Book Review

Deep Ploughing—or Numerical Plant Physiology. It is widely accepted that biologists should be conversant with the basic techniques of Mathematics just as they are expected to know some Physics and rather more Chemistry. To this end some Universities, including Edinburgh, offer courses in Mathematics and Physics specifically designed for Biology students with the intention that at the end of the course such bogeymen as differential and integral calculus, the Normal distribution, the Physics of diffusion and even feedback in a circuit, should have lost their terrors. There is implicit recognition that if the mechanistic approach to biological problems is to be successful it must rely heavily on the rigorous analysis only possible using the tools of the physical scientist. Yet all too often in University courses there is a gap between intention and achievement. Regrettably the biologist often baulks and gives only an imprecise description of topics crying out for a more detailed examination. In consequence the student remains unaware of the unifying enlightenment that can come from proper analysis in depth. Part of the reason for this sad state of affairs is that so many biologists lie in limbo, having rejected the purely descriptive approach yet lacking the mathematical expertise to progress forward. Plant physiologists will therefore welcome the bridge offered by Park Nobel in this book* which is important not so much for what it covers as for the approach that is employed. The book shows at once how far the biologist has to develop his knowledge of Physics and Mathematics and also the great rewards to be gained in understanding once such competence is achieved.

Biophysical Plant Physiology is an extensively rewritten version of an earler work, *Plant Cell Physiology—a Physicochemical Approach*, with two additional chapters. In the previous book the important topics of growth and development were not considered; instead interest was centred on two areas, firstly, movement of water and solutes in cellular systems with treatments of diffusion, chemical and water potential and the application of irreversible thermodynamics to ion fluxes, and secondly, the absorption of light energy and its conversion into chemical and electrical energy. This scheme has been retained in the first six chapters where expansion and rewriting has benefitted the treatment. Consideration of diffusion (Chapter 1) and solute transport across membranes (Chapter 3) are improved while the additional material incorporated into the section on Bioenergetics (Chapter 6) gives this a more polished look. My reservations on the final two chapters headed 'Leaves' and 'Plants' lie in a belief that too much is attempted in the space available; to treat leaf resistance to diffusion and water vapour, carbon dioxide and energy fluxes in leaves in some 60 pages makes considerable demands on the reader's stamina as well as having him take a number of statements on trust. In the final chapter there is a short and almost irrelevant treatment of the water relations of phloem with passing reference to ideas on the translocation mechanism yet no mention of the Bowen ratio when fluxes above the leaf canopy are discussed. It is unfortunate that Nobel does not use SI units throughout the book. The table of conversion factors, given as one of several useful appendices is a help, but since SI units will eventually become accepted even in North America it would have been better to dispense with calories and the like. Also I find that widespread use of superscript as well as subscripts in symbols makes even quite simple expressions appear very forbidding at first sight especially when they are incorporated as an integral part of the text as is very often, and quite properly, the case.

This brings me to the final point. The great merit of this book is that it shows how proper use of Mathematics and Physics can help to explain and predict the behaviour of living material in quantitative terms. Again and again in the text Nobel uses knowledge of physical principles involved to calculate relevant and often highly informative data. Thus, for instance, he shows that a small molecule with diffusion coefficient of about $10^{-5}cm^2/sec$ will diffuse across a cell of 50 μm in length in 0·6 sec; another calculation shows the resistance of the plasmalemma to diffusion of CO_2 across it to be of the order of 5 sec/cm whereas that to HCO^{-3} is about 10^4 times higher—estimates of some interest to those concerned with the physiology of photosynthesis. The problems at the end of each chapter are also original and to the point. Anyone who can solve them all will know a great deal about plant physiology. This book then is an important addition to the literature of the subject and deserves widespread success; it is gratifying that the publishers have been able to keep the price down to almost the same level per page as the earlier version.

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* Introduction to Biophysical Plant Physiology. By Park S. Nobel. xii + 488 pp. W. H. Freeman, San Francisco, 1974. £7.10.