Int. J. Heat Mass Transfer. Vol. 19, p. 348. Pergamon Press 1976. Printed in Great Britain

BOOK REVIEW

Review of **Heat and Mass Transfer in the Biosphere: I. Transfer Processes in the Plant Environment**, D. A. de Vries and N. H. Afgan, eds., Scripta Book Company, 1975, Washington, D.C., 594 pages.

THIS book is the first volume in a proposed series dealing with heat and mass transfer in the biosphere. It contains the invited lectures and research papers presented at the seminar on "Heat and Mass Transfer in the Environment of Vegetation", organized by the International Center for Heat and Mass Transfer, and held at Dubrovnik, Yugoslavia, 26–30 August, 1974. The purpose of this seminar, the 7th international seminar sponsored by the Center, was to review the state of the art in heat and mass transfer in the plant environment, and to promote cross-disciplinary contacts between researchers and practitioners in soil physics, micrometeorology, crop physiology, hydrology, and physical ecology, on the one hand, and specialists in engineering heat and mass transfer on the other.

The book is divided into two parts. The first part deals with transfer processes occurring in the soil, in the lower atmosphere, and in plants themselves. The second part deals first with methods aimed at increasing crop productivity, for which the term phyto-engineering is introduced, and then with pollution of soil, water and the plant canopy in relation to plant growth and productivity. Each part in this volume begins with invited lectures, followed by shorter communications which are mostly based upon narrow and specialized areas of research. The first group of invited lectures deal with the environment of a vegetation system. D. A. de Vries (Netherlands) covers heat transfer in soils; J. R. Philip (Australia) gives a review of water movement in soil; and S. F. Nurpan (USSR) relates the thermodynamic and rheological peculiarities of soil water to energy and mass transfer. The first two of these papers deal with heat and moisture transfer from a continuum mechanics viewpoint, whereas Nurpan focuses on intergranular effects and surface phenomena. The second group of invited lectures deal with the lower atmosphere. G. A. Bussinger (USA) describes the features of the lowest 10–20 m of the atmosphere, often referred to as the atmospheric boundary layer, and presents tentative expressions to account for surface roughness due to trees, shelter belts, etc. J. M. Norman (USA) presents a summary of radiative transfer in vegetation, pointing out that the foliage of plant canopies exhibits a gross radiative reflectance which is non-diffuse, and that inferences concerning canopy structure can therefore be deduced without knowing the details of the canopy geometry. Heat and mass transfer within plant canopies is treated by B. Lake and B. L. Monteith (United Kingdom), general principles of natural evaporation by F. Kreith and W. D. Sellers (USA) and methods of observation of heat and mass transfer in the lower atmosphere and in plant canopies by A. Perier (France). Water transfer in plants is covered by P. J. Jarvis (United Kingdom) who presents a mini-course in plant physiology.

In the second part of the book, which deals with applications, A. A. Nichiporovich (USSR) presents a summary of energy and mass transfer in plant communities. He discusses the effects of radiant energy, water and nutrients on plant growth, indicating that optimization of these parameters combined with density planting could at least double the crop to dry weight ratio produced. The implication of these assessments for alleviating the world's food crisis are obvious, and should receive careful attention from agricultural engineers. A challenging and imaginative presentation of energy use in modern agriculture is presented by G. Stanhill (Israel) in a national case study.

The final series of papers deal with pollution in the plant environment, an area which is probably too large to be appended to the variety of papers in the first part. Little is known quantitatively in this area and the papers presented at this seminar do not add significantly to our state of knowledge.

On the whole, the invited papers are of high quality and all of them have adequate bibliographies to permit an overview of the field. Most of the contributed papers are reports of experimental investigation, some dealing with flow through and above forest canopies, others treating the thermal and aerodynamic effects of hedges and windbreaks. One is a study of a model leaf to obtain gross mass transfer properties, and two deal with computer modeling of soil-sky interactions. Some research papers cover new instrumentation. Outstanding contributions are the careful and thoughtful work done by R. H. Shaw (USA) and G. den Hartok (Canada) and C. J. Stigter (Netherlands). The first of these describes a small anemometer designed for measuring turbulent transport within canopies, whereas the other paper describes a diffusion porometer to measure the evapotranspiration from leaves.

The past decade has seen an increasing interest in problems related to the environment of vegetation, an interest which is probably stimulated to a great extent by the significance which the future production of food holds for the peace and welfare of mankind. In reading this book, one is struck by the complexity of the problems facing the researcher, and by the difficulty of applying laboratory studies to full-scale systems. This book presents an excellent introduction to heat and mass transfer in vegetation, a field which has heretofore received more attention from practitioners and scientists than from engineers who could serve a useful function in relating the existing knowledge to the practical implementation of eco-system management and protection.

FRANK KREITH

Boulder, Colorado