The role of microbiology in ecology will increase greatly. In all natural systems, the cycling of matter and the degradation of energy includes the fungi and bacteria, a biological component second only to the green plants in quantitative significance. We know shockingly little of the physiology and ecological roles of free living microorganisms, and even less of their taxonomy. In both soil and water, we need technological breakthroughs in methods for separating dissolved material from particulate material, living material from dead material, producer material from decomposer and consumer material. The standard methods of soil chemistry, for example, are entirely unsuited to an analysis of nutrient cycling in ecosystems. In natural ecosystems, up to a third of the animal protoplasm exists in small soil organisms, and an equal proportion of plant protoplasm may exist in soil decomposers. These are lumped with the "humus" in most studies.

Finally, the greatly increased public emphasis on problems of the environment will alter the role of ecologists to include, in addition to their basic scientific activity, an unavoidable involvement in human problems. Some of the problems that ecologists will have to think about, and act upon, include the following:

1. The nature and degree of restrictions on human and other populations and environments that are necessary and desirable.
2. The extent to which a laissez-faire philosophy of politics (national and state) and economics have ecological survival value.
3. The necessity for and means of regulating modification of climate and the chemistry of the biosphere.
4. The most equitable or efficient use of the world's natural resources on an international basis, e.g. open sea fisheries, continental water resources, land types.
5. The minimum and optimal requirements of space, natural environments, and recreation in human environments.
6. The amount of undisturbed natural environment and species diversity required to minimize disturbances from endemic and introduced pest species and to provide population stability.
7. The evolution of legal mechanisms for regulating environments on a national, or international basis with respect to scientific evidence, and without regard for political or short-term economic expediency.
8. Application of ecological analyses and concepts to human affairs, including use and conservation of renewable and non-renewable resources, landscape design, land policy and agricultural and urban development.
9. Relation of ecological principles to the management of water, soil, native plants and animals, and the management of wilderness areas so as to maintain their integrity.
10. The course and effect of pollutants on plant and animal communities, the chronic effects of domestic toxicants, the causes of eutrophication and means of reversing the process.
11. A national ecology center to store and classify ecological data, to provide data to government and industry, and to act as a scientific manpower center for consultation on regional and national ecological problems.
12. Direct cooperation with local, state and national governments in the design and regulation of human environments, including town and regional planning, pollution control, planned use of natural resources, etc.
13. Ecology training programs for non-professionals concerned directly or indirectly with the application of ecological principles and knowledge to problems of human environment.

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## THE INTERNATIONAL BIOLOGICAL PROGRAM AND THE SCIENCE OF ECOLOGY

(By Frederick E. Smith)

**Much of the International Biological Program is based upon the development and application of ecological principles. Success in the program requires a strong acceleration in the growth of ecology, especially in those areas of knowledge**