needed to solve problems already facing mankind. These problems exist in both the emerging nations and in advanced countries such as ours. Having such information now, not later, or in 1970, not 1980, may have profound effects upon decisions to be made as man completes his domination of the earth.

Ecology is the study of interrelations among organisms and their environments. It is a minor science, primarily because science as a whole has developed in countries that have had little need of ecological knowledge. All of these countries have adequate natural resources such as soils, water, and fuel. Utilization of these resources has been very profitable, and the capacity of the land to support mankind has been greatly increased, even though the methods used may have been wasteful or ecologically unsound. In such areas as forestry and agriculture, for example, we have been able to afford methods of production and of pest control that make little use of ecological knowledge.

From the point of view of natural selection and evolution, man has enjoyed an unprecedented excess of competitive advantage over other organisms, and has been able to exploit the world rapidly without need of ecological efficiency. It is obvious, however, that as man continues to expand, the value placed upon efficiency will increase. Eventually, also, man must reach a workable agreement with the biosphere as a whole that will guarantee him the necessary supplies of renewable resources.

Most of us know that the fossil fuels we are using were produced through geologic time as a byproduct of biological activity. In addition, major features of our environment are controlled by organisms. All of the soils of the world are produced by organisms, and their maintenance depends today upon a protective mantle of vegetation. Without life, we would have only thin layers of rockdust washing rapidly to the sea. The atmosphere, also, is greatly changed by biological activity. All of the molecular oxygen is of biological origin. In a literal sense, for every gram of free oxygen in the air and in the sea, there is somewhere on earth an equivalent amount of organic matter. If the total mass of organic matter is reduced, the amount of oxygen in the air must be reduced correspondingly. When the major forms of life first became abundant in the ocean, the air seems to have been about 10% oxygen. When life covered the land surface, it had risen to about 15%. Now it is about 20%, but the destruction of forests and the burning of fuel raises doubt on the levels of oxygen in the future. Finally, the world distribution and movement of many elements such as phosphorus, nitrogen, potassium, iron, and sulfur, is affected strongly by the accumulated activities of organisms.

Man is beginning to have a significant effect upon the biosphere as a whole. It is essential to his future that he does not upset the biogeochemical cycles that have made the earth an inhabitable planet.

As human expansion continues, problems in two major areas of human welfare place increasingly strong demands upon ecology. First, now that the most favorable environments of the earth are occupied and developed, man is concerned with the development of the remaining countries. Their environments are far less tolerant of inefficiency and error, and we will have to know much more than we do about the capacities of organisms and the limitations of environments, if such ventures are to succeed. Second, in the advanced countries where the problems of existence are not so pressing, man is concerned with the quality of the environment. Constructive participation in environmental processes requires the application of ecological principles, often in systems that are exceedingly complex. The greatest challenge will be to find methods of improving the environment that do not conflict with human activity. Getting rid of people is not an acceptable recommendation.

Thus, the need for ecological knowledge is increasing, and the International Biological Program is designed in part to fill this need. Particular contributions to ecology are more easily discussed if the nature of the field is summarized.

Quantitative ecology is a young science developing within a subject that has a long and rich history. Modern research can be classified in three levels with respect to the complexity of the unit of study: the individual, the population, and the ecosystem.

At the level of the individual, physiological and behavioral ecology is concerned with the environmental needs of organisms, the environmental extremes they can tolerate, and their capacities to function well in a broad spectrum of conditions. Such capacities often are based upon homeostatic mechanisms as complex and subtle as those that regulate the internal physiology of organisms. They may operate rapidly through behavioral mechanisms, such as the way leaves control