3000–4000 calories poorer. I would like to have seen in the chapter on Catabolism (Chapter 4) some reference to the efforts of P. H. Vernon and of Barbara Banks to give an alternative account of the rôle of ATP, especially in coupled reactions, to that originating with Lipmann. I recommend particularly Barbara Banks in *School Sci. Rev.* **52,** No. 179, pp. 286–297 (1970). This article is also important in pointing out some widespread misapplications of thermodynamics to biological systems. It is pretty strong stuff!

With these reservations—and a few other minor blemishes—I consider this new edition the best book on plant metabolism for first, even second year undergraduates who are seriously interested in the subject. Much re-writing has been done and a number of useful metabolic cycles added. In Chapter 4, the TCA figure has been tarted up—not entirely satisfactorily; there is additional material on fat metabolism; a re-drawing and extension of the electron transport scheme and a brief account of the Chemiosmotic hypothesis. The following chapter (Anabolism) is also considerably revised, for example, on protein synthesis, photosynthesis (Hatch and Slack pathway briefly dealt with) and there is new material on assimilation of nitrogen and sulphur. Chapter 7 (Absorption, secretion, translocation) contains a section on ion fluxes and membrane potentials which, I suspect, will be found heavy going for many students. The revised account of sieve tube transport is enriched by a splendid electron micrograph of a sieve plate. The final chapters remain much the same, but there is some expansion.

Each chapter, as before, ends with a selection of references. Many useful titles have been added up to 1970. The index has been re-set to take into account textual alterations.

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Phytochemical Ecology (Proceedings of the Phytochemical Society Symposium, April 1971): edited by J. B. HARBORNE. Academic Press, London, 1972. 272 pp. £5.

MANY types of interactions between plants, micro-organisms and animals exist in nature. Some of these interactions are governed by secondary metabolites elaborated in great diversity by higher plants. Biologists of the 19th century like Stahl, Kerner von Marilaun and Beijerinck interpreted most of these phytoconstituents as forming part of the defence strategy of plants. Later such a teleological approach fell in discredit; the secondary products became waste products (Hobelspähne) of plant metabolism to most biologists. It is only in recent times that a serious reappraisal of secondary plant metabolites began. This was faciliated by many new and better analytical tools which allowed the quick elucidation of structures and which made large scale comparative studies possible. Furthermore, similar compounds were detected in many micro-organisms and animals. By analysing the behaviour of animals and by observing competition between cultivated micro-organisms it became clear that secondary metabolites must have ecological functions. Consequently, the ecological approach to secondary metabolites of higher plants revived. The present book reviews several attitudes in the rapidly expanding field of research, which is suitably termed chemical ecology. The fourteen contributions included in this book demonstrate clearly that secondary metabolites, in many instances, play an important role in the biosphere. They are involved, e.g. in the determination of palatability of plants to plant eaters and of accessibility of plants to plant parasites. It is beginning to become clear that the spectrum of secondary metabolites of a given taxon is the result of its past history and its evolutionary strategy; like other attributes of plants, it is largely fixed in its present state by selection, because it has definite functions. The book demonstrates very well that chemical ecology is a field of high

complexity; it is far easier to postulate ecological functions for plant constituents than to prove the latter unequivocally.

The fourteen chapters treat several types of chemical interactions in nature. Chapter 1 (M. Rothschild) discusses protection of phytophagous insects against predators by substances elaborated by host plants. J. M. Cherrett analyses factors involved in leaf choice by fungus-growing leaf-cutting ants and Chapter 3 (H. F. van Emden) is devoted to host selection by aphids. E. C. Bate-Smith and G. W. Arnold and J. L. Hill treat food selection by mammals and ruminants. D. A. Jones illustrates, notwithstanding the complexity of the situation, that it is possible by careful experimentation to prove that cyanogenesis of plants represents a defence mechanism. In Chapter 10, E. A. Bell reviews non-protein amino acids of Leguminosae and discusses their possible functions. C. H. Muller and Ch.-H. Chou treat classical allelopathy, e.g. chemical interactions between higher plants. One chapter (B. J. Deverall) is devoted to phytoalexins and another one (W. G. H. Edwards) to the so-called *Orobanche* and *Striga* factors which stimulate the germination of seeds of these angiospermous parasites.

The chapters on aflatoxin and related mycotoxins (M. O. Moss), selenium toxicity (A. Shrift) and on toxicity and metabolism of *Senecio* alkaloids are perhaps a little beyond the narrower scope of phytochemical ecology, because they discuss toxicological, metabolic and physiological aspects of the respective compounds. The same may apply to T. A. Rohan's chapter on the chemistry of flavour. It must be stressed, however, that an understanding of animal perception and an exact knowledge of the biochemistry and toxicology of plant constituents are essential to chemical ecology.

Understandably, the book covers only part of the vast subject of chemical interactions in nature. Chemical stimuli involved in pollination and dispersal ecology are scarcely touched upon; the same applies to relationships between the chemical make-up of plants and their attack by most groups of phytophagous insects, slugs, snails, nematodes and phytopathogenic micro-organisms. The book, however, demonstrates clearly that phytochemical ecology is no longer a field of unproven theories; it is becoming rapidly a field of critical experimentation.

The editor and the authors are to be congratulated on their performance. For both biologists and phytochemists, this book will form a fascinating and most useful reading. The phytochemist interested in evolutionary aspects of plant metabolites should learn from it that natural products are very often involved in evolutionary strategies of plants and may therefore be as easily affected by convergencies and rapid divergences as are other characters.

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Carotenoids: edited by OTTO ISLER. Birkhäuser, Basle, 1971. 932 pp. Swiss Fr. 118.

THIS MAGNIFICENT monograph is intended to update the earlier classic account of these important natural pigments by P. Karrer and E. Jucker, which was published by the same press in 1948. Although this volume is very much longer than Karrer and Jucker (it runs to 932 pp.), it only briefly covers biochemical aspects, since it is intended as a complementary volume to the second edition of T. W. Goodwin's *Comparative Biochemistry of the Carotenoids*, which is due to be published in 1973–4. In spite of these restrictions, this is a valuable addition to the phytochemical literature and will be an essential source book for all research workers dealing with natural colouring matters.