News and views

International Geophysical Year

MANY YEARS AGO it was realized that it would be very worth while to have certain kinds of observations made on a world-wide basis. There are many phenomena in nature which are of a world-wide character, and which require observations at several different stations simultaneously. Illustrations which come at once to mind include observations of the aurorae, terrestrial magnetism, ionospheric reflection of radio signals, earth currents, meteorology, cosmic rays, glaciology, and upper atmosphere studies. In 1882–3 and again a half-century later, in 1932–3, the scientific societies of the world agreed on a common program. The year was designated a Polar Year, arctic research being the main beneficiary of the international program on the first two occasions.

The results of this program were excellent beyond anticipation. The first Polar Year produced the discovery of the auroral zone and laid the foundation of our present understanding and world picture of terrestrial magnetism. The second yielded the first observations of the ionosphere in the arctic, discovered the polar ionospheric blackouts, permitted a numerical theory of geomagnetism to be evolved, and in increasing research facilities led to the establishment of the Geophysical Institute at the University of Alaska which has contributed so significantly to research in this region.

With the broadening of science, it has now become evident that many sciences require data from areas other than polar, and the next period in the observing cycle has been termed an International Geophysical Year. We shall refer to it as IGY. Actually IGY extends from July 1, 1957 to December 31, 1958. This period covers the approach to the maximum of the next sunspot cycle, a particularly fortunate and potentially fruitful occurrence. Each of the major scientific societies of the world has set up a committee to consider how the proposed work should best be coordinated to produce a maximum of useful results, what measurements should be made, where observing stations should be located, and a host of other allied problems.

In the United States, the coordinating agency is a U. S. National Committee set up by the National Research Council. Dr. J. Kaplan of the University of California at Los Angeles is its chairman. Each science has a reporter, who recommends to the committee the procedures within his own science which offer the greatest possibility of securing a maximum of significant information.[1] The U. S. National Committee will send delegates to report to the International Committee, formed by the International Union of Geophysics and Geodesy, organized under Professor Sydney Chapman, which will meet in Rome in the latter part of September 1954.

The international character of many of the observations can be illustrated by a few examples. Thus in meteorology it is not known whether there is a mass movement of air across the equator. In cosmic rays it is not known whether it is correct to assume that the intensity distribution at any elevation is symmetrical at corresponding latitudes north and south of the geomagnetic equator. Radio waves are also no respecters of political boundaries, and ionospheric studies likewise require that instruments shall be located with the world-wide aspects of the problem rather than with a particular nation in mind. The majority of the earth sciences are international in character and many illustrations in the field of aurora and airglow studies, geomagnetism, and glaciology will at once occur to the intelligent reader.

This year also provides a unique opportunity for a major antarctic expedition. Such an expedition, with several bases, is at present being organized and will have as its main objective the execution of the scientific program now being formulated.

As the plans progress, we will keep the readers of *Physics Today* informed of various developments. In the meantime, investigators who have programs which would logically fit into a world picture are invited to outline details and proposed arrangements with the present author, or with any of the reporters of the various fields.

Serge A. Korff
New York University

Science and Public Policy

THE THIRD ANNUAL REPORT[2] of the National Science Foundation, transmitted to the White House in November and sent by the President to Congress in January, summarizes the Foundation's

---

[1] Reporters for the IGY are the following:
Aurora and Airglow, C. T. Elvey, Geophysical Institute, College, Alaska.
Cosmic Rays, S. A. Korff, New York University, University Heights, New York 53, New York.
Geomagnetism, E. B. Roberts, U. S. Coast and Geodetic Survey, Washington 25, D. C.
Glaciology, P. A. Siple, Office Quartermaster Corps, Department of the Army, Washington 25, D. C.
Ionospheric Physics, H. G. Booker, Electrical Engineering Department, Cornell University, Ithaca, New York.
Latitude and Longitude, G. M. Clemence, U. S. Naval Observatory, Washington 25, D. C.
Meteorology, H. Wexler, U. S. Weather Bureau, Washington 25, D. C.
Rocket Exploration of the Upper Atmosphere, J. A. Van Allen, Forrestal Laboratory, Princeton, New Jersey.
Solar Activity, S. B. Nicholson, Mt. Wilson Observatory, Pasadena, California.

[2] *The Third Annual Report of the National Science Foundation* is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 40 cents.

activities for the 1953 fiscal year, which ended last June 30th. The total cost of NSF operations in 1953 was $4.43 million, of which almost seventy-five percent was used for research grants and for fellowships. Most of the remainder was spent on national science policy studies, a review of the research and training programs, dissemination of scientific information, and attendance at international scientific meetings.

Some shift of emphasis can be noticed in the Foundation's allocation of funds for the support of basic research in the natural sciences. Grants for work in the mathematical, physical, and engineering sciences were increased from $1 053 762 in fiscal year 1952 to $1 698 150 in 1953. (In physics, eight grants amounting to a total of $71 600 were awarded in 1952 while 22 grants involving $282 400 were awarded in 1953.) In the biological and medical sciences, research grants amounted to $745 462 in 1952 and were increased only to $798 800 in 1953.

In the Foundation's graduate fellowship program, a total of 557 awards is listed for the 1953–54 academic year as compared with 624 for the previous year. At the same time the Foundation received more applications—about 3300 as against 3000 in the previous year. The largest group of fellowships (129) was awarded in chemistry and the second largest (115) in physics and astronomy.

According to the report, the Foundation had completed preliminary plans for a survey of the nation's present efforts and needs in research and development by June 30, 1953, and was at that time well along toward completion of several phases of the plan. The over-all survey will include the following six major sections: (1) Research programs of the Federal Government; (2) Research in industry; (3) Research at nonprofit institutions; (4) Studies on scientific manpower; (5) Studies on the exchange of scientific information; and (6) Studies on the current status of scientific progress.

A significant part of the Foundation's annual report is given over to discussions of the present imbalance between basic and applied research. Noting that in recent years only six percent of all Federal research and development funds have been devoted to basic studies, the Foundation reemphasizes a warning from its *Second Annual Report,* which pointed out that "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". The present report also makes the following remarks concerning the Foundation's attitude towards the Federal sponsorship of basic research:

> "It has been the stated policy of the Executive branch of the Government to increase the responsibility of the National Science Foundation for Federal support of basic research. At the same time, it is desirable for other agencies to support basic research closely related to the solution of problems for which they have statutory responsibility.
>
> "The appropriation requests for fiscal year 1954 of the various agencies reflected this point of view to some extent and the pattern of distribution of Federal funds for research during the year ending June 30, 1953, indicated that the research agencies were already making adjustments in their programs.
>
> "The effort to centralize support of basic research in the Foundation is desirable from the standpoint of logical administration of Federal research support, but it will clearly work against the best interests of science in the United States unless the Foundation together with the other research agencies can provide adequate support for basic research in order to balance support given to applied research and development. The Foundation has been fully aware of this danger. In order that the Foundation might be able to carry its appropriate share of basic research support, the Congress removed the limitation in the National Science Foundation Act which restricted the appropriation in any fiscal year to $15 million.
>
> "The Foundation is in full accord with the view that other agencies should carry on basic research programs directly related to their operating functions. There are two principal factors in support of this position. First, there is the need of an operating agency for an assured and continuing direct flow of fundamental knowledge relating to its practical problems. Second, in view of the increasing dependence of these agencies upon scientific and technical developments, it is essential that the operating personnel maintain effective contact with the scientists of the country. Conversely, it is to the advantage of the country that scientists be encouraged to be interested in fields of great potential importance to national defense and welfare. Support of basic research in areas of immediate interest to the agency provides opportunity to maintain this two-way exchange on a healthy basis."

Also of interest is a "statement of principles" expressing the views of the National Science Board on "certain broad problems of the Foundation" which is given in the following excerpt from the Foreword to the report, written by the Board's chairman, Chester I. Barnard:

> "The Board learned with satisfaction that the Congress had amended the Act of 1950 removing the $15 000 000 ceiling upon annual appropriations to the Foundation. This action cleared the way for the Foundation to assume greater responsibility for the support of basic research—a course clearly thought to be desirable by the Administration and the Congress. More important, however, in the view of the Board, under the previous ceiling the Foundation could not have fulfilled the functions with which it is charged by the Act. The existence of a ceiling made a contradiction in the Act that appeared likely to interfere with the maintenance of competent staff and the continued cooperation and support of individuals and public and private academic institutions.
>
> "The sympathetic response to this problem by many members of the Congress was encouraging. Nevertheless, it seems clear that misunderstanding or lack of understanding of science and its methods is widespread.

This is probably due, at least in part, to the great speed of scientific development in the past 50 years. In 1900 X-rays and radioactive elements had just been discovered, nuclear physics hardly begun, and the nature and carriers of yellow fever and malaria only recently learned, modern genetics barely started, antibiotics unknown—the list could be expanded for pages. Progress in science almost stuns us, yet it is easy to take for granted. We fail to realize that it comes from deep devotion, hard work, sacrifices, and the popular support of our academic institutions. Wider public understanding of science, scientists, and the implications of scientific development is of vital concern not only to the National Science Foundation, but to the Federal and state governments, academic institutions, and industrial concerns.

"The very rapid progress outlined above has wrought radical changes in, what I shall call, the economics of basic scientific research. Perhaps 50, certainly one hundred, years ago, it was uneconomic to give general support to basic scientific research. The lag between a scientific discovery and its practical application was so great that even a large ultimate value had little present worth. The isolation of scientific discovery caused the lag. Scientific knowledge was not dense. A glance at present-day textbooks, encyclopedias, libraries, and the voluminous digests convinces one of how this has changed. There are and probably will continue to be new isolated discoveries, but for the most part new knowledge is quickly tied to old knowledge, and the inferences from the combination rapidly lead to further expansion of knowledge or new practical applications.

"We ask today: How much can we afford to spend for basic research? The answer is: We cannot spend as much as would be economically advantageous. The bottleneck, I believe, will be lack of men and women who have the capacity, the interest, and the willingness to pursue science. In numbers they constitute a restricted part of the population; and science is not the only profession calling for high intelligence and disciplined capabilities.

"The upshot is that an economic test of basic research is now irrelevant. This does not mean that we should disregard budgetary, fiscal, and short-term administrative problems. It does mean that solutions to many current problems reside in the long-term functions of the National Science Foundation. It is the duty of the National Science Board to make this clear.

"What are the relatively immediate consequences of basic research? First, the development of scientists. These are the people who by training and experience know how to use scientific knowledge, scientific techniques, and scientific instruments. Second, the production of new scientific knowledge, a high proportion of which may prove useful in ways unforeseeable today. Third, the application of the results of research to the solution of practical problems by a body of men who know how to apply scientific methods. An example is what has been called "Operations Analysis", which has for its objective not knowledge, but the best practical decisions. More and more we shall depend upon such talent for both military and industrial operations.

"The National Science Foundation Act of 1950 authorizes and directs the Foundation 'to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences.' Except for certain specified operating functions, the Foundation is essentially an authoritative advisory body, potentially capable of securing factual knowledge and advisory opinion, that makes its advice authentic but not determinative. Whom does it advise? Obviously, the President and the Congress; but also, through publication and consultation, other agencies and institutions, public and private, and individuals. The point to these observations is that the Foundation can neither police nor direct activities of other agencies, of academic institutions, of industrial research, or of individual scientists.

"The Board believes it important to emphasize this view, because there is, on one hand, a natural tendency to utilize the Foundation for secondary purposes and immediate administrative convenience and, on the other, a fear that the interposition of government in science will lead to attempts to dominate science and thus to destroy it. The Board is aware of these dangers. It believes that its major function is to operate so as to minimize both dangers. But we realize that a new era has come when the interest of governments and of societies in the development of science is great and the need exists for large financial support to scientific research and for the development of adequate numbers of scientists."

It should be noted that the President's budget message to Congress, also submitted in January, recommends the appropriation of $14 million for NSF operations during the 1955 fiscal year, which begins next July 1st. Previous NSF appropriations approved by Congress have been $225 000 for 1951, $3.5 million for 1952, $4.74 million for 1953, and $8 million for 1954.

Budget Message

ADDITIONAL BASIC RESEARCH, President Eisenhower told Congress, "is needed to build up the fund of knowledge on which will be based the development of new crops for agriculture, new methods of safeguarding health, new tools for industry, and new weapons. A further important result is the training which basic research projects provide for graduate students in our universities. The number of trained scientists graduating each year falls short of the needs of our growing economy and is still declining. Enlargement of the research program and the related fellowship program will help counteract this trend."

The President, emphasizing the importance of NSF's role in formulating an "adequate scientific research policy for the Nation", added that approximately one-half of the recommended $6 million increase in NSF appropriations "is in reality a transfer of the responsibility and the financing for certain basic research programs from the Department of Defense to the National Science Foundation. The remainder of the increase is needed to expand basic research."

The budget message contains recommendations for Federal expenditures of $2.01 billion on scientific research and development in the 1955 fiscal year, of