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Editorial remarks. Supplying our planet with energy is a process which soon will have to contend with the fact that solar energy is the sole, inexhaustible and regenerable energy source we have. Of course, the numerous technologies devoted to tapping the sun's energy cannot all be valued equally. For this reason, we are pleased that our coordinator, Professor R. Bachofen, has succeeded in bringing together in the following review such multifaceted and critical examinations of how solar energy can be gained from biological systems. The exploitation of conventional fuels - oil, coal, natural gas, uranium - will lead, irrevocably, to the exhaustion of these resources in the next century - if not in the coming decades. True, there are those who see little advantage in expending major efforts to develop solar energy programs when 'the more efficient and simple answer to all energy problems lies in nuclear fusion'. We disagree. Ecological and economic considerations not only justify, they make mandatory intensified research on solar energy - it is this work which will force practical breakthroughs in the generation and harnessing of power for the future. H. M.

New trends in research and utilization of solar energy through biological systems

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Preface

In 1970, when the report by the Club of Rome, 'Limits of Growth', was published and discussed widely, it became obvious to everyone that the conventional forms of energy we use for our daily requirements, as well as many other important resources, are not inexhaustible. The energy shortage in 1973 demonstrated the necessity for discussing and evaluating alternatives to oil. The development of nuclear power is quite advanced in many countries and helps to satisfy a substantial part of the energy demand. But even power from nuclear fission is not unlimited. Moreover, heightened popular opposition to this form of energy and rapidly increasing costs compared to those incurred by earlier hydroelectric power plants may limit severely its further distribution. Therefore, the oldest form of energy used by mankind, solar energy, is becoming fashionable again. Actually, solar energy is not merely an alternative energy source; it is the only form of energy which is able to sustain life by giving food to all living organisms through the process of photosynthesis. Plants are able to convert sunlight into a chemical form of energy which serves as the energy source for all heterotrophs.

The amount of energy from the sun that reaches the surface of the earth is by several orders of magnitude higher than the world's energy requirement (approximately 10^{24} J versus 10^{20} J annually). However, the energy density of the solar radiation on earth is rather low (ca. 1 kW/m^2 at the vertical position of the sun). Therefore, a technical utilization of solar energy requires large absorbing areas. Such light absorbing areas are provided by nature in the form of plants covering the surface of the earth. The complex reactions of photosynthesis have converted sunlight into chemical energy for billions of years. Engineers constantly deny the energetic future of bioenergy and biomass based on the rather low efficiency of energy conversion of photosynthesis of about 0.1% worldwide. Actually, the conversion efficiency for fields and forests is in the range of 1–5%; the low figure is due to the fact that the light is usually not the limiting factor for the biomass yield and that large areas on the earth are not suited for plant production. Furthermore, it is often forgotten that biomass, the product of the photosynthetic energy conversion, is very stable and can be stored for a long period of time in contrast to heat that is gained from sun collectors or electricity from sun cells.