

NATIONAL SCIENCE FOUNDATION

The  
Developing Role  
of the  
National Science Foundation  
in International Science

# THE DEVELOPING ROLE OF THE NATIONAL SCIENCE FOUNDATION IN INTERNATIONAL SCIENCE

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Although man's hopes of resolving ideological and political differences seem to meet frustration at every turn, international cooperation in science is not only a reality but is constantly growing. Increasingly, the National Science Foundation is being called upon to lead United States participation in this growing worldwide effort to decipher nature's cryptogram.

The challenges and the promise of science could readily absorb both the money and energies that nations have in the past devoted to far less fruitful occupations, such as the harassment of their neighbors. Science and technology are now a matter of keen rivalry among nations, but such rivalry could be directed into more constructive channels. Perhaps it is not too much to say that in the present state of affairs, science, especially in its more fundamental aspects, is one of the few subjects on which nations can agree. A number of factors are responsible for this gratifying trend.

The first is the nature of science, which is not limited in its development by either national boundaries or geographical barriers. The history of science is replete with examples of discoveries that have occurred independently and almost simultaneously in various countries of the world.

Second is the tradition among scholars of sharing research plans and findings. This kind of cooperation is one of science's most ancient and honored institutions. The early annals of science consist largely of the correspondence of scholars, and one finds them journeying great distances to visit one another, despite the incredible hardships of travel in earlier centuries. Today the means of both communication and transportation have been so miraculously transformed by modern technology that scientists may not only exchange their views with ease and rapidity but may also interrupt their teaching or their research for brief visits across the world.

Third, a steady improvement in economic conditions plus recognition of the importance of foreign travel to research enable a growing number of scholars to travel to scientific meetings and to visit their fellow scientists along the way.

Finally, a significant factor that is contributing to international cooperation in science is the growing realization that problems which are global in scope require for their solution the combined efforts of scientists in many parts of the world. Astronomy, oceanography, meteorology, and, of course, the phenomena of outer space, can be effectively studied only on a worldwide basis; moreover, problems of nutrition, disease, fresh water resources, pollution of the atmosphere, and contamination of food sources are universal. Not only do they require the best minds of many countries for their adequate solution but they need regional and local study for complete understanding of the problem at hand.

## **The International Geophysical Year**

The value of the synoptic system of data accumulation and collation became evident during the 18-month period of the International Geophysical Year (IGY) between July 1957 and December 1958. Sixty-six nations of the world teamed their resources during that period to conduct the most concentrated study ever undertaken of the earth as a planet. The IGY marked the first of a series of international science activities which the National Science Foundation managed and administered for the United States Government. The Foundation accepted the task of coordinating the Federal effort for the IGY at the request of the National Academy of Sciences-National Research Council, adhering body to the International Council of Scientific Unions which organized the IGY program. To underpin the effort of the United States in the IGY, the Congress made available to the Foundation, on its request, a total of \$43.5 million. Thereupon, with the advice and operational planning by the IGY Committee of the NAS-NRC, the Foundation carried forward the program by grants to universities and research organizations and by transfers to other Federal agencies.

These funds made possible a magnificent effort by scientists themselves, financed and supported by the people of the United States through the Congress. Geopolitical differences were submerged under the cosmic weight of geophysical research as scientists of East and West worked together in a mighty effort to gather new knowledge about the planet earth, about the sun, and a wide variety of extraterrestrial phenomena.

Possibly of even more abiding significance than the fulfillment of its scientific mission, the IGY removed the Antarctic from the sphere of political influence and dedicated it to the advancement of man's knowledge. Twelve nations, signatory to the Antarctic Treaty of 1959,

reserved the area for scientific exploration and experiment. It was not to be contaminated by nuclear explosions nor used for disposal of radioactive waste. Furthermore, research that proved so fruitful during the IGY was not terminated as it closed but has rather been broadened and extended to include a variety of biological, geological, and other studies not originally planned as part of the IGY program.

## **United States Antarctic Research Program (USARP)**

The global significance of Antarctica, its isolation and vast size, and the magnitude of the scientific and environmental problems it presents, preclude gaining major insights through studies conducted only in a single nation, or in any brief span of years.

Scientific observations, however comprehensive, are of limited significance unless they are part of similar observations throughout a wide area made during significant periods of time. Simultaneous observations in many studies greatly increase the usefulness of what is learned. Rapid progress in scientific studies in Antarctica requires a network of stations that make their findings available to scientists everywhere. Only by coordinated gathering and disseminating of data in this manner are scientists enabled to piece into meaningful form facts that by themselves could not be related either to each other or to broad problems involving studies far removed from the area.

The concept of a cooperative scientific program undertaken on a large scale, embracing many aspects of science, calls for the cooperative efforts of scientists everywhere, and support from many governments. Therefore, in August of 1960 the President directed the National Science Foundation "to exercise the principal coordinating and management role in the development and carrying out of an integrated U.S. scientific program in the Antarctic." The same directive instructed the Foundation to coordinate and arrange for the conduct of cooperative scientific programs with other nations participating in the Antarctic.

The productive and constructive interrelationship of scientists from many nations that had its genesis in the IGY has been continued and expanded in the research that is now being carried forward under Foundation auspices in the Antarctic. Scientists of the world involved in Antarctic research formed the Scientific Committee on Antarctic Research (SCAR) under the International Council of Scientific Unions (ICSU). In the United States, at the request of the Foundation, the Committee on Polar Research advises the Foundation on the long range program in the Antarctic.

The seven-station network operated by the United States during the IGY in Antarctica was reduced to four—Byrd, Hallett, McMurdo, and Pole. The Department of Defense, through the U.S. Naval Support Force, Antarctica, provides logistical support to USARP at these stations, such support involving air and ship transportation to and from the continent, air transportation within the continent, and maintenance of the stations.

For several years parties of United States scientists have conducted both winter and summer programs at Argentine and Chilean stations in the Palmer Peninsula area. U.S. scientists have also conducted programs at Wilkes Station, maintained by Australia, and in a bilateral exchange with the U.S.S.R., research has been performed for more than four years at Russia's Mirnyy Station.

Australia has maintained U.S. entomologists and physicists on Macquarie Island, in the Pacific between Australia and the Antarctic continent. The British Antarctic Service has provided transportation and facilities to a bird-banding program conducted on Bird Island, near South Georgia. (For additional information about the work of the Foundation in the Antarctic, see page 40.)

## The International Indian Ocean Expedition

From the fertile seedbed of international scientific cooperation sown by the IGY there germinated many fruitful plans for further exploration of the world's natural resources. Once again the National Science Foundation was called upon to provide United States leadership for a new effort, this time a massive scientific survey of the resources of the least known of the oceans, the Indian Ocean. A White House announcement of June 1960 directed the Foundation to plan and coordinate Federal support for U.S. participation in the International Indian Ocean Expedition. The scientific assault on the Indian Ocean will involve an armada of approximately 40 vessels and scientists from 30 nations.

The United States program for the Expedition will be devoted to the scientific examination of four areas of great interest. The first of these areas is divided into four parts: (1) the origin of the ocean basin; (2) forces that have shaped and are continuing to shape the basin; (3) resemblances between this piece of the earth's crust and any other; and (4) differences between this piece of the Indian Ocean basin and other ocean basins. Techniques to be used in attempting to answer these questions will be primarily geophysical and geological, and will have

been or will be employed on expeditions sent out by Scripps Institution of Oceanography, Lamont Geological Observatory, and Woods Hole Oceanographic Institution.

The second broad area of investigation involves the chemical and physical properties of the Indian Ocean, and includes a study of the motions of these waters. Sampling will be done in predetermined patterns, with respect both to horizontal distribution and to vertical spacing. Studies will encompass concurrent precise measurements of water temperature; subsequent chemical and isotopic analyses of the water samples; and determination of current flow at various depths by numerous means. Although all United States ships participating in the IIOE will be equipped for such water sampling, the direct measurement of current flow is the particular objective of a University of Rhode Island expedition embarked in the Scripps Institution vessel ARGO.

The third major field of interest is the living populations, plant and animal, of the Indian Ocean. All United States ships will be equipped to sample plankton and to observe surface biological phenomena, and some will measure primary productivity. The research vessel *Anton Bruun* will have biological oceanography as her primary mission, and the Stanford University vessel *Te Vega* will concentrate on biological and physiological studies of island groups and other shallow water areas.

The fourth main area of research is concerned with the interaction between the ocean and the atmosphere. Several of the U.S. research vessels that will work in the Indian Ocean will be equipped to make upper-air meteorological observations, but the United States will have the greater part of its meteorological effort based ashore. Observations from meteorological aircraft of the U.S. Weather Bureau and of Woods Hole Oceanographic Institution, working in connection with the International Meteorological Center that has been established with the assistance of the Government of India and the United Nations Special Fund; from meteorological satellites; and from meteorological buoys (to be planted in the Bay of Bengal and Arabian Sea with the help of the Indian Navy), will be utilized in the program.

## The International Year of the Quiet Sun

A third scientific venture of worldwide significance that emerged rather directly from the stimulating environment of the IGY is known as the International Year of the Quiet Sun (IQSY). The program of the IQSY was originally proposed by the International Committee on Geophysics (CIG) of the International Council of Scientific Unions

at ICSU's September 1961 meeting in London. In authorizing United States participation, President Kennedy, in a letter to the Director of the National Science Foundation, observed: ". . . As a natural complement to the strikingly successful International Geophysical Year, it is an attractive proposal and the attention and planning that have already been devoted to it by the scientific community assures that it will make an important contribution to the understanding of our environment.

"I am pleased to authorize, with this letter, United States participation in the program. In addition, I hereby designate the National Science Foundation as the responsible agency to correlate the Federal Government's regular activities which contribute to the program and to coordinate and make necessary budgetary arrangements for those additional activities which may be required . . ."

As during the IGY, the National Academy of Sciences-National Research Council is developing the United States scientific programs of the IQSY and will work on these programs in cooperation with the Foundation.

The IQSY program is not to be regarded as a small repetition of the IGY. Full advantage will be taken of the new knowledge of solar-terrestrial relationships gained during the IGY and also of the improved and new techniques of geophysical research. Certain types of IGY synoptic programs will be repeated, but in many fields new experiments have been suggested stemming from the knowledge gained from the IGY and also from the fact that certain experiments and observations will be possible that could not have been made during the maximum portion of the solar cycle.

The international program calls for observations of solar activity, geomagnetism, aurora and airglow, ionospheric physics, and cosmic rays; for space research; and for meteorology and aeronomy. Emphasis will be placed on solar mechanisms; determining the state of the interplanetary medium during solar minimum; mapping the earth's radiation zone to establish its configuration and density at minimum; observing solar events and the transit through the interplanetary medium of the solar plasmoids and the interaction of the plasmoids with the geomagnetosphere; observing at magnetically conjugate points on the earth the auroral, ionospheric, geomagnetic, and hydromagnetic consequences of such interactions; determining the energy content of the solar ionizing radiations that influence the aeronomy of the middle atmosphere; studying the winds and circulation of the ionospheric regions; determining the basic photochemical character of the middle atmosphere and ionosphere in its least disturbed condition; and undertaking such programs as studies of the low energy portion of the galactic cosmic-ray spectrum

that are best done during times of solar quiet. Also included will be the completion of certain network synoptic programs of aurora, geomagnetism, ionospheric physics, and cosmic rays throughout the present solar cycle; therefore, it was suggested that these networks be operated for the IQSY with coverage at least as complete as was done for IGY, making such modifications as might be desirable in the light of the IGY experience.

## **United States-Japan Committee on Scientific Cooperation**

Based on plans agreed upon during the past year, it will not be long before teams of United States and Japanese scientists will be studying the volcanoes of Hawaii and Japan, comparing, developing, and sharing instrumentation and working together to analyze and evaluate data. The result should be the advancement of science in both countries beyond what each could have accomplished working alone. This would be but one in a wide range of cooperative scientific activities—exchanges of scholars, exchange of scientific information, joint research on the Pacific Ocean, and research in the medical sciences. The U.S.-Japan program for scientific cooperation is the most advanced example of a new approach to international science activities being urged forward by the Foundation—the advancement of science through cooperative activities in which the cooperating countries provide both scientists and a part of the support.

Opportunity for the Foundation to open this new road to international scientific cooperation grew out of an agreement between President Kennedy and Prime Minister Ikeda of Japan, in June of 1961, to establish the U.S.-Japan Committee on Scientific Cooperation. Chosen to head the United States Delegation was Harry C. Kelly, the Associate Director of the Foundation for Educational and International Activities. Delegations representing the two governments met first in Japan in December 1961, and later in the United States in May 1962.

At its May meeting, the Committee adopted recommendations for consideration and action by their governments concerning (1) the exchange of scholars in the sciences, and (2) the exchange of scientific and technical information and materials. The Committee adopted as well, recommendations to be considered for prompt implementation by their governments relating to (1) scientific investigations of the Pacific Oceans, (2) animal and plant geography and ecology in the Pacific area, and (3) research in the medical sciences. The date of the next meeting of the Committee has been tentatively set for May 1963.

## The Foundation's In-House Support of International Scientific Activities

Mid-century science, as we have noted above, presented a challenging environment for the advancement of international amity, and mid-century scientists representing many nations of the world have effected, through close cooperation, significant scientific achievements. On the part of the United States, the National Science Foundation was privileged to play a leading role in the broad, all-encompassing program of the International Geophysical Year, and is privileged to provide leadership for the United States Antarctic Research Program, the International Indian Ocean Expedition, the International Year of the Quiet Sun, and the United States-Japan Committee on Scientific Cooperation.

Despite its preoccupation with such "extra-curricular" responsibilities, the Foundation has maintained the steadily increasing pace of its own "curriculum" in international science activity. In-house programs of the Foundation in international science cover a wide spectrum of support represented by grants for research in environments unnatural to the United States, others in science education that contribute to strengthening science in the United States through close cooperation with educational leaders in other countries, and still others that speed the acquisition of the published results of research performed by scientists of repute throughout the world. Examples come readily to mind in support of:

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the Senior Foreign Scientist Fellowship Program, (5) continue the Visiting Scientists Program which brings to the United States distinguished foreign scientists to broaden the perspectives of our own science faculties and graduate students, (6) make possible publication of *Education and Professional Manpower in the U.S.S.R.*, by Nicholas DeWitt, Research Associate of the Russian Research Center, Harvard University—definitive source of information about professional employment and education in the Soviet Union.

• • • Programs designed to provide U.S. scientists with the published results of scientific research in other nations—including acquiring foreign scientific publications through purchase or exchange, provision of data on sources and availability of foreign scientific information, increasing the scope and quantity of translations, and stimulating cooperation with international organizations to increase the store of information and improve scientific communication on an international scale. Specific examples of such activities are: establishment of a center at Massachusetts Institute of Technology to announce and make available Communist Chinese scientific publication; support of massive exchanges with the U.S.S.R. in Soviet and Chinese mathematical publications; preparation of guides to scientific publications in a number of languages; support of directories of Soviet scientists and of Japanese scientific periodicals and research institutions; support of increased U.S. abstracting coverage of Soviet bloc material in a number of sciences; support of cover-to-cover translation of over 40 Soviet scientific journals and of selective translation of papers in others; support of guides to U.S. scientists to the scientific literature of the U.S.S.R., Japan, and East European countries; cooperation, with partial support of some activities, with U.N. Educational, Scientific and Cultural Organization, International Conference of Scientific Unions Abstracting Board, European Productivity Agency (EPA), Organization for Economic Cooperation and Development (OECD), International Federation of Library Associations (IFLA), and International Standards Organization (ISO); and participation in, with partial support of, the Pacific Science Congress and other such conferences.

• • • Maintenance in Tokyo, Paris, and Rio de Janeiro of one or two Foundation representatives—professionals who work closely with Scientific Attachés representing the U.S. Department of State and whose primary tasks are to establish at those localities scientific liaison, and scientific information gathering and dissemination, and to foster exchange of scientists.

Any recitation of accomplishment by the National Science Foundation in international science would be incomplete, and indeed presumptuous,

if it ignored the contributing strengths supplied by the several agencies and institutions with which the Foundation works closely in fulfilling its high missions. No undertaking of the U.S. Government involving relationships with other nations moves into action without the knowledge and support of the Department of State. Broad surveillance of official United States interests in and relationships with international science is exercised by that Department through its Office of International Scientific Affairs. From this office the Foundation invariably receives warm support and cooperation at every juncture of its attempts to establish productive international relations in science. Similarly, the execution of Foundation-supported programs in the Antarctic and in the Indian Ocean would have been quite impossible had it not been for the ready and willing logistic strengths supplied by the Department of the Navy, whose men and ships contributed immeasurably to the success of many scientific missions. Nor could have the Foundation's responsibilities in these vast scientific explorations been discharged effectively without the constant and full-bodied support and encouragement extended at every turn by the officers and scientists associated with the National Academy of Sciences-National Research Council who, in very substantial measure, have provided sound counsel and leadership for this Nation's effort in international scientific cooperation.