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.

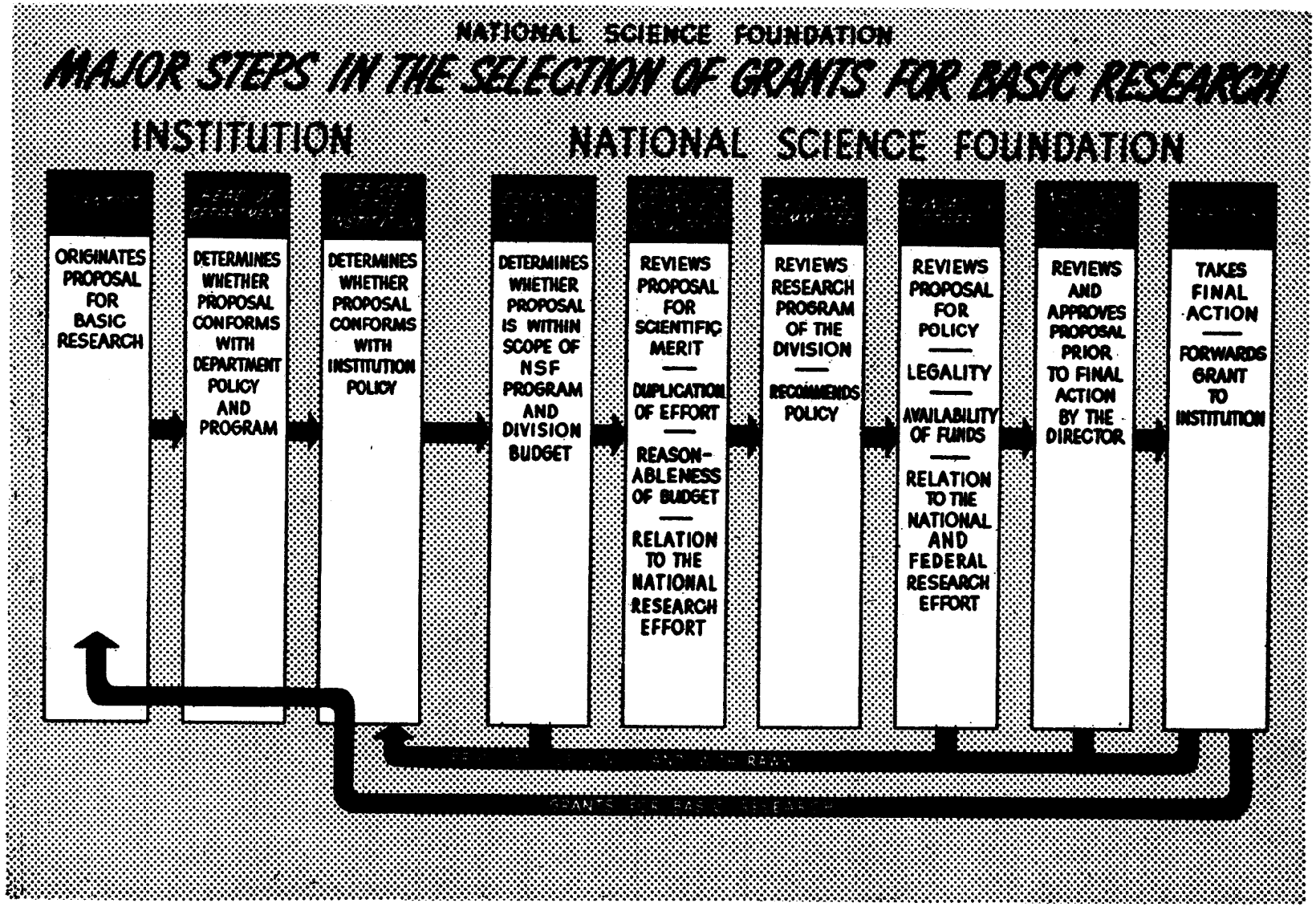
The direct grant has been adopted by the Foundation as the most appropriate type of instrument for supporting basic research. The administration of grants has proved to be comparatively simple, both for the grantor and the grantee. Basic research cannot be bought by the gross or the pound, and not only 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during the year ending June 30 of which $1.1 million (8 percent) was approved, $5.1 million (38 per cent) was declined, withdrawn, or represented reductions in budgets of approved proposals, and $7.1 million (54 per cent) was pending.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The proportion of declined and withdrawn proposals is high compared with the experience of other Federal agencies and private foundations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 — REASONABLENESS 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

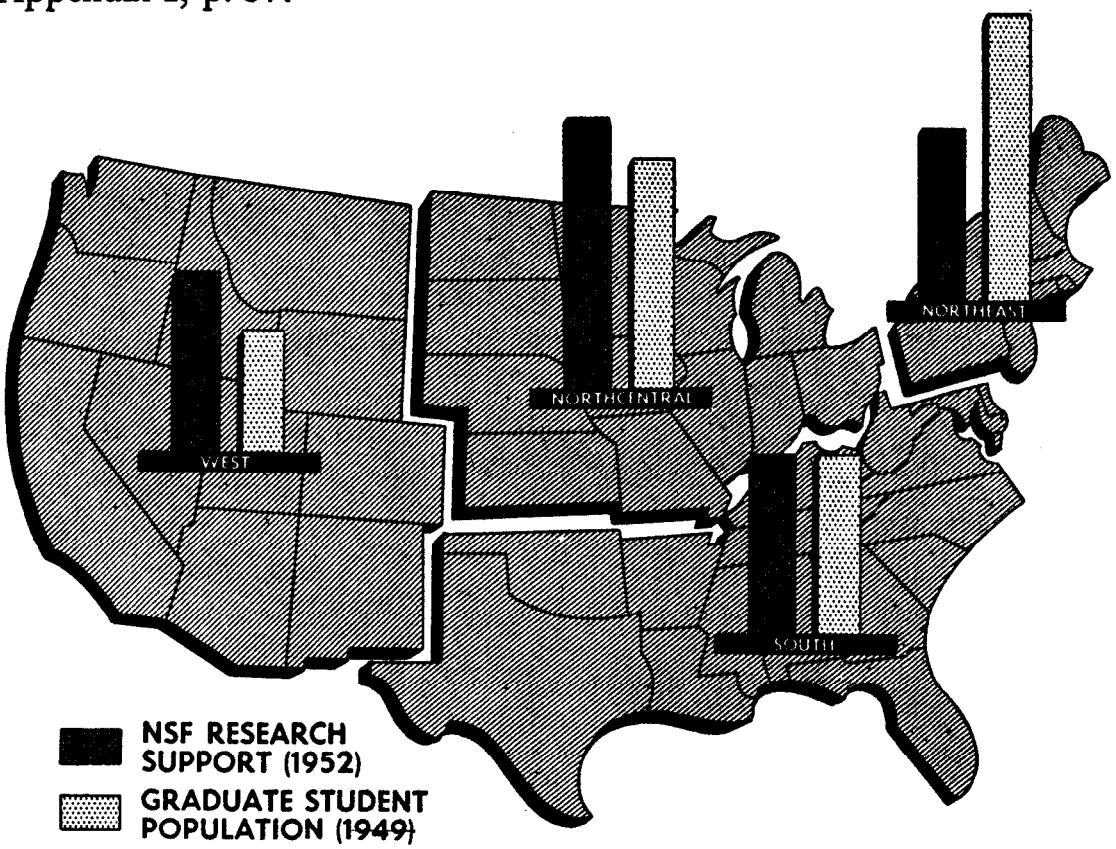
REVIEW AND EVALUATION PROCEDURE

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.