Biochemical Models of Leaf Photosynthesis. Techniques in Plant Sciences No. 2. S. von Caemmerer. CSIRO Publishing, P.O. Box 1139, 150, Oxford Street, Collingwood VIC 3066, Australia. IX + 165 pp. Price: A$85/US $60.

Life on this planet essentially depends on the unique process of photosynthesis by green plants which harvest and convert sunlight into chemical energy and release molecular oxygen from water. During the process, energy is stored in the form of organic compounds by the reduction of atmospheric carbon dioxide. Our knowledge of photosynthesis goes back to nearly 230 years with the discovery of release of molecular oxygen from green plants by Joseph Priestley in the 1770s. However, the progress of knowledge was not remarkable till the turn of the twentieth century. A landmark in the history of photosynthesis research was in 1937 when R. Hill has established that oxygen released in photosynthesis originates from water and not from carbon dioxide. It was with the availability of radioactive carbon for experimentation that M. Calvin and his colleagues in 1950s mapped out the path of carbon in photosynthesis. The same period could also be considered as a golden era in photosynthesis research when the hitherto unknown unique reaction of photophosphorylation, a direct conversion of light into chemical energy was discovered by D. I. Arnon and his colleagues.

In the late sixties of twentieth century, the existence of C_4 photosynthesis has come to be known with the discovery by Kortschak *et al.* and subsequent formulation of the detailed biochemical pathway by Hatch and others in several tropical crops and weed flora. It is clear that all the green plants fix carbon dioxide ultimately through the enzyme rubisco while in plants which follow the C_4 pathway, there is an additional carboxylation leading to a CO_2 concentrating mechanism at the site of rubisco, making C_4 plants more efficient.

During the last three decades, spectacular developments have taken place in the field of photosynthesis in view of its importance both as a fundamental process and its relevance for crop and plant productivity. The subject is highly interdisciplinary, ranging from basic plant physiology and biochemistry to biophysics and molecular biology and biotechnology. The tremendous developments in this branch of science are evidenced from the presentations at International Photosynthesis Congresses held every three years organized by the International Society for Photosynthesis Research. The next congress is going to be held in Brisbane, Australia in August 2001 where the current developments will be discussed in several symposia. Recently in 1999 two monographs 'The Biology of C_4 Photosynthesis' edited by Sage and Monson and 'Photosynthesis: Physiology and Metabolism' edited by Leegood *et al.* have appeared. All these remarks go to demonstrate the extraordinary advances that are taking place in the understanding of photosynthesis.

Several new areas are also emerging in this field including work with transgenic plants. Recently in literature there have been reports of *Arabidopsis* mutants being generated for undertaking the photosynthetic light harvesting and the genes responsible for synthesis of chlorophyll-binding proteins involved in energy dissipation. Also, transgenic tobacco plants are reported with modified membrane characteristics regulating in the acclimation process to higher temperatures.

In the contemporary scenario of photosynthesis, the above monograph by von Caemmerer is highly relevant and a welcome addition. This monograph is second in the series *Techniques in Plant Sciences* published by CSIRO, Australia. The book specifically deals with the biochemical models of leaf photosynthesis aimed at the use by advanced students, research scientists and faculty in the related fields of plant sciences. The biochemical models are extremely useful in understanding the regulation of photosynthesis by environmental variables and constraints and in identifying the gaps existing in our present state of knowledge.

The preface of the book is self-contained and describes in a cogent manner the content of various chapters to enable the readers obtain a total glimpse of the treatment of the subject matter. It also reflects the views of the author on the different chapters and his analysis (rubisco). Chapter 1 has exclusively been devoted to the kinetics and regulation of the enzyme. Careful attention has been given to the activation of rubisco and a model of activase action was presented. However, the aspects of engineering a more efficient rubisco with suggestion of the use of techniques of modern molecular genetics was presented in Chapter 2 only. This chapter presents the Farquhar model of C_3 photosynthesis and its subsequent modifications by Farquhar and the author of this book, von Caemmerer. In the model, several photosynthetic parameters are assigned. It is interesting that reference has also been made on the use of transgenic tobacco plants containing reduced amounts to determine kinetic constants of rubisco.

One of the most rapidly fluctuating environmental factors to which plants are exposed in nature happens to be the level of irradiance. This factor was brought out in the model in sufficient detail. Long term effects of environment including the growth performance at elevated carbon dioxide levels and those of temperature regimes are discussed.

The use of non-destructive technique of chlorophyll, a fluorescence for the determination of chloroplast electron transport and for the assessment of the overall function of photosystem-II activity is the theme of Chapter 3. C_3 photosynthesis involves not only the oxygen evolution but also the uptake of oxygen from more than a single reaction. The uptake of oxygen which relates to photorespiratory cycle is composed of the rubisco oxygenate activity and is due to the Mehler ascorbate–peroxidase reaction. The latter is known to take place in the absence of regular electron acceptors when oxygen is reduced to superoxide radicals. The significance of this reaction is less understood. Various aspects of oxygen exchange accompanying the C_3 photosynthesis are presented in a systematic manner in Chapter 3.

C_4 photosynthesis which occurs in only 1% of all the angiosperms and yet in some of the world's important crops including sugarcane, maize and sorghum has attracted much attention over the past thirty years in view of its higher efficiency and of the unique biochemical and specialized anatomical attributes. It is evident that modelling C_4 photosynthesis is inherently more complex compared to that of C_3 photosynthesis. Chapter 4 is devoted to C_4 photosynthesis models presented by Berry and Farquhar, Peiskar and Henderson and by Collatz, Ribas-Carbo and

Berry. The Chapter also includes consideration in brief of the three subgroups of C_4 photosynthesis, the NAD-ME, NADP-ME and PCK. However the parameters involved in this connection including those of bundle sheath conductance are relatively difficult to model, and should await further advances.

The coverage of C_3–C_4 intermediate photosynthesis in Chapter 5 is quite adequate. The C_3–C_4 intermediacy is itself not fully understood presently. It is not clear whether these intermediates are in the course of evolution towards C_4 pathway or if they are actually stabilized hybrids between C_3 and C_4 plants. Great deal of variation also exists in the biochemistry of the different intermediate species, the common denominator being only the reduced level of photorespiration. The models of Peiskar and that of von Cammerer are presented well. The glycine shuttle is discussed clearly as a possible mechanism for the refixation of photorespiratory CO_2. The final Chapter 6 involves a one-page conclusion stating clearly the summary, the philosophy and basis of the content in the book. The author has also mentioned very rightly the gaps regarding the lack of models for CAM photosynthesis. The inclusion of work relating to antisense transgenic plants in the context of photosynthesis is to be appreciated.

Throughout the book the style of presentation is excellent and highly lucid. There is adequate introduction preceeding every aspect covered in the text and considerable background information including the development of present concepts has been provided. The techniques described and the models discussed would help in furthering the new areas of investigation and are expected to stimulate the researchers in this area. The analytical approach followed by the author is an asset for the book.

The Appendix constitutes a good addition giving explanation of symbols used in the text and will serve as a ready reference. The literature cited is fairly exhaustive and is upto date till 1999 and includes some forthcoming in 2000. The book can be considered as a highly important reference work on latest developments in the area of research on photosynthesis and can be recommended for the use of postgraduates, research students and teachers in Plant Sciences, Biochemistry, Environmental Sciences and Biotechnology.

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Mathematics of Wave Propagation. Julian L. Davis. Princeton University Press, 41, William Street, Princeton, New Jersey, 08450, USA. 2000. 395 pp. Price: US $49.50.

This book should more appropriately be called *Physics of Wave Propagation*, since it is in the modeling and elucidation of a variety of wave phenomena that it excels. That indeed is the title of its first chapter. Mathematics serves to quantitatively describe the phenomenon, but it is kept here at a very elementary level. Ironically, that, for many readers, may prove to be an attractive feature of the book.

The range of wave phenomena described here is quite wide and extensive, waves in viscous and nonviscous fluids, stress waves in elastic and viscoelastic solids and in thermoelastic media, and water waves. There are a couple of chapters which may aptly be called mathematics of wave propagation, for example those dealing with PDEs, wave equations in one and higher dimensions, and calculus of variation.

Chapter one introduces elementary concepts in the propagation of waves – transverse waves, travelling waves, characteristics, sinusoidal waves, interference phenomena, reflection of waves, the Doppler effect, etc. Each concept is illustrated in a physical context.

To appreciate the approach of the author it is best to discuss one chapter, say, PDEs of wave propagation. Here initial and boundary value problems for first order PDEs, both linear and nonlinear, are discussed with special reference to characteristics, which naturally form the sinews of hyperbolic wave phenomenon. Several examples are treated, but the author stops short of any discussion on shock waves.

Second order linear and nonlinear scalar equations are discussed quite adequately. Chapter three on wave equation does some justice to the mathematics of waves. The material here, however, is fairly standard and may be found in any good book on PDEs, for example, by W. E. Williams.

Again, wave propagation in fluids (Chapter 4) and water waves (Chapter 8) are treated quite succinetly. The strength here again is in introducing the relevant physical ideas with the help of some simple examples. However, much of the material is quite standard: one-dimensional compressible gas-dynamics, two-dimensional steady flows, and some simple viscous flows. The flows, with and without shocks, are discussed with the help of characteristics.

The viscous fluids are also included, but not quite in depth – Poiseuille flow and Stokes flow with Oseen approximation are quickly dealt with. Water waves in Chapter 8 are discussed mainly in the linear approximation.

To summarize, the book by Julian Davis would amply meet the needs of students who, with minimal background, wish to be initiated into wave phenomena. The book provides excellent physical and mathematical motivation to the study of the phenomena. This book is not for specialists. This is borne out by the bibliography which enlists some basic books giving the background material; there is no reference to any research papers. The reader must look into recent literature to find out what is the current status of research in any specific aspect of a linear or nonlinear wave phenomenon.

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