mex.; Dr. John R. Green and Dr. Victor H. Regener, Department of Physics; *Nature of Penetrating Showers in Cosmic Radiation;* 1 year; $4,500.

PENNSYLVANIA STATE COLLEGE, State College, Pa.; Dr. Arthur H. Waynick, Ionosphere Research Laboratory; *Upper Atmosphere Research Using Long-Radio-Wave Pulse Techniques;* 1 year; $12,800.

REED COLLEGE, Portland, Oreg.; Dr. Frederick C. Brown, Department of Physics; *Conduction and Trapping Processes in Ionic Crystals;* 1 year; $3,500.

REED COLLEGE, Portland, Oreg.; Dr. Kenneth E. Davis, Department of Physics; *Study of Cosmic Rays;* 2 years; $6,200.

ST. OLAF COLLEGE, Northfield, Minn.; Dr. Marvin E. Wyman, Department of Physics; *Mechanism of Transport Through Living and Non-Living Membranes;* 1 year; $4,300.

ST. LOUIS UNIVERSITY, St. Louis, Mo.; Dr. Vincent P. Jacobsmeyer, Department of Physics; *Photoconduction and Photoemission of Boron;* 2 years; $5,800.

Psychobiology

KANSAS STATE COLLEGE, Manhattan, Kans.; Dr. Howard E. Evans, Department of Entomology; *Behavior Patterns of Solitary Hymenoptera;* 3 years; $9,500.

INDIANA UNIVERSITY, Bloomington, Ind.; Dr. W. K. Estes and Dr. C. J. Burke, Department of Psychology; *Mathematical Models for Behavior Data;* 2 years; $13,800.

Regulatory Biology

California Institute of Technology, Pasadena, Calif.; Dr. James Bonner, Division of Biology; *Photoperiodism and Vernalization;* 2 years; $17,700.

California Institute of Technology, Pasadena, Calif.; Dr. James Bonner, Division of Biology; *The Biochemistry of Plant Growth;* 1 year; $10,500.

California Institute of Technology, Pasadena, Calif.; Dr. Arthur W. Galston, Division of Biology; *Auxin Physiology;* 1 year; $5,000.

California Institute of Technology, Pasadena, Calif.; Dr. C. A. G. Wiersma, Division of Biology; *The Central Nervous System of Lower Animal Forms;* 2 years; $13,300.

University of California, Los Angeles, Calif.; Dr. Theodore Holmes Bullock, Department of Zoology; *Neurological Responses to Infra-Red Radiation;* 1 year; $5,300.

Institute for Cancer Research, Philadelphia, Pa.; Dr. Sidney Weinhouse, Department of Metabolic Chemistry; *Anterior Pituitary Hormone Effects on Fatty Acid Metabolism;* 3 years; $10,300.

State University of Iowa, Iowa City, Iowa; Dr. Robert P. Muir, Department of Botany; *Chemical Structure and Physiological Activity of Plant Growth-Regulators;* 2 years; $7,700.

Johns Hopkins University, Baltimore, Md.; Dr. Manfred M. Mayer, School of Hygiene and Public Health; *Cytotoxic Reactions Mediated by Antibody and Complement;* 3 years; $41,400.

Princeton University, Princeton, N. J.; Dr. W. W. Swingle, Department of Biology; *Isolation, Bioassay and Physiological Properties of the Amorphous Fraction of Adrenal Cortical Extracts;* 2 years; $11,500.

University of Tennessee, Knoxville, Tenn.; Dr. D. Frank Holtman, Department of Bacteriology; *Role of Amino Acids in the Host-Parasite Relationship;* 1 year; $5,000.

Tuskegee Institute, The Carver Foundation, Tuskegee Institute, Ala.; Dr. James H. M. Henderson, Research Associate; *Mechanism of Action of Plant Growth Regulators;* 2 years; $16,600.

Vanderbilt University, Nashville, Tenn.; Dr. Frank R. Blood, School of Medicine; *Nutrition and Biochemistry of the Bat;* 1 year; $4,600.

University of Wisconsin, Madison, Wis.; J. W. Williams, Department of Chemistry; *Kinetic Methods for Determination of the Valence of Precipitating Antibodies;* 2 years; $14,200.

University of Wisconsin, Madison, Wis., Dr. F. M. Strong, Department of Biochemistry; *Chemistry and Metabolism of Biologically Active Substances;* 1 year; $5,000.

Yale University, New Haven, Conn.; Dr. Grace E. Pickford, The Bingham Oceanographic Laboratory; *Response of Some Lower Vertebrates to Hormones;* 2 years; $5,700.

Systematic Biology

Chicago Natural History Museum, Chicago, Ill.; Jose Cuatrecasas, Department of Botany; *Taxonomic Study of the Tropical Plants of Colombia;* 3 years; $25,000.

DEPAUW UNIVERSITY, Greencastle, Ind.; Dr. Truman G. Yuncker, Department of Botany; *Botanical Survey of the Tongan Islands;* 18 months; $3,000.

UNIVERSITY OF HAWAII, Honolulu, Territory of Hawaii; Dr. D. Elmo Hardy, College of Agriculture, Department of Entomology; *Diptera of Hawaii;* 3 years; $19,000.

STATE UNIVERSITY OF IOWA, Iowa City, Iowa; Dr. G. W. Martin, Department of Botany; *Fungi of Panama;* 1 year; $2,100.

INDIANA UNIVERSITY, Bloomington, Ind.; Dr. Frank N. Young, Zoology Department; *Biometry and Taxonomy of Aquatic Beetles;* 18 months; $2,400.

UNIVERSITY OF KANSAS, Lawrence, Kans.; Dr. E. Raymond Hall and Dr. Rollin H. Baker, Department of Zoology; *Speciation of North American Mammals;* 3 years; $23,900.

UNIVERSITY OF MINNESOTA, Minneapolis, Minn.; Dr. John W. Hall, Department of Botany; *Coal Ball Floras;* 2 years; $780.

UNIVERSITY OF MISSISSIPPI, University, Miss.; Dr. Frank Montgomery Hull, Department of Biology; *Taxonomy and Phylogeny of Diptera;* 2 years; $9,000.

TULANE UNIVERSITY, New Orleans, La.; Dr. Fred R. Cagle, Graduate Department of Zoology; *Speciation in the Genus Graptemys;* 2 years; $14,200.

UNIVERSITY OF TULSA, Tulsa, Okla.; Dr. Albert P. Blair, Zoology Department; *Relationships of Selected Species of Bufonidae in the Southwestern United States;* 1 year; $2,300.

YALE UNIVERSITY, New Haven, Conn.; Dr. John R. Reeder, Department of Plant Science; *Embryos of Gramineae as an Aid in Classification and Phylogeny;* 2 years; $4,800.

General

NATIONAL ACADEMY OF SCIENCES, Washington, D. C.; Pacific Science Board; *Operating Expenses of the Pacific Science Board;* 2 years; $24,000.

NATIONAL ACADEMY OF SCIENCES, Washington, D. C.; Elmer G. Butler, Chairman, National Research Council Committee on the Naples Station; *American Table at the Naples Zoological Station;* 2 years; $2,260.

SMITH COLLEGE, Northampton, Mass.; Albert F. Blakeslee, Genetics Experiment Station; *Life Processes in Plants;* 2 years; $12,000.

STANFORD UNIVERSITY, Stanford, Calif.; L. R. Blinks, Hopkins Marine Station; *Basic Biology of Marine Organisms;* 3 years; $34,500.

GUIDE FOR THE SUBMISSION OF RESEARCH PROPOSALS

Introduction

The National Science Foundation, established by the National Science Foundation Act of 1950, is authorized to support basic scientific research in the mathematical, physical, medical, biological and engineering sciences, by making grants for such research to educational, industrial, governmental or other institutions, or individuals. The policy of the Foundation ordinarily is to award grants to institutions for research by specified individuals.

Proposals

The Foundation is now in a position to evaluate proposals for basic research grants and to make grants within the limits of available funds. Proposals are usually initiated by the scientist interested in carrying out the work. He may submit a proposal at once, or he may first choose to discuss the project informally, either by letter or in person, with an appropriate staff member of the Foundation. In the latter case a proposal will usually follow the preliminary discussion. Emphasis in the review of proposals is placed by the Foundation on the scientific merit of the suggested research, including the competence of the investigator.

Establishing the Amount of the Grant

In considering the budget for a grant the Foundation recognizes that substantial contributions are made by the grantee in such forms as space, equipment, library facilities, and, in many cases, in payment of the salary of the principal investigator. The Foundation will normally provide sufficient funds in the grant for such items as the salaries of personnel, materials, equipment, necessary travel, publication, and other direct costs. In addition, the grant will normally be sufficient to cover indirect costs up to 15 percent of the total direct costs covered by the grant.

Payment of the Award

Payments will be made in advance on a quarterly, semiannual, or annual basis depending on the relative size of the total grant.

Equipment

The Foundation will not normally require that title to equipment purchased with granted funds vest in the Government; such equipment may thus be retained by the grantee. No accounting for equipment will be necessary.

Reporting

The Foundation desires to be kept adequately informed of the progress of work covered by the grant and of the use of funds made available thereby. Normally this policy would be satisfied by filing of an annual progress report and a final report on the research work, and quarterly or semiannual financial reports. Publication of research papers is encouraged as appropiate, and may take the place of progress or final reports.

Security

In cases where there is a reasonable chance that information may be developed that should be classified in the interest of the national security, clearance may be required for investigators on the project. When, in the judgment of the principal investigator, information is developed that should be classified, he should notify the Foundation immediately.

Express Conditions

The typical grant instrument will contain express conditions which, upon acceptance of the grant, will bind the grantee. These conditions relate to the nature and scope of the research, revocation of the grant, return of unused funds, and patent rights.

Suggestions for Preparing a Research Proposal

The Foundation does not recommend any specific form for proposals at this time. The handling of proposals is facilitated, however, if they are submitted in 15 copies on letter size paper to the National Science Foundation, Washington 25, D. C. It is also suggested that proposals cover the following points insofar as they may be applicable:

1. *Name and address of institution.*
2. *Name of principal investigator.*
3. *Title of proposed research.*
4. *Description of proposed research.* A description of the work to be undertaken, its objectives and its relation to the present state of knowledge in the field and to comparable work in progress elsewhere, together with pertinent literature citations should be included.
5. *Procedure.* This should consist of an outline of the general plan of the work, including design of experiments to be undertaken, if any, and the procedure to be followed.
6. *Facilities.* Facilities and major items of permanent equipment that are available should be described.
7. *Personnel.* A short biographical sketch and a bibliography of the principal investigator and other professional personnel should be included.
8. *Budget.* The budget should comprise an estimate of the total cost of the project and a statement of its proposed duration, with a breakdown of costs for each year. Funds requested from the Foundation should be indicated for each of the categories listed below. If there are contributions from other sources, itemize in similar categories.
   a. *Salaries.* Itemize positions, giving names of professional personnel, if selected.
   b. *Permanent equipment.* Itemize major pieces of equipment required.
   c. *Expendable equipment and supplies.*
   d. *Travel.*
   e. *Other direct costs.* Itemize other direct costs not included in *a* through *d* above, such as costs of publication and of physical facilities.
   f. *Indirect costs.* Not to exceed 15 percent of the total of funds for direct costs requested of the Foundation, *a* through *e* above.
9. *Approval.* One copy of the proposal should be signed by the principal investigator, by the department head, and by an official authorized to sign for the institution.

APPENDIX III

Contracts and Grants Other Than Research Awarded in Fiscal Year 1952

Studies in Science

American Physiological Society, Washington, D. C.; *Survey and Inventory of Physiological Science;* 27 months; $117,500.

National Academy of Sciences, Washington, D. C.; *Committee on Photobiology;* 1 year; $5,500.

National Academy of Sciences, Washington, D. C.; *Committee on Applied Mathematics;* 1 year; $9,200.

Research Education in the Sciences

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts; Dr. Alfred C. Redfield, Associate Director; *Research and Training in Oceanography;* 8 months; $7,200.

Training of Scientific Personnel

National Academy of Sciences, Washington, D. C.; *Evaluation of NSF Fellowship Applications and Analyses of Fellowship Programs;* 9 months; $87,800.

National Academy of Sciences, Washington, D. C.; *Studies of Student Population of Institutions of Higher Learning in the United States;* 1 year; $11,440.

Scientific Information

John Crerar Library, Chicago, Illinois; H. H. Henkle, Librarian; *Functions and Organization of Information Services in Scientific Libraries;* 1 year; $8,400.

American Physical Society, New York, N. Y.; *Support of The Physical Review for the Calendar Year 1952–53;* 2 years; $50,000.

Columbia University, New York, New York; *Investigation of Russian-English Scientific and Technical Dictionary;* 7 months; $39,300.

Biological Abstracts, Inc., Philadelphia, Pennsylvania; *Support for the Publication of Biological Abstracts;* 1 year; $69,720.

American Association for the Advancement of Science, Washington, D. C.; Dr. Howard A. Meyerhoff; *Publication of Several Papers on Russian Science under the Title "Soviet Science";* 1 year; $1,300.

Princeton University, Princeton, New Jersey; Dr. Nathaniel Thon, Department of Chemistry; *Translation of "Diffusion and Transport Phenomena"* by D. A. Frank-Kamenetskii; 1 year; $2,700.

International Travel Grants

Giulio L. Cantoni, Western Reserve University, Cleveland, Ohio, to Paris, France.

Waldo E. Cohn, Oak Ridge National Laboratory, Oak Ridge, Tennessee, to Paris, France.

William E. Cornatzer, University of North Dakota Medical School, Grand Forks, North Dakota, to Paris, France.

Sherman R. Dickman, University of Utah Medical School, Salt Lake City, Utah, to Paris, France.

A. Clark Griffin, Stanford University, Stanford, California, to Paris, France.

Einar Hille, Yale University, New Haven, Connecticut, to Rome, Italy.

Frank M. Huennekens, Jr., University of Washington Medical School, Seattle, Washington, to Paris, France.

Nathan Jacobson, Yale University, New Haven, Connecticut, to Tel Aviv, Israel.

Nathan O. Kaplan, The Johns Hopkins University, Baltimore, Maryland, to Paris, France.

Seymour Kaufman, NYU-Bellevue Medical Center, New York, New York, to Paris, France.

John R. Kline, University of Pennsylvania, Philadelphia, Pennsylvania, to Rome, Italy.

Fritz Lipmann, Harvard University Medical School, Boston, Massachusetts, to Paris, France.

Walter O. Lundberg, Hormel Institute, Austin, Minnesota, to Paris, France.

Saunders MacLane, University of Chicago, Chicago, Illinois, to Rome, Italy.

Boris Magasanik, Harvard University Medical School, Boston, Massachusetts, to Paris, France.

Karl Meyer, Columbia University College of Physicians & Surgeons, New York, New York, to Paris, France.

Eugene Roberts, Washington University Medical School, St. Louis, Missouri, to Paris, France.

Howerde E. Sauberlich, Alabama Polytechnic Institute, Auburn, Alabama, to Paris, France.

Otto Schales, Alton Ochsner Medical Foundation, New Orleans, Louisiana, to Paris, France.

Esmond E. Snell, University of Texas, Austin, Texas, to Paris, France.

Yale J. Topper, Public Health Research Institute of the City of New York, to Paris, France.

Oscar Touster, Vanderbilt University School of Medicine, Nashville, Tennessee, to Paris, France.

Gordon P. Whyburn, University of Virginia, Charlottesville, Virginia, to Rome, Italy.

APPENDIX IV

Graduate Fellowship Program

Distribution of Accepted Fellowships by State of Residence

Region and State	*Applications Received*	*Fellowships Accepted*
NORTHEAST		
Connecticut	53	10
Maine	15	2
Massachusetts	152	37
New Hampshire	15	2
New Jersey	113	29
New York	511	119
Pennsylvania	201	37
Rhode Island	21	0
Vermont	8	1
SOUTH		
Alabama	19	2
Arkansas	12	1
Delaware	4	2
District of Columbia	36	10
Florida	58	9
Georgia	37	3
Kentucky	26	4
Louisiana	28	4
Maryland	67	10
Mississippi	10	1
North Carolina	38	9
Oklahoma	37	6
South Carolina	24	1
Tennessee	30	5
Texas	81	12
Virginia	39	10
West Virginia	15	3

Region and State	*Applications Received*	*Fellowships Accepted*
NORTH CENTRAL		
Illinois	223	47
Indiana	91	12
Iowa	46	9
Kansas	32	3
Michigan	115	18
Minnesota	51	12
Missouri	74	13
Nebraska	20	1
North Dakota	4	1
Ohio	106	24
South Dakota	14	3
Wisconsin	48	12
WEST		
Arizona	10	3
California	246	51
Colorado	48	10
Idaho	16	1
Montana	7	1
Nevada	1	0
New Mexico	16	2
Oregon	58	10
Utah	32	5
Washington	48	4
Wyoming	8	1
POSSESSIONS		
Alaska	3	0
Hawaii	5	1
Puerto Rico	3	0

Distribution of Accepted Fellowships by Year of Study and Field

Field of study	Predoctoral			Post-doctoral	Total
	1st year	2d year	Advanced		
Biological Sciences	25	41	65	9	140
Chemistry	43	38	43	3	127
Engineering	30	22	16	1	69
Geology	6	10	16	3	35
Mathematics	12	20	17	8	57
Physics	35	32	51	10	128
Astronomy	1	1	3	1	6
Physical Anthropology	1	0	2	0	3
Experimental Psychology	1	1	3	3	8
Total	154	165	216	38	573

Names, residence and field of study of persons awarded National Science Foundation fellowships for fiscal year 1952

ALABAMA

Arthur H. Neal, Birmingham, Chemistry.

Thomas A. Scott, Nauvee, Physics.

ARIZONA

Donald L. Bryant, Tucson, Geology.

Elmon Lee Coe, Yuma, Biochemistry-Physiology.

David Pettus, Tempe, General Zoology.

ARKANSAS

Bowman S. Garrett,[1] Springdale, Chemistry.

Robert J. Mackin, Jr., Little Rock, Physics.

CALIFORNIA

Jared Abell, Santa Monica, Chemistry.

Phillip A. Adams, Los Angeles, General Zoology.

Clarence R. Allen, Claremont, Geology.

Robert H. Allen, Berkeley, Chemistry.

Charles F. Andrews, Pasadena, Chemistry.

Barbara J. Bachman, Pacific Grove, Biochemistry-Physiology.

Richard P. Buck, San Marino, Chemistry.

David O. Caldwell, Los Angeles, Physics.

Chris D. Calsoyas, San Francisco, Physics.

Everett Clippinger, Los Angeles, Chemistry.

Arthur N. Cox, Van Nuys, Astronomy.

Raymond F. Dasmann, Berkeley, Zoology.

Donald De Fremery, Oakland, Biochemistry.

Bernard Elspas, Palo Alto, Engineering.

Herbert A. Forrester, Pasadena, Mathematics.

Glenn Fuller, Burbank, Chemistry.

Robert G. Ghirardelli, San Francisco, Chemistry.

Roy W. Gould, Jr., Rialto, Physics.

Andrew L. Gram, San Marino, Engineering.

Harry Greenberg, Los Angeles, Engineering.

Thomas W. Griswold, Berkeley, Physics.

[1] Fellowship declined.

JOHN HAMPTON, Berkeley, Chemistry.
BILLY J. HARTZ, Albany, Engineering.
RICHARD H. HELM, Chula Vista, Physics.
ROBERT L. HESS, Oakland, Engineering.
ROBERT S. HOFFMANN, Berkeley, Zoology.
JAMES A. IBERS, Temple City, Chemistry.
ROBERT EUGENE JONES, Watsonville, Engineering.
ARNOLD H. KAHN, Berkeley, Physics.
JULIAN LEE KAVANAU,[1] Los Angeles, Biology.
ROBERT M. KENDALL, Pasadena, Engineering.
WILLIAM A. KLEMPERER, Oakland, Chemistry.
PATRICIA M. KOHOUT, Temple City, Chemistry.
JOSEPH KRAUT, Pasadena, Chemistry.
LEO LICHTMAN,[1] Ontario, Engineering.
DAN L. LINDSLEY, Jr.,[1] Pasadena, Biology.
JAMES A. LOCKHART, Los Angeles, Botany.
THANE H. MCCULLOH, Santa Monica, Geology.
JON MATHEWS,[1] Hollywood, Physics.
DAVID H. MILLER, Oakland, Geology.
STANLEY L. MILLER, Oakland, Chemistry.
WILLIAM R. MOORE, Pacific Palisades, Chemistry.
MERRILL A. MUHS, San Francisco, Chemistry.
NORBERT MULLER,[1] Berkeley, Physics.
MONTGOMERY PHISTER, Long Beach, Engineering.
LYMON C. REESE, Berkeley, Engineering.
ROBERT C. REMPEL, Stanford, Engineering.
WERNER B. RIESENFELD, Los Angeles, Physics.
PHILIP R. RUCK, Los Angeles, Zoology.
THOMAS A. SEDGWICK, Pacoima, Engineering.
PAUL J. SCHLICHTA, Los Angeles, Chemistry.
WILLIAM R. SISTROM, Carmel, Microbiology.
WILLIAM GLENN SLY, Lakeside, Chemistry.
GEORGE H. TRILLING, Los Angeles, Physics.
EDWIN F. ULLMAN, Los Angeles, Chemistry.
VICTOR A. VAN LINT, Pasadena, Physics.
ARTHUR E. WENNSTROM, Los Angeles, Engineering.
WILLIAM V. WRIGHT, Long Beach, Engineering.
ROBERT E. WYCOFF, Pasadena, Engineering.
STANLEY A. ZWICK, Pasadena, Physics.

COLORADO

JAMES L. BREWBAKER, Longmont, Biology.
HARRY C. GRANGER, Denver, Geology.
WILLIAM G. HOEKSTRA, Golden, Biochemistry.
RUSSELL M. HONEA, Boulder, Geology.
JOHN L. KICE, Colorado Springs, Chemistry.
BEVERLY M. NEEPER, Monte Vista, Zoology.
CARL F. PRENZLOW, Englewood, Chemistry.
WALTER C. SWEET, Denver, Geology.
JOHN L. WESTLEY, Denver, Biochemistry.
DAVID J. WILSON, Fort Collins, Chemistry.

CONNECTICUT

JEAN F. DUBE, Hamden, Botany.
CLARENCE L. GREGORY, Greenwich, Engineering.
HARRY D. PECK, jr., Middletown, Biochemistry.
ZEVI W. SALSBURG, Hartford, Chemistry.
CHARLES L. SCHWARTZ, Bloomfield, Physics.
JOHN A. STROTHER, New London, Engineering.
ETHEL S. TESSMAN, New Haven, Biochemistry.
IRWIN TESSMAN, New Haven, Physics.
CHARLES F. WILCOX, Cos Cob, Chemistry.
GEORGE A. WILLIAMS, III, Higganum, Chemistry.

DELAWARE

RICHARD E. EMMERT, Newark, Engineering.

[1] Fellowship declined.

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Harry Weller, Wilmington, Biochemistry.

DISTRICT OF COLUMBIA

Thomas S. English, Zoology.
Royal B. Kellogg, Mathematics.
Francis L. Lambert, Zoology.
Edward A. Mason,[1] Chemistry.
Victor J. Mizel, Physics.
Jacques C. Poirier, Chemistry.
John C. Reed, Jr., Geology.
Jerome Spanier, Mathematics.
Granger G. Sutton, Geology.
Arnold M. Toxen, Physics.
David A. White, Geology.

FLORIDA

Arthur C. Bowbeer, Gainesville, Chemistry.
David B. Bright, Lakeland, Chemistry.
James A. Collinson, St. Petersburg, Physics.
Alexander Engel, Miami Beach, Physics.
Nelson H. Kemp, Miami Beach, Engineering.
Earl W. McKissom, Clearwater, Chemistry.
Robert S. Silas, Miami, Chemistry.
Harold Widom, Miami Beach, Mathematics.
Thomas H. Wood, Tallahassee, Biochemistry.

GEORGIA

Arthur M. Dowell, Jr., Atlanta, Chemistry.
Arthur W. Fort, Americus, Chemistry.
Vernon J. Hurst, Manor, Geology.

IDAHO

Darrell L. Davis, Corral, Zoology.

ILLINOIS

Charles B. Arends, Chicago, Chemistry.
Robert L. Blair, Rock Island, Mathematics.
Hugh N. Brown, Urbana, Physics.
John Buettner-Janusch, Chicago, Anthropology.
Bruce B. Burnett, Urbana, Chemistry.
Allan McC. Campbell,[1] Urbana, Microbiology.
Thomas R. Carver, Urbana, Physics.
Bernard Century, Chicago, Biochemistry.
Charles E. Cohn, Chicago, Physics.
John C. Craddock, Glen Ellyn, Geology.
Walter F. Davison, Ramsey, Physics.
Allen Devinatz, Chicago, Mathematics.
Donald C. Dittmer, Quincy, Chemistry.
William P. Dumke, Chicago, Physics.
Douglas A. Eggen, Chicago, Biochemistry.
Allan M. Feldman, Chicago, Chemistry.
John W. Firor, Chicago, Physics.
Frank J. Fishman, Jr., Cicero, Physics.
Marvin H. Friedman, Champaign, Physics.
Charles J. Goebel, Chicago, Physics.
Allen M. Gold, Chicago, Chemistry.
Jane Gray, Urbana, Geology.
Donald F. Holcomb, Urbana, Physics.
Louis N. Howard, Urbana, Physics.
John C. Jamieson, Chicago, Geology.
Owen J. Koeppe, Champaign, Biochemistry.
George Leppert, New Lennox, Engineering.
Robert L. Metzenberg, Jr., Highland Park, Biochemistry.
Robert E. Meyer, Bellwood, Chemistry.
Wheeler K. Mueller, Jr., Urbana, Engineering.
Theodore B. Novey, Chicago, Physics.
Franklin P. Peterson, Naperville, Mathematics.
Barth Pollak, Chicago, Mathematics.
Dewayne L. Richardson, Lake Zurich, Genetics.
Arthur H. Rosenfeld, Chicago, Physics.
Richard A. Rubenstein, Champaign, Physics.
Philip R. Ruby, Aurora, Chemistry.
Robert H. Schwaar, Chicago, Engineering.
Henry Selig, Chicago, Chemistry.
Norman Shapiro, Chicago, Mathematics.
Donald A. Speer, Morton Grove, Chemistry.
Henry Lewis Stadler,[1] Chicago, Physics.
Gene Strull, Chicago, Engineering.

[1] Fellowship declined.

ROBERT A. SWANSON, Chicago, Physics.
JOHN S. TADANIER, Chicago, Chemistry.
WILFORD F. WEEKS, Champaign, Geology.
JAMES W. WILT, Chicago, Chemistry.
JOHN W. WINCHESTER, Western Springs, Chemistry.
NANCY W. WORNER,[1] Lawrenceville, Genetics.
FREDRIK ZACHARIASEN, Chicago, Physics.

INDIANA

JAMES W. BASTIAN, West Lafayette, Zoology.
JAMES R. BEERBOWER, Auburn, Geology.
ARTHUR C. BROWN, Mishawaka, Physics.
HENRY M. BUTZEL, Jr., Bloomington, Zoology.
ROBERT L. CONNER, Marion, Biochemistry.
RICHARD S. COWAN, Indianapolis, Biology.
RAYMOND A. FLECK, C. S. C., Notre Dame, Chemistry.
EARL D. HANSON, Bloomington, Genetics.
THEODORE J. KRIEGER,[1] West Lafayette, Physics.
GORDON E. MALLETT,[1] Lafayette, Microbiology.
HAROLD L. SCOTTEN, Indianapolis, Microbiology.
CARL W. SMITH, Indianapolis, Chemistry.
LEE M. SONNEBORN, Bloomington, Physics.
THOMAS L. SWIHART, Elkhart, Astronomy.

IOWA

JOHN C. BELSHE, Spencer, Geology.
JOHN B. CARLSON, Ames, Botany.
ALLAN L. FISHER, Iowa City, Biochemistry.
HELEN L. HINRICHSEN, Ames, Physics.
THERESE M. KELLEHER, Des Moines, Botany.
WILLARD D. ROTH, Waterloo, Zoology.
MARY M. TREMAINE,[1] Mason City, Biochemistry.
MARY E. WARTERS, Des Moines, Zoology.
WILLIAM D. WARTERS, Des Moines, Physics.

KANSAS

SYDNEY ANDERSON, Lawrence, Zoology.
PHILIP OSBORNE BELL, Lawrence, Mathematics.
THOMAS M. BURFORD, Wichita, Engineering.
DAVID W. MCCALL, Wichita, Chemistry.
ROBERT L. SHAFFER,[1] Kinsley, Agriculture.

KENTUCKY

HERBERT E. HALL, Lexington, Microbiology.
WILLIAM W. HUNT, Jr., Franklin, Chemistry.
JOEL W. MCCLURE, Jr., Lexington, Physics.
EDWARD O. WILSON, Louisville, Zoology.

LOUISIANA

CHARLES E. CAPEL, New Orleans, Mathematics.
ALAN H. CHEETHAM, Shreveport, Geology.
CHARLES W. GORTON, Shreveport, Engineering.
CYRUS O. HARBOURT,[1] St. Gabriel, Engineering.
THOMAS A. OLIPHANT, Alexandria, Physics.
JASPER A. WELCH, Jr.,[1] Baton Rouge, Physics.

MAINE

PAUL L. CLOKE, Orono, Geology.
EDWIN R. FRENCH,[1] Millinocket, Biochemistry.
DAVID C. MAUZERALL, Sanford, Chemistry.

MARYLAND

ROBERT W. BASS, Annapolis, Mathematics.
JACOB J. BLUM,[1] Rockville, Biology.
RICHARD L. IRWIN, Westminster, Chemistry.
ROLF W. JUHLE, Ironsides, Geology.
ROBERT G. KULLER, Baltimore, Mathematics.
RUSSELL M. KULSRUD, Riverdale, Physics.

[1] Fellowship declined.

Frederick W. Lipps, Baltimore, Physics.
Miner B. Long, Baltimore, Geology.
Harold S. Morton, Takoma Park, Physics.
Helen L. Ruark, Baltimore, Geology.
Peter F. Stehle, Baltimore, Chemistry.

MASSACHUSETTS

Saul Aronow,[1] Watertown, Engineering.
Albert J. Bernatowicz, Worcester, Biology.
George R. Bird,[1] Sandwich, Chemistry.
William F. Brace, Winchester, Geology.
Norman H. Brooks, Milton, Engineering.
Edith C. Clarke, Concord, Biochemistry.
Robert A. Clement, Rockland, Chemistry.
James S. Coleman, Cambridge, Chemistry.
Richard H. Crowell, Cambridge, Mathematics.
Lloyd A. Currie, Somerville, Chemistry.
Samuel I. Epstein,[1] Dorchester, Chemistry.
Richard M. Franklin, Dorchester, Biochemistry.
Frank E. Harris, Jr., Quincy, Chemistry.
Jacques A-F. Hill, Brookline, Engineering.
Joseph H. Holloway, Brighton, Physics.
Quentin Jones, Cambridge, Botany.
Kenneth D. Kopple, Boston, Chemistry.
Samuel G. Levine,[1] Chelsea, Chemistry.
Jakob R. Loewenberg, Groton, Botany.
Robert M. Lurie, Brighton, Engineering.
James P. McLaughlin, Lowell, Microbiology.
John F. Moore, Concord, Physics.
Richard S. Palais,[1] Brookline, Mathematics.
Harris E. Petree, Cambridge, Chemistry.
John W. Pratt, Concord, Mathematics.
Carl A. Price, Cambridge, Biology.
Robert E. Putnam, Leeds, Chemistry.
Robert H. Romer, Cambridge, Physics.
John Ross, Newton, Chemistry.
Wilfred T. Rouleau, Quincy, Engineering.
Robert L. San Soucie, Adams, Mathematics.
Henry J. Smith,[1] Cambridge, Astronomy.
Peter C. Stein, Brookline, Physics.
George R. Stephens, Jr.,[1] Agawam, Agriculture.
Stephen J. Tauber, Springfield, Chemistry.
Vivianna Thimann, Cambridge, Biochemistry.
Edwin W. Tooker, Littleton Common, Geology.
Peter P. Vaughn, West Somerville, Zoology.
William G. Van Der Kloot,[1] Cambridge, Biology.
Peter H. Von Hippel, Weston, Biochemistry.
Matthew J. Wayner, Jr., Fairhaven, Psychology.
Robert C. West, Jr., Boston, Chemistry.
Calvin H. Wilcox, Waltham, Mathematics.
Sheldon Wolff, Lowell, Genetics.

MICHIGAN

Edwin Hall Battley, Port Huron, Microbiology.
Charles C. Bowen, East Lansing, Botany.
John L. Brown, Birmingham, Physics.
James L. Burkhardt, Birmingham, Physics.
George W. Ford, Troy, Physics.
Robert J. Gasser,[1] Detroit, Chemistry.
Thomas W. Hickmott, Kalamazoo, Chemistry.
Earl D. Holly, Coldwater, Chemistry.
John Lemish, Ann Arbor, Geology.
Robert R. Lewis, Jr., Ann Arbor, Physics.
Cecil R. Lubitz, Willow Run, Physics.
Charles B. Magee, Detroit, Chemistry.
Knut J. Norstog, Willow Run, Botany.
Herbert B. Pahl, Ann Arbor, Biochemistry.
Edward H. Poindexter, Lansing, Physics.
William C. Sayres, Detroit, Psychology.

[1] Fellowship declined.

WILLIAM G. SIMERAL, Ann Arbor, Physics.
THOMAS F. WATERS, Hastings, Zoology.
ARTHUR R. WOLCOTT, Lake City, Agriculture.

MINNESOTA

JOHN A. DAVISON, Minneapolis, Zoology.
ESTON M. GROSS, St. Paul, Chemistry.
ROBERT M. HEXTER,[1] St. Paul, Chemistry.
JOHN R. HOLUM, Minneapolis, Chemistry.
NAHMIN HORWITZ, Minneapolis, Physics.
JOHN A. JOHNSON, Minneapolis, Biology.
DONALD J. LEWIS, Adrian, Mathematics.
GEORGE K. LINDEBERG, Fairmont, Physics.
LAWRENCE H. MASON, Rochester, Biochemistry.
GEORGE PARSHALL, Minneapolis, Chemistry.
RICHARD L. PYCHA, Virginia, Zoology.
ROBERT J. TOMAN, Minneapolis, Chemistry.
RICHARD A. ZEMLIN, Minneapolis, Mathematics.

MISSISSIPPI

EDWARD E. GRACE, Corinth, Mathematics.

MISSOURI

WILLIAM H. ARNOLD, Jr., St. Louis, Physics.
ROBERT L. BECKER, Kirkwood, Physics.
STERLING G. BRADLEY, Springfield, Microbiology.
WILLIAM E. COOLEY, Cape Girardeau, Chemistry.
JULIAN C. EISENSTEIN,[1] Warrenton, Physics.
H. C. GRIFFITH, Boonville, Mathematics.
JAMES C. HAYWARD, Jr., St. Joseph, Engineering.
EDWIN R. HILLER, Jr., Glendale, Engineering.
HUGH H. ILTIS,[1] St. Louis, Biology.
LESTER H. KRONE, Jr., Jennings, Engineering.
MICHAEL W. LASALLE, Kansas City, Biochemistry.
RICHARD E. PRIEST, Kansas City, Mathematics.
KENNETH L. RINEHART, Jr., Chillicothe, Chemistry.
SIDNEY D. RODENBERG, Richmond Heights, Biochemistry.
LOUIS J. TICHACEK, St. Louis, Engineering.

MONTANA

JOHN E. WHITESITT, Stevensville, Mathematics.

NEBRASKA

JAMES R. MUNKRES, Broadwater, Mathematics.

NEW HAMPSHIRE

BRUCE W. KNIGHT, Jr., Hanover, Physics.
ELWYN R. LOVEJOY, Nashua, Chemistry.

NEW JERSEY

SIMON L. AUSTER, Highland Park, Biochemistry.
DONALD R. BAKER, Princeton, Geology.
GEORGE L. BATE, Bergenfield, Geology.
PHYLLIS A. BENNETT,[1] Avon, Biochemistry.
JOSEPH M. COOK, Summit, Mathematics.
LEONARD FINKEL, Highland Park, Engineering.
HAROLD M. FOSTER, Fair Lawn, Chemistry.
THOMAS N. K. GODFREY, Princeton, Physics.
OSCAR W. GREENBERG, Newark, Physics.
MARK A. HEALD, Princeton, Physics.
CARL S. HERZ, Pennington, Mathematics.
ROBERT D. KREBS, Nutley, Agriculture.
JOHN PETER LAZURUS, Long Branch, Physics.
MILTON LEVY, Newark, Physics.
DAVID N. LIMBER, Morris Plains, Astronomy.
SOLOMON L. LINDER, Bayonne, Physics.
JOHN P. MAYBERRY, Princeton, Mathematics.
ROBERT M. MAZO, Camden, Chemistry.
RICHARD H. MILBURN, Newark, Physics.
ROBERT M. MILLER, Tenafly, Chemistry.
JOHN W. MILNOR, Maplewood, Mathematics.
JOSHUA E. NEIMARK, Elberon, Engineering.

[1] Fellowship declined.

W. BARRY NIXON, Woodstown, Engineering.
BURTON RICHTER, Paterson, Physics.
JOHN C. SLONCZEWSKI, Summit, Physics.
FRANCIS G. STEHLI, Upper Montclair, Geology.
DONALD L. STRUVE, Freehold, Chemistry.
GEORGE S. SUTHERLAND, Princeton, Engineering.
WILLIAM G. ZOELLNER, East Orange, Chemistry.
WARREN J. WITTREICH, Princeton, Psychology.

NEW MEXICO

RICHARD C. DOVE, Albuquerque, Engineering.
JOHN K. S. WALTER, Jr., Santa Fe, Engineering.

NEW YORK

LEONARD G. ABRAHAM, Jr., Ithaca, Engineering.
DAVID E. ALBURGER, Brookhaven, Physics.
SEYMOUR ARONSON, Brooklyn, Chemistry.
ROBERT AUERBACH, New York, Genetics.
ROBERT J. AUMANN, Brooklyn, Mathematics.
EMANUEL BASKIR, Brooklyn, Physics.
ANATOLE BECK, Bronx, Mathematics.
MURRAY BERDICK, New York, Chemistry.
JOAN B. BERKOWITZ, Brooklyn, Chemistry.
JOSEPH BERKOWITZ, Bronx, Engineering.
LEWIS M. BERKOWITZ, Bronx, Chemistry.
HARRY H. BINGHAM, Jr., New York, Physics.
ABBY BONIME, New York, Psychology.
BARBARA P. BROWN, New York, Zoology.
LAURIE M. BROWN, Brooklyn, Physics.
DAVID CHALFIN, Bronx, Biochemistry-Physiology.
ADOLPH I. COHEN, Brooklyn, Biology.
CAROLYN COHEN, New York, Biochemistry.
MICHAEL COHEN, New York, Physics.
NAOMI K. COHN, Syracuse, Microbiology.
RANE L. CURL, Staten Island, Engineering.
ROBERT A. DARROW, Solvay, Biochemistry.
VERA R. DEMEREC, Cold Spring Harbor, Zoology.
STANLEY DESER, Brooklyn, Physics.
FRANK FEINER, Rego Park, Long Island, Physics.
GARY FELSENFELD, New York, Chemistry.
IRVING I. FINGER, Brooklyn, Zoology.
ISIDORE B. FLEISCHER,[1] Brooklyn, Mathematics.
MAXINE FRANK, Brooklyn, Biochemistry.
WILLIAM M. FRANK, Brooklyn, Physics.
HAROLD P. FURTH, New York, Physics.
WALTER G. GALL, Rochester, Chemistry.
JEROME GAVIS, Brooklyn, Chemistry.
HERBERT GELERNTER, Brooklyn, Physics.
JAMES M. GERE, Troy, Engineering.
ROBERT H. GIBBS, Jr., Ithaca, Zoology.
GEORGE GIOUMOUSIS, Brooklyn, Chemistry.
ALAN J. GOLDMAN, Brooklyn, Mathematics.
PETER GOLDMAN, New York, Biochemistry.
ERIC N. GOLDSCHMIDT,[1] Riverdale, Chemistry.
LESTER GOLDSTEIN,[1] Brooklyn, Biochemistry.
CHARLES M. GREENE, Corning, Mathematics.
MARJORIE E. GROESBECK, Hornell, Zoology.
LEONARD GROSS, Flushing, Long Island, Physics.
EVERETT M. HAFNER, Upton, Physics.
WILTON A. HARDY, New York, Physics.
NICHOLAS J. HARITATOS, Rome, Engineering.
CHARLES E. HECHT, Brooklyn, Chemistry.
HERMAN L. HELFER, New York, Astronomy.
DANIEL D. HENDLEY, New York, Biochemistry.
ROY W. HENDRICK, Jr., Buffalo, Physics.
LEONARD A. HERZENBERG, Brooklyn, Biochemistry.
JACK HILIBRAND, New York, Engineering.
DAVID A. HILL, Syracuse, Physics.
ROBERT B. HILL, Troy, Biochemistry.
RICHARD L. HINMAN,[1] Utica, Chemistry.

[1] Fellowship declined.

CHARLES A. HONIGSBERG, Brooklyn, Engineering.
BRINDELL HORELICK, New York, Mathematics.
PAUL HOROWICZ, New York, Biochemistry.
JACK HOROWITZ, New York, Biochemistry.
LAWRENCE P. HORWITZ, Forest Hills, Physics.
BENJAMIN M. JOHNSON, Minerva, Engineering.
FRED H. KANT, Bronx, Engineering.
CHARLES J. KAUFMAN, New York, Mathematics.
PAUL J. KELLOGG, Ithaca, Physics.
ROGER G. KETCHAM,[1] New Hartford, Chemistry.
BERTRAM KOSTANT, Brooklyn, Mathematics.
ARNOLD G. KRAMER, Mount Vernon, Physics.
HERBERT C. KRANZER,[1] New York, Mathematics.
WILLIAM E. M. LANDS, New Baltimore, Biochemistry.
NORMAN LAZAROFF, Brooklyn, Microbiology.
DANIEL LEDNICER, Tuckahoe, Chemistry.
MARIE LESNICK, Brooklyn, Mathematics.
CARL A. LEVINSON, New York, Physics.
RICHARD C. LEWONTIN, Flushing, Genetics.
DAVID B. LUDLUM, Rockville Centre, Chemistry.
PAUL R. MCISAAC, Ithaca, Engineering.
GUIDO V. MARINETTI, Rochester, Biochemistry.
PAUL C. MARTIN, Long Island, Physics.
ARTHUR P. MATTUCK, Brooklyn, Mathematics.
LAURA C. MAURER, Rockville Centre, Physics.
JEAN-PIERRE G. MEYER, New York, Mathematics.
ROBERT L. MILLS, Orangeburg, Physics.
MARTIN H. MOYNIHAN, Buffalo, Zoology.
ROBERT E. MOYNIHAN, Batavia, Chemistry.
JOSEPH E. NELSON, New York, Mathematics.
DONALD J. NEWMAN, Bronx, Mathematics.
JACK A. OFFENBACH, Schenectady, Chemistry.
JOHN M. OLSON, Niagara Falls, Biochemistry.
JOHN F. PARDO, New York, Engineering.
LEONARD M. PASSANO, Staten Island, Biology.
ARMIN R. PERRY, Jr., Buffalo, Biochemistry.
EMANUEL PARZEN, Concourse, Mathematics.
RICHARD J. PLOCK, Freeport, Chemistry.
HOPE H. PUNNETT, Buffalo, Botany.
STUART A. RICE, Bronx, Chemistry.
WALTER G. ROSEN, Forest Hills, Botany.
MALVIN A. RUDERMAN, Brooklyn, Physics.
LEO SARTORI, Bay Shore, Physics.
MALCOLM P. SAVEDOFF, New York, Physics.
MIRIUM SCHAPIRO, New York, Mathematics.
SILVAN S. SCHWEBER, Brooklyn, Physics.
GEORGE B. SELIGMAN, Attica, Mathematics.
ANDREW M. SESSLER, Jamaica, Physics.
JACOB SHAPIRO, Rochester, Biochemistry.
FRANK STERN, New York, Physics.
JOHN C. STEWART, New York, Physics.
JOSEPH SUCHER, Brooklyn, Physics.
FRED SUPNICK, New York, Mathematics.
GEORGE W. SUTTON, Brooklyn, Engineering.
ARTHUR TAUB, Brooklyn, Biochemistry.
HERBERT M. TEAGER, Brooklyn, Engineering.
WERNER ULRICH, New York, Engineering.
PHILIP TEITELBAUM, Brooklyn, Psychology.
RICHARD J. TURYN, Long Island City, Mathematics.
JAMES R. TROYER, New York, Botany.
PATRICK N. WALSH, Bronx, Chemistry.
ROGER WEINBERG, New York, Genetics.
JOHN WERMER, New York, Mathematics.
GROSVENOR S. WICH, Herkimer, Chemistry.
VICTOR J. WILSON, New York, Biochemistry.

[1] Fellowship declined.

BERTRAM WOLFE, Bronx, Physics.
BARBARA C. WOLFF, Flushing, Biochemistry.
HOWARD E. WOODIN, Scotia, Botany.
MICHAEL B. YARMOLINSKY, New York, Biochemistry.

NORTH CAROLINA

DOUGLAS R. ALLENSON, Durham, Chemistry.
WESLEY O. DOGGETT, Brown Summit, Engineering.
WILLIAM M. HOOKE, Greensboro, Physics.
FRANCIS C. HOWELL, Asheville, Anthropology.
HARVEY E. LEHMAN, Chapel Hill, Biology.
JOHN W. NIESTLIE, Jr., Winston-Salem, Engineering.
HERTHA D. E. SPONER,[1] Durham, Physics.
ROBERT P. UPCHURCH, Nashville, Agriculture.
JOSEPH M. WEAVER, Weaverville, Engineering.
CHARLES E. WINSLOW, Jr., Raleigh, Engineering.

NORTH DAKOTA

WALLACE E. LA BERGE, Grafton, Zoology.

OHIO

KENNETH B. ARMITAGE, Steubenville, Zoology.
TED G. BERLINCOURT,[1] Fremont, Physics.
ROBERT L. BIRKMEIER, Cincinnati, Chemistry.
JAMES A. CAMPBELL,[1] Oberlin, Chemistry.
BASIL CURNUTTE, Jr., Worthington, Physics.
SHERRY P. DOBROW, Akron, Chemistry.
MARSHALL P. ERNSTENE, Cleveland, Physics.
ALVIN E. FEIN, Cleveland Heights, Physics.
CASIMIR T. GRABOWSKI, Cleveland, Zoology.
WAYNE B. HADLEY, Farmdale, Chemistry.
THOMAS E. HUMPHREYS, Hudson, Botany.
WILLIAM H. KASNER, Killbuck, Physics.
ROBERT R. KOHN, Shaker Heights, Biochemistry.
WILLIAM L. MCLEISH, Cincinnati, Chemistry.
STEWART H. MERRILL, Andover, Chemistry.
RAYMOND E. METTER, Columbus, Geology.
MICHAEL D. MORLEY, Youngstown, Mathematics.
GEORGE R. MURRAY, Jr., Dayton, Physics.
ROBERT K. NESBET, Lakewood, Chemistry.
WILLIAM E. RANZ, Blue Ash, Engineering.
LAWRENCE J. SCHAAD, Wellston, Chemistry.
GILBERT C. SCHMIDT, Cincinnati, Biology.
RUFUS M. STILES, Manchester, Chemistry.
WILLIAM TOBOCMAN, Shaker Heights, Physics.
ANDREW A. WEAVER, Wooster, Zoology.
EDWARD E. ZAJAC, Cleveland, Engineering.

OKLAHOMA

LESLIE C. CASE, Tulsa, Engineering.
ROBERT J. DUNHAM, Tulsa, Geology.
WALTER C. HAMILTON, Stillwater, Chemistry.
JOSEPH P. HULL, Jr., Tulsa, Geology.
PAUL B. MCCAY, Muskogee, Biochemistry.
BUFORD D. SMITH, Omega, Engineering.

OREGON

DENNIS MCK. ASPINWALL, Bend, Engineering.
JOHN C. GODFREY, Tigard, Chemistry.
MARGERY P. GRAY, Eugene, Anthropology.
RALPH W. KAVANAGH, Eugene, Physics.
DONALD A. KOHLER, Springfield, Physics.
RUSSELL S. LEHMAN, Dayton, Mathematics.
ARTHUR E. LIVINGSTON, Eugene, Mathematics.
MICHAEL M. ROBISON,[1] Portland, Chemistry.
CLYDE M. SENGER, Portland, Microbiology.

[1] Fellowship declined.

ROBERT F. STEIDEL, Jr., Corvallis, Engineering.

RICHARD C. THOMAS, Jr., Corvallis, Chemistry.

PENNSYLVANIA

WALTER L. BAILY, Jr., Waynesburg, Mathematics.

EDWIN D. BECKER, Jr., Columbia, Chemistry.

GLORIA W. BORECKY, Pittsburgh, Zoology.

VICTOR H. COHN, Jr., Reading, Biochemistry.

DONALD J. DENNEY, Glenolden, Chemistry.

FRANK B. FAIRBANKS,[1] Pittsburgh, Engineering.

JACOB FELDMAN, Philadelphia, Mathematics.

MANUEL FINKELSTEIN, Scranton, Chemistry.

MARILYN A. GAGE, Williamsport, Botany.

H. NEWTON GARBER, Philadelphia, Engineering.

SADIE GARRETT, Swarthmore, Chemistry.

JOHN H. GAY, Drexel Hill, Mathematics.

ROBERT E. HANDSCHUMACHER, Glenside, Biochemistry.

WILLIAM R. HASEK, Pittsburgh, Chemistry.

ROBERT W. JAROSS, Duryea, Chemistry.

WILBUR LAKIN, Pittsburgh, Physics.

LAWRENCE G. LANG, Pittsburgh, Physics.

THEODOR A. LISS, Temple, Chemistry.

JOHN D. MCGERVEY, Pittsburgh, Physics.

PAUL S. MARTIN, West Chester, Zoology.

THRYGVE R. MEEKER, Pottstown, Chemistry.

THOMAS N. MORGAN, West Grove, Physics.

LEROY W. MORROW, Brownsville, Biochemistry.

HARRIS S. MOYED, Philadelphia, Microbiology.

JOHN S. NODVIK, Canonsburg, Mathematics.

ALEXANDER LEF. PUGH III, Bala-Cynwyd, Engineering.

HERBERT SCARF, Philadelphia, Mathematics.

IRVING H. SHER, Philadelphia, Biochemistry.

CARL E. SHERRICK, Jr., Carnegie, Psychology.

STANLEY STEIN, Philadelphia, Physics.

THOMAS R. STENGLE, Lancaster, Chemistry.

ROBERT D. TEETERS, Philadelphia, Engineering.

JOHN H. WEIKEL, Jr., Palmerton, Biochemistry.

EDWARD D. WEIL, Philadelphia, Chemistry.

KURT F. WISSBRUN, Philadelphia, Chemistry.

JOSEPH S. YUDELSON, Philadelphia, Chemistry.

WILLIAM ZIMMERMANN, Jr., Wyncote, Physics.

RHODE ISLAND

ROBERT M. BOYNTON,[1] Providence, Psychology.

SOUTH CAROLINA

WILLIAM P. CAVIN, Spartanburg, Chemistry.

SOUTH DAKOTA

CHARLES D. ANDERSON, Sturgis, Chemistry.

ANNE HOFFMANN, Pierre, Microbiology.

MELVIN H. RICE, Sisseton, Physics.

JAMES W. RICHARDSON, Sioux Falls, Chemistry.

TENNESSEE

HARVEY L. DIXON, West Point, Engineering.

THEODORE M. HALLMAN, Oak Ridge, Engineering.

WENDELL G. HOLLADAY, Huntingdon, Physics.

MARGARET J. OWEN, Bristol, Biochemistry.

LEE S. RICHARDSON, Oak Ridge, Engineering.

TEXAS

ROBERT D. BIGGS, Wichita Falls, Engineering.

[1] Fellowship declined.

ROBERT D. CHENOWETH, College Station, Engineering.
JAMES W. CRONIN, Dallas, Physics.
MASIL B. DANFORD, Buffalo, Mathematics.
PAUL L. DONOHO, Houston, Physics.
DANIEL O. ETTER, Fort Worth, Mathematics.
BETTY L. GEALY, Corpus Christi, Geology.
JOHN R. HILL,[1] Edcouch, Biochemistry.
LEON KRAINTZ, Houston, Biochemistry.
ERNEST L. LUNDELIUS, Jr., Austin, Geology.
ULRICH MERTEN, Houston, Chemistry.
JAMES R. SMITH, Houston, Physics.
JAMES C. WILHOIT, Jr., Houston, Engineering.

UTAH

EARL M. CHRISTENSEN, Provo, Botany.
CHARLES E. JACOB, Salt Lake City, Geology.
EDWARD P. PALMER, Cedar City, Physics.
RICHARD B. SELANDER, Salt Lake City, Zoology.
ROBERT K. SELANDER, Salt Lake City, Zoology.

VIRGINIA

RICHARD L. BERNARD, Williamsburg, Agriculture.
COLIN L. BROWNE, Charlottesville, Chemistry.
JOSEPH CALLAWAY, Alexandria, Physics.
JOHN C. DALTON, Bluefield, Zoology.
WILLIAM H. DARNELL, Harrisonburg, Engineering.
WILLARD F. DAY, Fair Harbor, North, Psychology.
JAMES T. KOFRON, Jr., Petersburg, Chemistry.
RICHARD F. LACEY, Arlington, Physics.
FRANK G. LESURE, Rustburg, Geology.
HARRY R. POWERS, Jr., Norfolk, Agriculture.
CHARLES P. THORNTON,[1] Norfolk, Geology.

VERMONT

JOHN B. FRALEIGH, Burlington, Mathematics.

WASHINGTON

PHILIP A. CRUICKSHANK, Blaine, Chemistry.
FRANCIS H. HARLOW, Jr., Seattle, Physics.
THERAN D. PARSONS, Seattle, Chemistry.
JOHN H. RUMELY, Pullman, Botany.

WEST VIRGINIA

RICHARD R. BOND, Salem, Zoology.
ORLEY T. LAW, Jr., Bridgeport, Psychology.
SYLVAN M. SAX, Wheeling, Chemistry.
DONALD M. SIMONS, Buckhannon, Chemistry.
ROBERT V. SPERRY,[1] McArthur, Engineering.

WISCONSIN

AARON I. GALONSKY, Madison, Physics.
MARJORIE A. GILBERT, Brodhead, Biochemistry.
EUGENE R. JOLLY, Madison, Biochemistry.
CHARLES C. LAING, Milwaukee, Botany.
URBAN J. LEWIS, Jr.,[1] Madison, Biology.
WAYNE E. MAGEE, Madison, Biochemistry.
DONALD LLOYD PETITJIAN,[1] Madison, Chemistry.
MARC H. ROSS, Madison, Physics.
PAUL W. SCHMIDT, Madison, Physics.
PHYLLIS L. WEISEL, Milwaukee, Botany.
GERALD A. WEMPNER, West Allis, Engineering.
DONALD B. WETLAUFER, Madison, Biochemistry.
FRANK O. WYSE, Milwaukee, Mathematics.

WYOMING

RICHARD E. CUTKOSKY, Cheyenne, Physics.

HAWAII

DOROTHEA BENNETT, Honolulu, Zoology.

[1] Fellowship declined.

INSTITUTIONS ATTENDED BY NATIONAL SCIENCE FOUNDATION FELLOWS AS UNDERGRADUATES AND GRADUATE STUDENTS

Institution and location	Number of fellows attending: As undergraduates	Number of fellows attending: As graduate students
Abilene Christian College, Abilene, Tex	1	....
Amherst College, Amherst, Mass	3	....
Antioch College, Yellow Springs, Ohio	1	....
Arizona State College, Flagstaff, Ariz	1	....
Baker University, Baldwin, Kans	2	....
Barnard College, New York, N. Y	3	....
Bates College, Lewiston, Maine	1	....
Beloit College, Beloit, Wis	1	....
Berea College, Berea, Ky	1	....
Bermuda Biological Station, Bermuda	......	1
Bethany College, Bethany, W. Va	1	....
Birmingham-Southern College, Birmingham, Ala.	1	....
Boston College, Chestnut Hill, Mass	......	1
Boston University, Boston, Mass	1	1
Bowdoin College, Brunswick, Maine	2	....
Brigham Young University, Provo, Utah	1	....
British Museum of Natural History, London, England	......	1
Brooklyn College, Brooklyn, N. Y	10	....
Brooklyn Polytechnic Institute, Brooklyn, N. Y	3	2
Brown University, Providence, R. I	1	....
Bryn Mawr College, Bryn Mawr, Pa	3	....
Bucknell University, Lewisburg, Pa	1	....
California Institute of Technology, Pasadena, Calif.	18	31
Cambridge University, Cambridge, England	1	6
Canisius College, Buffalo, N. Y	1	....
Carleton College, Northfield, Minn	1	....
Carnegie Institute of Technology, Pittsburgh, Pa	9	7
Case Institute of Technology, Cleveland, Ohio	4	....
Central College, Fayette, Mo	1	....
Cincinnati College of Engineering, Cincinnati, Ohio.	1	....
Clark University, Worcester, Mass	1	....
Colgate University, Hamilton, N. Y	1	....
College of the City of New York, New York, N. Y	13	....
College of Wooster, Wooster, Ohio	2	....
Colorado A & M, Fort Collins, Colo	1	....
Colorado College, Colorado Springs, Colo	1	....
Columbia University, New York, N. Y	8	23
Cooper Union Institute of Technology, New York, N. Y	1	....
Cornell University, Ithaca, N. Y	20	14
Danish Geological Survey, Charlottelund, Denmark	......	1
Dartmouth College, Hanover, N. H	3	....
De Pauw University, Greencastle, Ind	3	....
Drexel Institute of Technology, Philadelphia, Pa	1	....

NOTE.—Number of undergraduates in each entry represents fellowship awards, while number of graduate students represents fellows now actually in graduate school. The total number in the latter category is somewhat smaller than the former because of declinations.

INSTITUTIONS ATTENDED BY NATIONAL SCIENCE FOUNDATION FELLOWS AS UNDERGRADUATES AND GRADUATE STUDENTS—Con.

Institution and location	Number of fellows attending: As undergraduates	Number of fellows attending: As graduate students
Duke University, Durham, N. C	......	1
Eastern Illinois State Teachers College, Charleston, Ill	1	....
Elmira College, Elmira, N. Y	1	....
Emory University, Emory, Ga	......	1
Farmington State Teachers College, Farmington, Maine	1	....
Federal Institute of Technology, Zurich, Switzerland	......	1
Fordham University, New York, N. Y	1	1
Franklin & Marshall College, Lancaster, Pa	2	....
Fresno State College, Fresno, Calif	1	....
G. Verga Instituto, Italy	......	1
George Washington University, Washington, D. C.	3	....
Georgia Institute of Technology, Atlanta, Ga	1	2
Hamilton College, Clinton, N. Y	1	....
Harvard University, Cambridge, Mass	32	39
Haverford College, Haverford, Pa	1	....
Hope College, Holland, Mich	1	....
Howard College, Birmingham, Ala	1	....
Illinois Institute of Technology	4	2
Indiana University, Bloomington, Ind	2	6
Institute for Advanced Study, Princeton, N. J	......	4
Iowa State College, Ames, Iowa	2	3
Johns Hopkins University, Baltimore, Md	5	18
Kalamazoo College, Kalamazoo, Mich	1	....
Lafayette College, Easton, Pa	1	....
Lawrence College, Appleton, Wis	1	....
Lehigh University, Bethlehem, Pa	4	....
Louisiana Polytechnic Institute, Ruston, La	1	....
Louisiana State University, Baton Rouge, La	1	....
Loyola College, Baltimore, Md	1	....
Luther College, Decorah, Iowa	1	....
Maryville College, Maryville, Tenn	1	....
Massachusetts Institute of Technology, Cambridge, Mass	33	51
Merrimack College, Andover, Mass	1	....
Michigan State College, East Lansing, Mich	4	2
Montana State University, Missoula, Mont	1	....
Mt. Holyoke College, Mt. Holyoke, Mass	1	....
Muhlenberg College, Allentown, Pa	1	....
Nebraska Wesleyan, Lincoln, Nebr	1	....
New Mexico School of Mines, Socorro, N. Mex	1	....
New York State Teachers College, Albany, N. Y	1	....
New York University, New York, N. Y	7	2
Nobel Institute of Physics, Stockholm, Sweden	......	1
North Carolina State College, Raleigh, N. C	5	7
Northwestern University, Evanston, Ill	3	3
Oberlin College, Oberlin, Ohio	11	....
Ohio State University, Columbus, Ohio	8	6
Oklahoma A & M, Stillwater, Okla	2	....

Oregon State College, Corvallis, Oreg	2	1
Oxford University, Oxford, England	1	2
Pennsylvania Military College, Chester, Pa	1	....
Pomona College, Claremont, Calif	6	....
Princeton University, Princeton, N. J	8	32
Purdue University, LaFayette, Ind	5	10
Queens College, New York, N. Y	2	....
Queens University, London, Ontario, Canada	......	1
Radcliffe College, Cambridge, Mass	3	7
Reed College, Portland, Oreg	4	....
Rensselaer Polytechnic Institute, Troy, N. Y	4	....
Rice Institute, Houston, Tex	3	2
Ripon College, Ripon, Wis	1	....
Rutgers University, New Brunswick, N. J	......	2
St. Lawrence University, Canton, N. Y	2	....
St. Michael's College, Winooshi Park, Vt	1	....
St. Olaf College, Northfield, Minn	4	....
St. Thomas College, St. Paul, Minn	3	....
Salem College, Salem, W. Va	1	....
San Diego State College, San Diego, Calif	1	....
Simmons College, Boston, Mass	1	....
South Dakota School of Mines and Technology, Rapid City, S. Dak	2	....
Southern Methodist University, Dallas, Tex	2	....
Southwest Missouri State, Springfield, Mo	1	....
Stanford University, Stanford, Calif	12	19
State College of Washington, Pullman, Wash	2	....
Swarthmore College, Swarthmore, Pa	14	....
Syracuse University, Syracuse, N. Y	2	1
Temple University, Philadelphia, Pa	2	....
Texas A & M., College Station, Tex	1	....
Texas Christian University, Fort Worth, Tex	1	....
Trinity College, Hartford, Conn	2	....
Tufts College, Medford, Mass	4	....
Tulane University, New Orleans, La	1	2
Union College, Albany, N. Y	4	....
U. S. Merchant Marine Academy, Kings Point, N. Y	1	....
U. S. Naval Academy, Annapolis, Md	2	....
University of Alabama, Tuscaloosa, Ala	1	....
University of Bern, Bern, Switzerland	......	1
University of Buffalo, Buffalo, N. Y	1	....
University of California, Berkeley, Los Angeles, Davis, Calif	15	34
Universidad del Cauca, Popayan, Colombia	......	1
University of Chicago, Chicago, Ill	22	50
University of Cincinnati, Cincinnati, Ohio	2	....
University of Colorado, Boulder, Colo	3	1
University of Connecticut, Storrs, Conn	1	....
University of Copenhagen, Copenhagen, Denmark	......	1
University of Delaware, Newark, Del	......	2
University of Detroit, Detroit, Mich	1	....
University of Florida, Gainesville, Fla	4	2
University of Georgia, Athens, Ga	1	....
University of Illinois, Urbana, Ill	11	31
University of Iowa, Iowa City, Iowa	......	3
University of Kansas, Lawrence, Kans	3	2
University of Kentucky, Lexington, Ky	1	1
University of Leiden, Leiden, The Netherlands	......	1
University of Lund, Lund, Sweden	......	1
University of Maryland, College Park, Md	1	....
University of Massachusetts, Amherst, Mass	3	....

INSTITUTIONS ATTENDED BY NATIONAL SCIENCE FOUNDATION FELLOWS AS UNDERGRADUATES AND GRADUATE STUDENTS—con.

Institution and location	*Number of fellows attending As undergraduates*	*As graduate students*
University of Michigan, Ann Arbor, Mich	8	18
University of Minnesota, Minneapolis, Minn	8	10
University of Missouri, Columbia, Mo	1	....
University of North Carolina, Chapel Hill, N. C	2	3
University of North Dakota, Grand Forks, N. Dak	1	....
University of Notre Dame, South Bend, Ind	3	1
University of Oklahoma, Norman, Okla	2	1
University of Oregon, Eugene, Oreg	3	....
University of Pennsylvania, Philadelphia, Pa	......	7
University of Pittsburgh, Pittsburgh, Pa	4	4
University of Rochester, Rochester, N. Y	5	7
University of San Francisco, San Francisco, Calif	1	....
University of the South, Sewanee, Tenn	1	....
University of South Dakota, Vermillion, S. Dak	1	....
University of Texas, Austin, Texas	3	2
University of Toronto, Toronto, Canada	1	....
University of Utah, Salt Lake City, Utah	5	2
University of Vermont, Burlington, Vt	1	....
University of Virginia, Charlottesville, Va	2	4
University of Washington, Seattle, Wash	6	6
University of Wisconsin, Madison, Wis	7	29
Ursinus College, Collegeville, Pa	1	....
Utah State Agricultural College, Logan, Utah	1	....
Valparaiso University, Valparaiso, Ind	1	....
Vanderbilt University, Nashville, Tenn	1	....
Vassar College, Poughkeepsie, N. Y	1	....
Virginia Polytechnic Institute, Blacksburg, Va	4	....
Wabash College, Crawfordsville, Ind	1	....
Washington University, St. Louis, Mo	5	4
Washington and Jefferson College, Washington, Pa	1	....
Wesleyan University, Middletown, Conn	3	....
West Virginia Wesleyan, Buckhannon, W. Va	1	....
Western Kentucky State Teachers College, Bowling Green, Ky	1	....
Western Reserve University, Cleveland, Ohio	2	....
Williams College, Williamstown, Mass	2	....
Wofford College, Spartanburg, S. C	2	....
Woods Hole Marine Biological Laboratory, Woods Hole, Mass	......	2
Worcester Polytechnic Institute, Worcester, Mass	1	....
Yale University, New Haven, Conn	4	25
Yeshiva University, New York, N. Y	3	....

APPENDIX V

Survey of Federal Obligations for Scientific Research and Development at Nonprofit Institutions

PRELIMINARY ESTIMATES OF FEDERAL FUNDS FOR SCIENTIFIC RESEARCH AND DEVELOPMENT AT NONPROFIT INSTITUTIONS, BY SCIENTIFIC FIELDS, FOR YEARS ENDING JUNE 30, 1951, AND 1952

(In millions of dollars)

Character of work	Field of work						Total	
	Bioligical, medical, and agricultural sciences		Physical, mathematical and engineering sciences		Social sciences			
	1951	1952	1951	1952	1951	1952	1951	1952
Basic research	14.1	15.7	59.8	54.0	1.9	1.4	75.8	71.1
Applied research	43.7	47.0	91.5	110.7	8.5	15.0	143.7	172.7
Development	2.8	3.1	51.4	74.0	.3	.2	54.5	77.3
Increase of Research and Development Plant	5.6	4.0	17.1	16.2	.2	0	22.9	20.2
Total	66.2	69.8	291.8	254.9	10.9	16.6	296.9	341.3

PRELIMINARY ESTIMATES OF FEDERAL FUNDS FOR SCIENTIFIC RESEARCH AND DEVELOPMENT AT NONPROFIT INSTITUTIONS BY SELECTED FEDERAL AGENCIES AND CHARACTER OF THE OBLIGATION, FOR YEARS ENDING JUNE 30, 1951 AND 1952

(In millions of dollars)

Agency	Character of work								Total	
	Basic research		Applied research		Development		Increase of research and development plant			
	1951	1952	1951	1952	1951	1952	1951	1952	1951	1952
Department of Defense	43.9	34.3	94.5	119.5	20.4	27.3	2.8	0	161.6	181.1
Atomic Energy Commission	24.4	27.9	22.7	26.6	30.5	46.4	20.1	20.2	97.7	121.1
Federal Security Agency (PHS)	5.1	5.1	11.7	12.8	.2	.4	0	0	17.0	18.3
Department of Agriculture	1.0	1.3	11.7	11.7	.3	.3	0	0	13.0	13.3
Other Agencies	1.4	2.5	3.1	2.1	3.1	2.9	0	0	7.6	7.5
Total	75.8	71.1	143.7	172.7	54.5	77.3	22.9	20.2	296.9	341.3

DEFINITIONS FROM INSTRUCTIONS FOR REPORTING DATA TO THE NATIONAL SCIENCE FOUNDATION

Scientific research and development is intended broadly to include not only the actual conduct of research and development, but also obligations incurred for: (a) Indirect costs of nonprofit institutions related to their conduct of research and development; (b) operating and maintenance costs of research and development facilities, installations, or activities owned, used or managed by nonprofit institutions, even though no actual research or development may be sponsored at the facility or installation by the agency involved; (c) increases in the capital research and development plant of nonprofit institutions; and (d) arrangements under which funds will be distributed by a nonprofit institution to other organizations or individuals for research and development. It is not intended to include obligations for activities concerned *primarily* with the dissemination of scientific information or with the training of scientific manpower.

Research and development classifications. For this report, data is requested by three categories, *basic research, applied research,* and *development.* Simple, brief definitions of each of these general classifications are given below. In presenting these definitions it is recognized that simple definitions for items such as these are exceedingly difficult to formulate in such a way as to be acceptable to the scientist and to the administrator. The general concept of basic research in particular has often been subdivided into a number of additional categories such as background and fundamental, directed and undirected, programmatic and nonprogrammatic, etc., in order to distinguish between what sometimes appear as widely differing types of activity, or to characterize the motivation behind the work. Similar difficulties have been experienced with applied research and development. However, in a report of this nature, covering an extensive body of facts developed from a large number of sources, it appears desirable to keep the categories as few, and their definitions as simple, as possible. Admittedly, there is often no clear-cut line of demarcation between categories such as these. Nevertheless, it is evident that very many cases, certainly the majority, may be classified with little difficulty. Thus the names of the categories themselves have a general validity as definitions.

In cases where uncertainty exists with respect to the proper classifications, the advice of research scientists representative of the field or fields concerned is of value. In cases where an overlap between categories exists, the obligation with its associated activity should be assigned to the category most appropriate to the principal emphasis of the undertaking, unless there is a logical basis for subdividing the work among different classifications.

As a general statement, *research* may be said to be systematic, intensive study directed toward fuller knowledge of the subject studied. For proper prosecution it requires highly trained personnel and special techniques.

1. *Basic research* is that type of reseach which is directed toward the increase of knowledge in science.

2. *Applied research* is that type of research which is directed toward practical applications of science.

3. *Development* is the systematic use of scientific knowledge directed toward the production of useful materials, devices, systems, methods or processes; the term excludes design and production engineering.

Scientific fields. In addition to the classification by the nature of the activity, it is also requested that the data be classified according to scientific fields. Short definitions of the field classifications to be used are given below. As in the case of the classification by type of research, it is recognized that many specific undertakings can be classified only with difficulty and will tend to overlap other fields. Again, it is suggested that, where classification difficulties arise, the opinion of representative research scientists be sought and, that where overlap exists, the obligation be assigned to the category most appropriate to the principal emphasis, unless a logical basis for subdividing the work is present.

1. *Biological, Medical, and Agricultural Sciences.* Generically speaking, the biological sciences are those sciences dealing with life processes. For this report, the biological sciences as a whole are divided into (a) *medical sciences,* i. e., those sciences which, apart from the clinical aspects of professional medicine, are concerned primarily with the utilization of scientific principles in understanding diseases and in maintaining and improving health; (b) the *agricultural sciences,* i. e., those sciences directed primarily toward understanding and improving agricultural productivity such as agronomy, animal husbandry, forestry, horticulture, range management, soil culture, etc.; and (c) *biological sciences,* all sciences other than those listed in (a) and (b) above which deal with life processes. In addition to work done in disciplines traditionally considered as being a biological science there should also be included work done in other disciplines or subjects where the work is undertaken primarily for the purpose of understanding life processes.
2. *Physical, Mathematical, and Engineering Sciences.* For this report (a) *physical sciences* are those sciences concerned primarily with the understanding of the natural phenomena associated with nonliving things; (b) *mathematical sciences* are those sciences which employ logical reasoning with the aid of symbols and which are concerned with the development of methods of operations employing such symbols, including mathematics, pure and applied; astronomy, theoretical mechanics, statistics, logistic research, and computer research exclusive of engineering; (c) *engineering sciences* are those sciences which are concerned with studies directed toward making specific scientific principles usable in engineering practice.
3. *Social sciences* are those sciences directed toward an understanding of the behavior of individuals as members of a group. These include such sciences as cultural anthropology, economics, education, history, logistics, political science, social psychology, sociology, etc. In addition to work done in disciplines or subjects traditionally considered as being a social science, there should also be included work done in other disciplines or subjects where the work is undertaken primarily for the purpose of understanding group behavior.

APPENDIX VI

FINANCIAL REPORT FOR FISCAL YEAR 1952

APPROPRIATED FUNDS

Status of Appropriation from the Congress to the National Science Foundation as of June 30, 1952

RECEIPTS

Appropriation for fiscal year 1952		$3,500,000

OBLIGATIONS

Research policy development and services

Development of national science policy	$130,200	
Dissemination of scientific information	69,700	
Attendance at international scientific meetings	17,153	
Maintenance of information on scientific personnel	104,000	
Support of the interdepartmental committee on scientific research and development	18,755	
Subtotal	339,808	
Research support		
Biological and medical sciences	762,675	
Mathematical, physical and engineering sciences	311,300	
Subtotal	1,073,975	
Training of scientific manpower		
Graduate fellowships	1,532,971	
Research education in the sciences	7,200	
Subtotal	1,540,171	
Operating costs		
Subtotal	512,046	
Total obligations		3,466,000
Unobligated balance carried forward		34,000

WORKING FUND

Status of Funds Transferred from Federal Agencies to the National Science Foundation as of June 30, 1952

RECEIPTS

Atomic Energy Commission	$10,000	
Department of Defense:		
Department of the Army	52,700	
Department of the Navy	12,000	
Department of the Air Force	10,000	
Federal Security Agency	9,720	
Veterans Administration	10,000	
Total receipts		104,420

OBLIGATIONS

Development of national science policy	2,000	
Dissemination of scientific information	101,720	
Total obligations		103,720
Unobligated balance carried forward		700

TRUST FUND

Status of Funds Donated from Private Sources to the National Science Foundation as of June 30, 1952

RECEIPTS

Unobligated balance from fiscal year 1951	$512	
Donations received during fiscal year 1952	550	
Total receipts		1,062

OBLIGATIONS

Services		15
Unobligated balance carried forward		1,047

APPENDIX VII

Federal Expenditures for Research and Development—Fiscal Years 1940–52

[In millions of dollars]

Agency	1940	1942	1944	1945	1946	1947	1948	1949	1950	1951	[1] 1952
Atomic Energy Commission	...	...	...	...	...	31.0	84.0	111.0	121.1	116.7	162.9
Federal Security Agency: Public Health Service	2.8	3.2	3.3	3.4	3.5	10.1	19.6	21.9	32.1	34.4	38.5
National Advisory Committee for Aeronautics	2.2	5.0	18.4	24.1	23.7	26.5	29.8	37.9	42.5	44.3	49.4
National Science Foundation	...	...	...	...	...	...	...	...	...	.1	1.1
Office of Scientific Research and Development	...	11.0	86.8	114.5	36.8	5.6	.9	...	...	...	...
Department of Agriculture	28.4	28.5	30.5	32.0	35.0	37.3	40.7	48.0	50.6	49.8	51.7
Department of Commerce	3.3	3.2	5.2	5.0	5.0	4.3	6.2	10.0	10.0	11.0	15.4
Department of Defense:											
Air Force	8.7	83.8	110.2	136.0	121.0	152.4	187.3	212.4	193.4	238.2	314.0
Army	3.8	68.4	161.3	134.0	114.0	93.6	113.2	124.0	108.8	143.8	246.0
Navy	13.9	58.9	176.6	243.0	183.0	269.3	233.7	270.5	237.4	276.7	320.0
Secretary of Defense	...	...	...	...	...	...	...	...	...	...	10.0
Total, military functions	26.4	211.1	448.1	513.0	418.0	515.3	534.2	606.9	539.6	658.7	890.0
Department of the Interior	7.9	13.5	20.7	18.0	17.0	16.5	19.1	28.3	27.7	28.8	31.9
Other agencies	2.4	3.4	32.6	20.0	11.0	9.9	27.5	29.7	16.0	16.3	19.3
Total, comparable items	73.4	278.9	645.6	730.0	550.0	656.5	762.0	893.7	839.6	960.1	1,260.2
Indirect costs, all agencies [2]	[3]	[3]	[3]	[3]	[3]	[3]	158.4	161.8	199.7	273.7	356.0
Construction of facilities, all agencies	[3]	[3]	[3]	[3]	[3]	53.7	62.0	115.9	149.6	201.9	400.0
Manhattan Engineer District, total expenditures	...	...	730.0	859.0	366.0	186.0	...	...	...	...	...
Grand total	[3]	[3]	[3]	[3]	[3]	[3]	982.4	1,171.4	1,188.9	1,449.7	2,016.2

Source: Bureau of the Budget. [1] Estimated. [2] Indirect costs for Department of Defense are included only in part. [3] Not available.