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Bio-Energy

Scientists and engineers will share the energy shortages that the public will endure for the next decade or two, but with a difference. They are problem-solvers, and they are in a unique position to help satisfy energy needs. Already many are exploring promising areas. Some are working to expand the availability of energy derived from materials formed by photosynthesis. The extent and variety of these efforts are not generally known. But a large fraction of the federally supported and many of the privately financed activities are described in a recently released *Bio-Energy Directory.** In this volume of 539 pages, nearly 500 projects are noted. Topics treated include fundamental studies on photosynthesis, sources of biomass, and methods of converting biomass to other forms of energy.

Ultimately, perhaps half of the nation's energy will be provided via photosynthesis and subsequent conversion of its products. Attaining such a goal will not be easy or quick. The best land is already being used to produce food, fiber, building materials, and paper products. In addition, current energy consumption is enormous. Even if the total harvest of corn grains were fermented to alcohol, the liquid would provide only one-eighth of current gasoline demand. Hunger around the world will tend to limit the amount of grain that can be diverted to energy. Useful supplies of energy are being obtained from agricultural, forest, and urban wastes, but these sources are not likely to supply more than a minor fraction of total demand. However, in many instances, conversion of wastes serves the double purpose of producing energy and diminishing pollution.

The crucial opportunity for obtaining additional energy supplies lies in expanding the useful output of biomass. This can be done by genetic improvement, better management and choice of species for a given area, cultivation of plants for production of hydrocarbons, and utilization of land and marine areas not currently harvested. Progress is being made along all these lines. Forest product companies say they have already doubled yields on some land through selection of trees and better management. Projects in different sections of the country are assessing local vegetation.

An intriguing concept is to foster vegetation that yields hydrocarbons. The practice of obtaining hydrocarbons from trees has a long history. Oleoresins have been tapped as a source of turpentine for many years. Natural rubber has been used for more than a century. It is superior to the synthetic variety. The desert plant guayule produces a latex whose principal component is identical to that obtained from trees. Another desert plant with interesting potential is jojoba, which yields nuts that contain a valuable oil. Melvin Calvin is enthusiastic about producing hydrocarbons from a species of *Euphorbia*. He speaks of getting the equivalent of 10 to 20 barrels of oil per acre from "petroleum plantations."

It has been said that "wood is too valuable to be burned," and it is unlikely that most wood will be used that way. Instead, major efforts will be made to convert wood to valuable chemicals and liquid fuels. One of the principal means will be use of microorganisms. Fermentation microbes can be chosen that produce high yields of specific substances. At one time, the United States obtained its industrial alcohol, acetone, and butanol from fermentation of glucose derived from starch. Much effort now is being directed to obtaining chemicals from cellulose, which is also a polymer of glucose. A major goal is effective conversion of wood. This is not easy, because wood has a complex structure that involves cellulose, lignin, and hemicellulose. The *Bio-Energy Directory* lists a number of projects in which this crucial problem is being addressed.

In the United States, energy from biomass will face competition from other sources such as coal and oil shale. But should the CO_2 problem loom large, it will be essential to have available renewable energy sources that do not produce a greenhouse effect.—PHILIP H. ABELSON

**The Bio-Energy Directory*, Bio-Energy Council, 1625 Eye Street, NW, Washington, D.C. 20006; $30 through 31 July, $40 thereafter.