12.13: The Anthrosphere in Support of the Biosphere

Although humans are commonly blamed — usually with ample justification — for adverse effects upon the biosphere, human activities and modern technology have a high potential for benefitting the biosphere. This is especially true now that there is such an explosion in the understanding of biological sciences. The realization that the biosphere can contribute immeasurably to the benefit of humankind through such things as the provision of renewable feedstocks as raw materials provides a strong incentive to use technology to the benefit of the biosphere.

The most direct interface between the biosphere and technology occurs in agriculture. The production of biomass per unit area of land has increased in a spectacular fashion in recent decades with the use of fertilizers, herbicides, insecticides, and sophisticated means of cultivation and harvesting. Now the application of recombinant DNA technology (see Section 12.12) to agriculture promises even greater advances. In the past, the ways in which techniques for improved agricultural productivity were applied were largely divorced from considerations of the natural ways in which plants and animals grow on land. Fortunately, there is a growing realization of the important information that nature can provide in maintaining agricultural productivity. For example, in the prevention of water erosion, terraces constructed on land are designed to funnel excess water runoff onto grassed waterways. By planting these waterways to native grasses, a tough, erosion-resistant sod can be established that stands up under the punishment of occasional deluges of runoff water while surviving intermittent severe droughts. On a larger scale, in place of cultivating drought-prone prairie land to grow grain to feed to cattle, a better approach may be to reseed these lands to tough native grasses and allow bison to feed upon the grass as a source of meat (less fat and more healthy than beef from cattle).

The restoration and development of "natural" areas has become an important endeavor commonly termed **restoration ecology**. This often is advised with farmland that is too marginal to support profitable agricultural operations. The example of restoring native grasslands was mentioned above. Much of the rocky, hilly, unproductive farmland in New England is now reverting to forests. In such restoration efforts, modern construction machinery with the capacity to move enormous quantities of dirt have proven useful. One example in which such machinery is used is in leveling large areas for the construction of wetlands. Rivers that were once straightened to facilitate water flow — with catastrophic results in the form of flooding and erosion — are now being restored with the bends and meanders that characterize a healthy river. As discussed in Chapter 8, Section 8.2, following the catastrophic 500-year floods on the Missouri and Mississippi Rivers in 1993, large areas of cropland in the river bottoms were purchased by the Federal Government, river dikes designed to prevent flooding were breached, and the land was allowed to revert to a wild state. Land disrupted by strip mining has been smoothed over to reduce erosion, topsoil applied, and trees planted to produce natural areas and wildlife habitat.

A significant amount of restoration ecology has been devoted to restoring game animals, some of which had been driven virtually to extinction by over-hunting and habitat destruction. Animals that have come back in significant numbers include wild turkeys, wood ducks, snowy egrets, and American bison. Some of these efforts have been almost too successful. Once endangered Canadian geese have greatly increased in numbers and now populate many suburban areas where they often show their displeasure with sharing their new habitats with humans by hissing, flapping their wings aggressively, and even pinching exposed flesh with their sturdy beaks. In many areas deer now destroy crops and are a traffic hazard. Sophisticated captive breeding techniques are now used to reproduce endangered species of animals, and animal cloning may reach a point at which these efforts are routine.

In the area of green chemistry, sophisticated chemical analysis techniques can now be used to find and eliminate the sources of chemical hazards to wildlife. The classic example of this occurred in the 1960s when it was found that insecticidal DDT, biomagnified through the food chain, was preventing reproduction of endangered eagles and hawks at the top of the chain. In 1970 a newly developed technique for the determination of mercury showed that large fish were contaminated by this heavy metal released from sediments by bacterial methylation. Analysis of lipid tissue in humans, caribou, and polar bears now indicate a global distillation mechanism by which persistent organic compounds evaporate into the atmosphere in warmer regions of Earth and condense in the polar regions, leading to significant contamination of food supplies. One of the major objectives of green chemistry is the elimination of the generation and use of such materials.

As the projected effects of global warming become more pronounced during the next century, technology will be employed to a greater extent to deal with these effects upon the biosphere. Increasingly sophisticated genetic engineering techniques will be used to develop plant varieties that can withstand the heat and drought resulting from global warming. Another possibility is the development of plants that can grow in saltwater. Using renewable solar and wind energy, vast water desalination projects will be developed to provide fresh water to irrigate high-value crops where the costs can be justified.