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Mission to Planet Earth

In some ways we know more about our neighboring planets than we do about the earth. For decades scientists have peered at Venus and Mars through telescopes, and in the last decade they have had radar images of the planet surfaces made from the earth and from orbiting satellites. They have probed the atmospheres of these planets and measured and sampled their surfaces with instruments of the space age. Of course, through the centuries we have accumulated a mountain of detailed data points and much phenomenological knowledge about the earth and the constituents of its geosphere and biosphere. However, we lack synoptic, systematic, and temporal knowledge of our own planet and an understanding of the mechanisms underlying the global processes that affect it.

Modern technology has given us the tools of measurement and of computation to study the earth as a system. We can now gain comprehensive knowledge, not only of the state of the earth system and of global processes, but also of changes in state and processes. We have become uncomfortably aware that changes are indeed taking place, and we know that our own species is responsible for some of the changes.

Economic developments over large portions of the earth have required dramatic changes in traditional patterns of land and water use. There has been large-scale extraction of energy from fossil fuels and widespread application of man-made chemicals to control plant and animal disease and to foster production. These activities are believed to be related to alterations in the global cycles of essential nutrients—carbon, nitrogen, sulfur, phosphorus, and water. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased. There are indications of increases in carbon monoxide and other oxides of nitrogen. The uptake of sulfur has resulted in enhanced sulfate levels in precipitation in many areas. There is hardly a major river that has not been affected by phosphate runoff, and there are numerous examples of altered precipitation patterns and extended drought.

A concept for an international cooperative research program, termed Global Habitability and aimed at gaining a broad understanding of the earth as a system, was first proposed by the United States at the United Nations Conference on Peaceful Uses of Outer Space in Vienna in 1982. Since then, there has been substantial progress in turning the concept into a viable set of research activities for investigating long-term physical, chemical, and biological changes on a global scale.

The research will be interdisciplinary and will involve many organizations and countries. It will require bases for making observations from space, air, land, and sea. It will include investigations of specific ecosystems, studies of estuarine and coastal systems, measurements of horizontal and vertical motions in the oceans, and studies of the chemistry, physics, and motions of the upper and lower atmospheres. Interdisciplinary models will be needed to synthesize and correlate subsystem dynamics and to predict changes.

The National Academy of Sciences is reviewing the scientific merits of the Global Habitability concept and looking at how it might be coordinated with the broader efforts of the proposed International Geosphere Biosphere Program to be coordinated by the International Council of Scientific Unions (*Science*, 5 October 1984, p. 33).

We now have the technology and the incentive to move forward on this "mission to planet Earth," as the Academy's Space Science Board has suggested. To quote Lewis Thomas on the subject,* "I cannot think of a better work for the international scientific community, on the ground or out in space, and I hope we will get on with it."—BURTON I. EDELSON, *Associate Administrator for Space Science and Applications, National Aeronautics and Space Administration, Washington, D.C. 20546*

*L. Thomas, *Discover* 4, 65 (1983).