NATIONAL SCIENCE FOUNDATION

Reappraisal

and

Reorganization

THE STATUS OF SCIENCE

IN THE UNITED STATES,

1958–59

REAPPRAISAL AND REORGANIZATION— THE STATUS OF SCIENCE IN THE UNITED STATES, 1958–59

A sense of crisis gripped the United States following the launching by the U.S.S.R. of the first earth satellite in October 1957. During the ensuing year many people, at every level of Government and in private life, sought ways to meet the challenge which, they felt, had thus been so forcefully presented to the Nation.

The haste and urgency of late 1957 were far less apparent in 1958–59. Instead, the past year has been devoted largely to consolidation of some of the actions already taken. Though it was, for some, a year of inquiry into further steps that the Nation might take to secure a sound structure of education and science, it was for far too many others a year for slipping back into complacency. The feeling of crisis waned. Many Americans seemed to want to forget that we live in a competitive world in which our Nation, to remain strong and free, must understand the dangers it faces and be determined to surmount them.

Those who wished could, and did, take a deeper look into some of the relationships between science and government. In the scientific and political communities, the form and substance of proposed improvements in our educational system and our organization for science have been the subject of continuing scrutiny. Important issues have been raised. The fact is acknowledged that quick resolution of some of them is neither possible nor desirable. Thoughtful persons differ over the direction we should take.

The Federal Government and Science Policy

Through the debates and the actions, some progress could be distinguished. Enactment of Public Law 85–568 of July 29, 1958, was the culmination of previous months of discussion about our position in research and engineering with respect to outer space. The law created the National Aeronautics and Space Administration, "to provide for research into problems of flight within and outside the earth's atmosphere," and for many other purposes. Its activities began officially in October 1958 and NASA announced early in 1959 a 10-year program of space exploration directed toward scientific study of the atmosphere; the ionosphere; energetic particles; astronomy; and magnetic, electric, and gravitational fields.

The same law also established the National Aeronautics and Space Council, to coordinate space activities and establish space policy at the highest level. This Council is composed of the President, the Secretaries of State and Defense, the Administrator of the NASA, the Chairman of the Atomic Energy Commission, and a maximum of one additional Government member (at present the Director of NSF) and three additional non-Government members. The Council advises the President on all significant aeronautical and space activities of the United States, on comprehensive programs for these activities as conducted by Federal agencies, and on differences that may need resolving among Government bodies with respect to aeronautical and space activities.

The National Defense Education Act became law September 2, 1958, capping extended debate on the character of the educational system in the United States and the responsibility of the Federal Government for improving education. Among the results of the first year's operation under the act have been—

1. Student loan funds, totaling $30.5 million, distributed to 1,201 institutions of higher learning.

2. Fellowship awards made to 1,000 graduate students, with 18 percent of them in biological science and 28 percent in physical science and mathematics.

3. Twelve foreign language institutes conducted during the summer.

4. Establishment of 19 language and area centers at colleges and universities for operation during the academic year.

5. Contracts placed for 20 modern foreign language research projects.

The President's Science Advisory Committee

The President's Science Advisory Committee (PSAC) issued two highly significant reports during the year: *Strengthening American Science,* released Dec. 27, 1958, and *Education for the Age of Science,* released May 24, 1959.

1. *Strengthening American Science.*—This report dealt with the fundamental problems of relationships between government and science in the United States. "It is apparent . . . ," the report said, "that the Government exerts a powerful shaping influence on all U.S. science and technology. Not only the Nation's security but its long-term health and economic welfare, the excellence of its scientific life, and the quality of American higher education are now fatefully bound up with the care and thoughtfulness with which the Government supports research. If this support is halting and erratic, if it emphasizes mechanism and hardware

to the neglect of fundamental understanding, if it lavishes money on a few popular fields and starves others of importance, if it fails to encourage exceptional men and exceptional programs, the net result could be an impoverished science and a second-rate technology."

It pointed out that throughout the history of science the various disciplines, seemingly unrelated, frequently stimulate each other. The interplay between fields, producing unexpected results, is at the heart of scientific and technological progress. One cannot predict the quarter from which the next scientific advance will come; the important thing is not to be overly concerned with how "practical" the research is, but rather to insure the research programs have great breadth and scope. "In the past, major advances in the Government's management of science have come about under the pressure of emergencies. Ways must now be found for recognizing the importance of stability and other long-term goals, while preserving the flexibility to respond to emergencies."

Together with this must come recognition of the need for fully integrated policies to give public and private laboratories an assurance of stable and sustained support. "Each year numbers of them must set aside valuable time to go back to the supporting agency, hat in hand, seeking another year's financing. Often a large laboratory must assemble funds from a number of Government agencies and then perform a complicated juggling act to adjust equipment costs, overhead, and salaries to match its income." The major problem, stated the report, was to meet the needs of these research institutions while continuing to meet the programmatic and policy needs of the agencies sponsoring research. "Without in any way encroaching upon the freedom and authority of each department or agency to manage its own programs, there is still an opportunity to pull together the policies developed in different agencies of the Government with a view of integrating and reconciling them as a whole."

To take advantage of this opportunity the report called for the establishment of a Federal Council for Science and Technology. The key to the recommendation was that top-level, policy-making representatives of the agencies concerned with research and development would be members of the new Federal Council. Each would then be in a position to speak with authority about his agency's position on a subject, to commit his agency to a plan of action, and to insure that his agency fulfilled its planned program. The Council was envisioned in this way as a truly effective planning and coordinating body, rather than merely a channel of communications. The Federal Council for Science and Technology, established as a result of this recommendation, is discussed in detail beginning on page 7.

Strengthening American Science also appraised many other aspects of the support and encouragement of science by the Government. It recommended careful study by Government officials of patterns prevalent in industry, where vice presidents for research take the lead in corporation planning for new scientific and technical activities. The Secretary of each Government department, the report suggested, should appoint an appropriate assistant to keep him in intimate touch with the department's scientific and technical activities and provide policy supervision over the activities. This would enable departments more clearly to state the missions of their laboratories, and thereby help the latter to plan and execute reasonable programs capable of meeting their needs.

The report made several recommendations concerning Government-sponsored research in non-Government institutions, a field of increasing importance as Government expenditures in private laboratories steadily grow. It named as a key problem that of providing university laboratories more opportunity for the planning of their research—something that is more difficult to achieve in the presence of extensive support of single research projects by Government and industry. Suggestions were offered for difficulties that arise under Federal policies and practices in the financing of research at non-Government organizations.

Extensive recommendations were also made concerning Government and private funding of research, including mention that policy activities of the National Science Foundation should be continued and strengthened in the general area of Government-university relationships in the conduct of Government-sponsored research.

2. *Education for the Age of Science.*—This report presented views as to ways in which our educational system can be strengthened so as more fully to meet the requirements of today's scientific era. It said:

> A modern educational system should not only sharpen the intellectual capacities and curiosities of each new generation, should not only extract the essential core from ever-accumulating stores of knowledge, should not only find ways to produce new leaders equipped to add to these stores and to create all the new tools that the civilization requires; it must also produce the citizens and leaders who will know how to use the knowledge and tools to advance social and cultural life.

Of fundamental importance is the need for intellectual excellence in America. "In a frontier society, such as that of America of 100 years ago, it was natural that physical prowess and bravery, inherent in the pioneer, should have been held in high esteem," the report said. "Today the frontier is intellectual; the scholar, the research worker, the scientist, the engineer, the teacher are the pioneers." It went on to underline the

fact that "well-trained minds are among the most critical of our present national assets, among the scarcest and most valuable of our resources."

To create the intellectual resources we need, the report pointed out, we must first better the lot of our teachers. Five things can be done: Many nonteaching tasks should be assigned to others. Teachers' salaries should be increased. Time should be provided to permit teachers to keep up with their subject matter. Teacher training should be reexamined, and new training methods used, with particular emphasis on substantive knowledge. And finally, teachers must be supplied with far more adequate and up-to-date teaching aids of all types.

Another key in creating needed intellectual resources is the identification of especially able youngsters. "We strongly urge that measures be evolved to discover and to provide financial support for bright students whose needs cannot be met in their local community, and to make it possible for them to study in more adequate schools. Such financial support begun, where necessary, in the secondary school and continued through college and graduate school, should be regarded not as a charity but as a prize honestly won for achievement—and a wise investment in maintaining the national welfare . . . . It is scarcely possible to put the matter too strongly. The potentially great scientist or engineer, scholar, physician, or educator who ends up, through no fault of his own, as an underling at a task below his native endowment, represents an indefensible national loss."

Federal Council for Science and Technology

The Federal Council for Science and Technology was established by Executive Order 10807, signed by President Eisenhower March 13, 1959. Named to the Council and serving as its first Chairman was the Special Assistant to the President for Science and Technology, Dr. James R. Killian, Jr. (succeeded by Dr. George B. Kistiakowsky at the close of the fiscal year). Serving as members of the Council are representatives from the Departments of Agriculture, of Commerce, of Defense, of Health, Education, and Welfare, and of the Interior, and from the National Aeronautics and Space Administration, National Science Foundation, and Atomic Energy Commission.

Functions of the Council, as enumerated in the Executive order, are to consider problems and developments in the fields of science and technology and related activities affecting more than one Federal agency, or concerning the Nation's overall advancement in science and technology. It recommends to the President measures designed: to provide more effective planning and administration of Federal scientific and technological programs, to identify research needs including areas of research

requiring additional emphasis, to achieve more effective utilization of the scientific and technological resources and facilities of Federal agencies, and to further international cooperation in science and technology. It is in a position to coordinate the interests and responsibilities of the various Federal agencies with research and development programs of mutual interest.

Close cooperation between NSF and the Federal Council was envisaged in the Order, with the Foundation continuing its substantive programs of support of basic research and education in the sciences and its basic science policy functions.

Executive Order 10807 also abolished the Interdepartmental Committee on Scientific Research and Development. Its former role, in modified form, is continued in the creation of a Standing Committee of the Federal Council for Science and Technology.

Increased NSF Responsibilities

During the year several additional responsibilities were assigned or transferred to the National Science Foundation, or became active programs within NSF.

1. *Coordination of Federal Science Information Activities.*—The importance of the information programs that had been carried on by the Foundation were emphasized by Congress in the National Defense Education Act of 1958. The act created a Science Information Service within NSF to develop better ways to make scientific information readily available to working scientists. Executive Order 10807 further strengthened these responsibilities of the Foundation, stipulating that NSF shall "provide leadership in the effective coordination of the scientific information activities of the Federal Government with a view to improving the availability and dissemination of scientific information." Other Federal agencies were directed to cooperate with and assist NSF in performing this function.

The Office of Science Information Service, established within the Foundation in January 1959, was assigned functions provided for in the Executive order. Since then it has continued to work closely with other Government agencies having interests or activities in the science information field, and has sought with them to improve the flow of scientific information within and outside the Federal Government.

2. *Research in Weather Modification.*—On December 31, 1957, the Advisory Committee on Weather Control presented its final report to the President and terminated its activities. The report recommended that its major functions be transferred to the National Science Foundation "to assist that agency in developing a long-range program of basic

and applied research in weather modification in cooperation with other agencies." At the beginning of the fiscal year, by Public Law 510, 85th Congress, the Foundation was given the responsibility to provide for a program of study, research, and evaluation in the field of weather modification. Other Government agencies, such as the Weather Bureau, will continue their work in this field.

On March 23, 1959, the Foundation announced grants amounting to $1,130,000 to both Government and private institutions for weather modification research. In commenting upon the program, the Director of the Foundation stated:

> We believe that these investigations are most necessary at the present stage of development of weather modification theory and practice. Until now, weather modification studies have been complicated by a large proportion of trial-and-error experiments of uncertain results, many without the controls necessary adequately to assess their meaning and significance. The work under the NSF program will increasingly move from scattered and unrelated investigations to efforts soundly based on scientific knowledge.

3. *The U.S. Antarctic Research Program.*—Also in March 1959 NSF announced the establishment of an Antarctic research program within the Foundation. Toward the conclusion of the International Geophysical Year a decision was made by the Government to maintain continuing scientific activity in the Antarctic based, in large part, upon certain of the IGY programs. NSF was selected as the Federal agency responsible for continuing such a U.S. Antarctic scientific program. For ideas and recommendations as to scientific programs that might be suitably carried on in the Antarctic, the Foundation receives advice from the National Academy of Sciences-National Research Council, as well as from Federal agencies with interests in the Antarctic.

The conduct of research in the Antarctic by U.S. scientists was made possible during the IGY by the logistic support of the U.S. Navy, which has had long experience in polar operations and which carried out its IGY duties with the traditional excellence that has come to be expected of the naval service. The Navy is continuing in this role in current and forthcoming scientific operations in the Antarctic.

4. *Information on Scientific and Technical Personnel.*—In April 1959, the Bureau of the Budget requested that NSF assume the responsibility for taking the leadership in developing, in cooperation with other Government agencies, a national program of informaton on scientific and technical personnel. NSF accepted the assignment, and has begun to organize its plans for the collection of information to provide as fully rounded a picture as possible of scientific and technological manpower

training, working conditions, and future trends. The Foundation continued to remain responsible for acting as a clearinghouse for scientific manpower information and for conducting studies in this area.

Other Changes in Government Organization for Science

At the end of 1958 the President's Committee on Scientists and Engineers went out of existence. The final report, transmitted to the President on December 17, summarized the 2-year program of the committee, and the Office of Civil and Defense Mobilization agreed to assume the responsibility for continuing two of the activites, the local action programs and the utilization conferences.

The appointment of Dr. Wallace R. Brode as science adviser to the Secretary of State on January 13, 1958, provided recognition of the important interrelationships between science and foreign policy. By the end of fiscal 1959 eight men were assigned to duty in six countries as part of the science attaché program. Four additional posts are expected to be manned soon.

The principal function of the science adviser is to provide the Secretary of State with advice and recommendations concerning the interactions of science and foreign policy. His staff maintains necessary liaison with Government and non-Government organizations and with international organizations, such as the science groups in the United Nations and the North Atlantic Treaty Organization.

Proposals To Alter the Federal Science Structure

Throughout the year, the question was frequently raised and debated as to whether the organizational changes discussed above were keeping pace with the scientific needs of the Nation. Was it possible, perhaps, that in attempting to assure freedom of investigation for scientists, the Nation was neglecting its own interests? Was more coordination, if not direction, from the Federal Government required? Furthermore, were not science and technology now recognized to be so important to our national existence that they should have a voice in Government equivalent to that of, say, labor or agriculture? And finally, is there not duplication and lack of direction among the many Federal agencies responsible for support of research and development, that call for centralized control?

Establishment of a Department of Science

In May 1959, the Subcommittee on Reorganization and International Organizations of the Committee on Government Operations, U.S. Senate, held hearings on three bills whose purposes were to try to solve such problems as those just raised. One would have provided a Department

of Science and Technology, another a Department of Science, and the third a Commission on a Department of Science and Technology.

It was pointed out that if a new department were established which controlled only a small portion of the research funds expended by the Government, the desired degree of centralization would not be present. One alternative, establishment of a department to control all, or most, Government research and development functions, was strongly opposed by many representatives of science within and outside Government. Primarily, it was pointed out, most Government-supported research is and should be related to the mission of the sponsoring agency. Each department or agency makes provision for scientific research and development in order better to accomplish its mission. Thus, with a typical agency, research and development per se is not the purpose; it is only a means to an end. If a new department were to take in the science functions required for the accomplishment of the missions of other agencies, the latter would be seriously hampered in carrying out their duties. Domination by a sort of superagency would have a demoralizing effect upon scientific activities of the Government.

Too, past experience has shown that often "applied research drives out basic," that is, that owing to the competition for funds within an agency which has both research interests and operating programs, applied research which contributes directly toward success of the operating programs tends to be emphasized at the expense of the more remote, less certain findings of basic research. At present, the National Science Foundation, with no direct responsibility for technological development, has the responsibility of maintaining a comprehensive program in support of basic research in many fields.

The Foundation has pointed out that the problem of unnecessary duplication in basic science does not exist as in other fields of human endeavor, provided effective communication exists between research workers. For each basic researcher is under compulsion—his own inner desires and the standards of his discipline—to uncover and publish significant new and original results in science. Except for purposes of verification, publication of work which duplicates that of others is absurd. The best way to insure that there is no undesirable duplication is therefore by insuring that scientists have ready access to all pertinent materials published in their fields. They know, themselves, whether or not to continue a proposed line of work. Centralized governmental control may have use in avoiding duplication of applied scientific or engineering work, but it is irrelevant and indeed harmful to the planning of new basic scientific research on a national scale.

In Foundation testimony before the Subcommittee on Reorganization and International Organizations of the Committee on Government Operations of the Senate, it was pointed out that the President's action in appointing a Special Assistant for Science and Technology and reassignment of the Science Advisory Committee to report to the President were impressive steps toward the solution of some of the most urgent problems having to do with science and technology. Furthermore, the establishment of the Federal Council for Science and Technology provides a valuable opportunity for promoting closer cooperation among Government agencies in planning their research and development programs and in strengthening the Nation's research efforts. By virtue of the nature of its membership and the authority granted it, the Council is an excellent means by which Federal departments can coordinate and collaborate effectively. The Council should be given full opportunity to carry on its work before judgments are made concerning a supposed need for a centralized agency with control over Federal scientific programs.

Calls From the Scientific Community for Increased Efforts in Critical Scientific Areas

Not only was the Federal structure the subject of continuing critical and constructive examination, but the role that Government agencies should play in certain vital scientific areas was also reviewed. The scientific community, aware equally with the Federal Government of the need for improvement, undertook through various groups studies designed to investigate and report upon ways in which our national effort in certain scientific fields might be bettered.

In some cases, it was recognized that the Federal Government must indeed play an expanded part with respect to areas of science where success or failure has a direct, immediate, and significant bearing on the national interest. The establishment of the Atomic Energy Commission in 1946 was an early example of necessary supervision of a large scientific and technological activity by the Federal Government. The National Aeronautics and Space Administration, with its responsibilities in space technology and research, is another more recent example. In a different context, increased Federal support is also called for in many scientific areas where facilities and instrumentation have become so costly as to render impossible the exclusive use of private financing.

Medical Research

A group headed by Stanhope Bayne-Jones, formerly dean of the Yale University School of Medicine, made its report to Marion B. Folsom, then Secretary of Health, Education, and Welfare, early in the

fiscal year. The group had been appointed by Secretary Folsom to advise him on long-term needs in medical research and education, and its report called for systematic increases in Federal support for medical research from the $330 million spent in 1957 to about $900 million by 1970. It stated that the number of research personnel should be more than doubled in that time, and that support be made more general, less limited to research in specific diseases. It noted that, as at present, one-half the funds should necessarily come from the Federal Government "unless there is a marked change in social philosophy leading to private gifts or State appropriations on an unprecedented scale."

Oceanographic Research

The Committee on Oceanography of the National Academy of Sciences-National Research Council, in a major report released February 15, 1959, warned that the United States must within the next 10 years double its present rate of deep-sea research or face serious economic, political, and military hazards. "Action on a scale appreciably less than that recommended," the Committee stated, "will jeopardize the position of oceanography in the United States relative to the position of the science in other major nations, thereby accentuating serious military and political dangers, and placing the nation at a disadvantage in the future use of the resources of the sea."

The three principal recommendations of the Committee were that—

1. The U.S. Government should expand its support of the marine sciences at a rate which will result in at least a doubling of basic research activity during the next 10 years. Cost of the 10-year program was estimated to be $651,410,000 above the present level of support.

2. The increase in support of basic research should be accompanied by a new program of oceanwide surveys, requiring a doubling of present surveying efforts.

3. The United States should expand considerably its support of applied marine sciences, particularly in the areas of military defense, marine resources, and marine radioactivity.

The National Science Foundation and the Navy, the report recommended, should each support about 50 percent of the new basic research activity. New ship construction, it said, should be financed about 50 percent by the Navy, with four other agencies including the Foundation sharing the remainder. Specific recommendations for support of pertinent areas of research and education were made for the Coast and Geodetic Survey, the Bureau of Commercial Fisheries, the Atomic

Energy Commission, the Office of Education, the Department of State and International Cooperation Administration, the Public Health Service, the Geological Survey, and the Bureau of Mines.

The Oceanography Report was made in the form of a summary report, with recommendations, which was the first chapter in a projected 10-chapter work entitled "Oceanography 1960 to 1970." Additional chapters have subsequently been published by NAS–NRC, and in total represented a highly significant analysis of an important and neglected area of science in the United States. They discuss in detail such topics as "Basic Research in Oceanography During the Next 10 Years," "Ocean Resources," and "Marine Sciences in the United States—1958."

Atmospheric Research

On March 18, the National Science Foundation announced receipt of the second progress report of the University Committee on Atmospheric Research, a group which with Foundation support had been looking into the state of the meteorological sciences in the United States.

The committee's report took the form of "Preliminary Plans for a National Institute for Atmospheric Research." Culminating 18 months of activity and studies, the reported emphasized, among other points, the "need to mount an attack on the fundamental atmospheric problems on a scale commensurate with their global nature and importance," and "the fact that the extent of such an attack requires facilities and technological assistance beyond those that can properly be made available at individual universities."

The report envisioned an institute established and operated by a university committee, and funded by the National Science Foundation. Capital and operating costs over a 6-year period were estimated in the report at around $70 million.

The Foundation reviewed thoroughly the recommendations of the University Committee and, as well, previous recommendations by the Committee on Meteorology of the National Academy of Sciences. As a result, the National Science Board adopted a resolution which recognized the growing importance of atmospheric research, its consequent need of increasing numbers of trained manpower, and such special facilities as computers, aircraft, balloons and rockets, and tie-ins with satellite exploration, and the need for participation in atmospheric research by other disciplines, such as physics, mathematics, chemistry, statistics, and engineering, as well as conventional meteorology. The Board resolution concluded with a recommendation that the Foundation take the lead in the following:

1. Encouraging and supporting research in atmospheric physics in existing departments of colleges and universities for the expansion and improvement of research and training in this field.

2. Encouraging other appropriate institutions to establish departments of atmospheric physics.

3. Taking prompt steps to arrange for aircraft and other observational and experimental aids suitably appropriate and available for field research together with suitably appropriate modern computing facilities. Consideration should be given to the manner in which such facilities should be managed and be made available to the atmospheric research community.

Subsequently the Board authorized the adoption of an agreement with the university committee to assemble a small scientific staff and director to initiate planning of research programs and facilities, to propose broad research programs involving so far as possible the collaborative efforts of existing university groups, and to establish limited specialized facilities where necessary for maximum usefulness and accessibility to active university groups. No concentration of major facilities, nor establishment of a central "research institute," was envisioned at that time. An immediate purpose of the enterprise, the Board stated, is to strengthen atmospheric research and training in all U.S. universities.

High Energy Physics

A major policy statement concerning Federal support of science was made by President Eisenhower, setting forth a program recommended by a special panel appointed by his Science Advisory Committee and the General Advisory Committee to the Atomic Energy Commission. In his talk, "Science: Hand-Maiden of Freedom," delivered at the symposium on basic research sponsored by the National Academy of Sciences, the American Association for the Advancement of Science, and the Alfred P. Sloan Foundation, the President clearly outlined the reason for Federal involvement in this project, when he said:

> I am recommending to the Congress that the Federal Government finance the construction as a national facility of a large new electron linear accelerator. Physicists consider the project, which has been sponsored by Stanford University, to be of vital importance. Moreover, they believe it promises to make valuable contributions to our understanding in the field in which the United States already is strong, and in which we must maintain our progress. Because of the cost, such a project must become a Federal responsibility. This proposed national facility, which will be by far the largest of its kind ever built—a machine 2 miles long—has

the endorsement of the interested Government agencies, including the Treasury. Construction of the accelerator will take 6 years, at an overall cost of approximately $100 million.

Released with the President's talk was an explanatory statement on elementary particle physics and a program of Federal support for high energy accelerator physics, prepared by the special SAC–GAC panel. A number of federally sponsored groups, notably the Advisory Panel on High Energy Accelerators of the National Science Foundation, had studied the problem. The statement recommended that the Atomic Energy Commission, the National Science Foundation, and the Department of Defense each support research in high-energy physics because of their separate responsibilities for the support of basic research, because of the fundamental nature and significance of high-energy physics, and because of the need for each agency to stay in close contact with scientists in this field of research. Establishment of an interdepartmental council on high-energy accelerators was proposed, with technical assistance to be provided by all three agencies. Finally, the statement recommended an increasing level of support for construction and operation of high-energy accelerators to a level of approximately $135 million by fiscal year 1963.

Changing Role of the National Science Foundation in Federal Science Organization

As the discussions continued throughout Washington and the Nation on the reorganization of science, a look at the National Science Foundation showed that within NSF changes were taking place that affected, and were affected by, the national concern for better science. There was increasing evidence, as outlined above, that other agencies were looking to NSF for leadership in specific situations involved with Federal support of scientific research. Too, NSF is assuming increased leadership toward the objective that Federal support of basic research be reasonably balanced and consistent with the varying needs of the different scientific disciplines.

Historically, the Foundation has depended upon the thinking of scientists throughout the Nation concerning the directions in which research was needed, and has endeavored to base its programs generally upon this consensus. In addition, where other organizations have undertaken studies of the needs of particular areas of science and have recommended additional support, the Foundation has been in a position to step in with assistance. This has happened in the case of the U.S. Antarctic Research Program, the weather modification program, and

the exchange of scientific information; it is also in process in the field of scientific manpower information.

Of particular note, the Foundation has since 1953 initiated a variety of experimental programs in science education. For example, its Summer Institute Program for Secondary School Teachers of Science and Mathematics is now represented by 348 institutes in all States of the Union, each institute serving an average number of 50 teachers. In addition, the Foundation supports 32 Academic Year Institutes, and 182 Inservice Institutes, widely scattered across the Nation. Curriculum-improvement programs have been initiated for courses in high-school physics, mathematics, chemistry, and biology. The program in physics, first to be initiated, is rapidly approaching the time when it will be available to all schools and teachers who wish to use it. Curriculum-improvement studies are carried forward by outstanding scientists in each discipline, working in close cooperation with many of the Nation's foremost teachers of high-school science; NSF financial support involves no control of these studies by the Foundation. Finally, the Foundation is supporting a score or more of new education-in-the-sciences programs designed to update teacher knowledge in the sciences, to provide increasing opportunities for teachers and students to participate in scientific research, and, in other ways, to strengthen the ties between secondary schools and colleges and universities across the whole spectrum of science instruction.

To accomplish its mission, the Foundation maintains continuing relationships with the scientific community, both within and outside the Government. The Foundation follows the work of the investigators in their respective fields, and submits for scrutiny by scientific advisers the proposals for research support which are received. NSF program directors are also in close informal touch with their opposite numbers in other Federal agencies interested in research, such as the Office of Naval Research, the Atomic Energy Commission, and the National Institutes of Health. Each division within NSF has a statutory Divisional Committee of prominent scientists in the fields covered by the division, whose advice is sought on policy and program matters. The various scientific societies contribute their knowledge and opinions on scientific issues to the Foundation through their many contacts with NSF.

Important, too, is the fact that NSF support is not keyed to a specific agency mission. Insofar as basic research leads naturally into applications and potential developments of military or economic significance, it must continue to be supported by the agencies with missions in those fields. But other large areas of research, important to the Nation as a whole, must continue to be nourished, else they starve; nor can agencies

with operational missions and limited budgets with which to accomplish those missions be expected to carry this load. It is in this area above all that NSF seeks to support the most worthy investigations. It does this in partial fulfillment of its own mission to advance science, and "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences."