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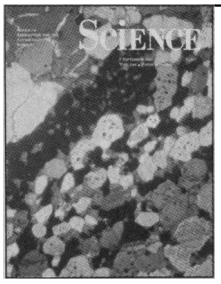
■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objectives are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.



COVER Photomicrograph of Hawaiian xenolith showing layers of cumulus spinel (black) and olivine (colored) grains, and intercumulus garnet (deep purple) in the spinel layer. This photo was taken with crossed polars and gypsum plate inserted. Vertical field of view is 65 millimeters. See page 1154. [Photograph by Gautam Sen. This xenolith is part of the Dale Jackson Collection (Smithsonian Institution)]

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Global Change

Ultimately the United States and other nations will find it necessary to make momentous long-term decisions with respect to energy policies. Bearing on the matter will be considerations of possible future global change arising from use of energy and from other human activities. Changes in energy use will have profound effects on life-styles and on job losses and shifts in employment. If sacrifices are to be made to combat global change, the problems will need to be more evident than they are at present.

Some fact about the impact of human activities on the environment such as the extent of deforestation are relatively well established. However, the actual extent of greenhouse effects is difficult to know. The magnitudes of annual and even decadal fluctuations in parameters such as average temperatures are large in comparison to baseline changes. Some of the data required to create believable models of greenhouse effect are missing. The role of clouds is not well known. What may be the largest deficiency is lack of knowledge about the oceans. They have a large area, huge heat capacity, and substantial biological activity. Needed information will be obtained by intensive global monitoring of many variables, and such an effort will inform us what is happening now. After perhaps a decade, enough data could be available to enable modelers to reliably predict effects of various energy policies on future global change.

Public concern here and abroad has accelerated the pace of important national and international programs for monitoring global change. Substantial numbers of satellites are under construction or planned by foreign countries. Many features of the earth's atmosphere, oceans, and land and sun's emissions will be observed. In addition many countries, including less-developed countries, will participate in ground-based efforts. A recent low-cost but important U.S. initiative is to more fully exploit valuable data that were collected during U.S. satellite flights beginning in the early 1970s. Data available on tapes include observations of clouds, land cover, radiation budget, ocean color, and sea-surface temperature. A new data information system (DIS) is being designed that will make them available broadly. The new DIS will serve as a precursor or pathfinder for the treatment of the enormous quantities of data that will flow as more satellites are launched and more ground truth is forthcoming. The new DIS will be particularly applicable to the major earth observation system starting with the launch of EOS-A in 1998.

A second constructive U.S. move has been the creation of an interagency U.S. Global Change Research Program (USGCRP). The fiscal year 1991 plan described in the President's budget reflects an unusual degree of federal coordination. The plan also reflects priorities established by the scientific community primarily through the National Research Council. A comprehensive report on the 1991 USGCRP contains an analysis of crucial features of the program and makes constructive suggestions for improvements in it.*

To achieve optimum success a global change program must involve many countries, and there are now several international programs. An important contribution to monitoring biosystems and global change will be made by the International Geosphere and Biosphere Program (IGBP) conducted under the auspices of the International Council of Scientific Unions. Preliminary consideration by groups of experts has led to a program that already involves at least 42 countries. A major meeting of IGBP marking the start of a decades-long effort was held in Paris on 3 to 7 September. Established IGBP core projects are International Global Atmospheric Chemistry Project, Joint Global Ocean Flux Study, Biospheric Aspects of the Hydrological Cycle, Global Change and Terrestrial Ecosystems, and Past Global Changes. Additional major components are to be included, and all will involve substantial activities.

If the global change programs are to be effective, the U.S. political system must give high priority to sustained support of the construction of satellites including EOS, the training of needed scientists, creation of the necessary data-handling systems, and the computational facilities that will be required. The phenomena of global change are too important to be subject to the usual inefficiencies of stop-and-go budgeting. This is a long-term program that must not be held hostage to the crisis of the moment.

—PHILIP H. ABELSON

*National Research Council, *The U.S. Global Change Research Program* (National Academy Press, Washington, DC, 1990).