

we can draw on. In the process plants remove carbon dioxide from the surroundings and return oxygen to the atmosphere. The efficiency in energy capture is low, but the scale is vast. Other living organisms break down organic matter into smaller pieces; others ultimately return it to a mineral form in which it can again be used. Still others convert plants into other more favored forms of food. But just as nutrients and energy move from one level to another in these food chains, so too do other compounds including such disadvantageous substances as radionuclides, heavy metals, and persistent organic compounds.

The living organisms that perform these functions are aggregated into communities, the members of which are determined by their common ability to tolerate the physical conditions of the site and interactions with the other members of the community. The relationship is not passive for the organisms in turn interact with and may change the site. Their tolerance levels are not necessarily identical, but they overlap in the range of conditions present on the site. As conditions change, new organisms with tolerances that fall within the new ranges may become a part of the community; some of those originally present may be eliminated. The less rigorous the conditions of the site, the greater will be the variety of the inhabitants. It is clear that man can affect two variables, in these dynamic systems. He can deliberately select and favor organisms that directly suit his needs as he does in agriculture—in fact he can manipulate them genetically to make them better suit his needs. Second, he can alter the characteristics of the site—physically or chemically. Again he does this deliberately in agriculture by addition of fertilizers, by plowing, etc. He may also alter both variables unwittingly.

Pollution is one of the ways by which we change the quality of a site. So long as a pollutant does not exceed the limitations of the organisms present, there will be no profound change. As the alteration in conditions becomes greater, changes in species will be greater—but there will not necessarily be changes in the basic processes that take place or in the value of these to man. All of which is to say that change *per se* is not necessarily bad. On the other hand, when changes reach such a magnitude that the functioning of the community is impaired, then there is reason for concern.

So much for my comments on ecology.

It seems clear to me that environmental management must consider not only the direct response of man to pollutants, but rather must consider the effects on all the living resources he requires or uses. And because each of these living organisms in turn depends on others, our concern must extend to most of the living world.

There are two general sources of man caused pollution: wastes that we deliberately dispose of, and materials that enter the environment by inadvertence or accident such as by-products of combustion or products of normal wear or pesticides that linger on after they have served their intended use. The strategies for managing these two categories of pollutants may be very different. For the deliberate wastes there are point sources, and we can act either to change the character of the waste so that it is not detrimental, or we can try to segregate it in a part of the environment where it will not be harmful. Much of the discussion before this committee has dealt with technology for handling these problems. We have so far to go in handling such wastes that it may be academic to worry about getting our environment "too clean." It is possible to remove the wrong things because we do not understand troublesome processes like eutrophication. And it is at least theoretically possible to return sewage effluents to our waterways essentially ion-free, which, carried to an extreme in intensively used rivers, could reduce or eliminate fish and aquatic life. More to the point, it would be economically wasteful. Our real problem with these wastes is to strike a balance that will utilize fully the capacity of the environment to assimilate them, but will not so overburden the environment as to lessen its usefulness.

The inadvertent or accidental pollutants are a different matter. Many of these compounds are new to the biological world, and in some instances they resist degradation by physical and biological means. The processes that have evolved over the millennia for returning "dust to dust" do not work with some of these compounds. Some of these compounds are washed into our streams, are carried into the atmosphere, are picked up by living organisms and carried in their bodies. Some of them, because of their persistence, travel vast distances. From the lead added to gasoline, we have increased the amount of lead in urban