

## Book Review

*Handbook of Lichenology*. Edited by Margalith Galun. CRC Press, Boca Raton, FL, 1988; Wolfe Medical Publications, 2-16, Torrington Place, London WC1E 7LT. 3 Vols., 625 pp. £283.

Lichenology in its many and varied facets is a rapidly growing science, and this three-volume set is very timely in enabling lichenologists and other interested readers to keep abreast of the many rapid developments. The three volumes are divided into 13 sections, with 33 chapters in all, presented by 26 contributors from 11 countries.

Volume I begins with an introductory chapter by Lorch presenting a detailed historical review upon the 'true nature of lichens', which should remind us all that lichenology should be approached with an open mind! The position of the lichenized fungi in the Fungal Kingdom is outlined by Hawksworth, emphasizing that some 20% of all known fungi, and nearly half of the ascomycetes, are lichenized.

Lagging far behind our rapidly increasing taxonomic understanding of the lichenized fungi is that of their photobionts; this being for largely technical reasons with the morphology and reproduction of algae (or cyanobacteria) often being highly modified in the lichenized state. What is known is diversely scattered throughout the international literature, such that the review on 'the algal partner' by Tschermak-Woess is most welcome. Included is a 16-page tabulated summary, 'Algal genera and species identified as lichen phycobionts', giving also the name of the lichen involved, the literature source and the means of identification (i.e. *in vivo*, *in vitro* etc.). There follows lengthy annotations to the table, together with detailed notes on some common and other, recently discovered photobionts. Also reviewed are reports of the occurrences of photobionts in the free-living state and the means of reproduction in the lichenized state — both areas ripe for further study.

Section 3 concerns the lichen thallus, and Jahns takes us through its varied form and structure, means of vegetative reproduction, development and degeneration, aided by 145 figures (mostly LM and SEM plates). He also offers thought-provoking remarks on the phylogeny of the lichen thallus, and the individuality (or not?) of lichens. In the next section on 'the fungus-algae relation', Galun looks more closely at the subjects with a review of the ultrastructural relationships between the bionts.

Section 5 on 'Reproduction' comprises accounts of the anatomy and development of the ascomatal and conidiomatal structures in lichens by Bellemère and Letrouit-Galinou and Hawksworth respectively. Unfortunately, neither chapter contains a much needed appraisal of the relative effectiveness of the means of reproduction, i.e. by ascospores, conidia or vegetative diaspores. Indeed

vegetative diaspores (isidia, soralia, thallus fragmentation, etc.) are not considered at all in this section! — although they are dealt with by Jahns in Section 3.

Section 6, lichen physiology, opens with a short chapter on carbon metabolism by Galun, followed by a more comprehensive treatment of nitrogen metabolism by Amar Nath Rai. These two chapters are developed further in a review by Vicente and Estrella Legaz, on lichen enzymology, an exciting field of study not only for physiologist but also for the systematist.

The first part of Volume II encompasses papers on aspects of ecology and ecophysiology. Armstrong takes us through colonization, growth and competition, areas of study where low-cost but careful observation and experimentation can add much to our understanding of lichen ecology and population dynamics. Rundel reviews the 'apparently' well-researched topic of water relations but stresses the dearth of quantitative information on the correlations between water flow rates and structural characteristics of lichen thalli. In the third chapter, Kappen takes us on a world tour to several different climatic regions of the world, explaining the morphological and ecophysiological characteristics and adaptations of the indigenous lichens. A short, but stimulating chapter by Farrar follows, reviewing and critically assessing the concept of 'physiological buffering'. Seaward's chapter on the 'contribution of lichens to ecosystems' draws together diverse aspects of lichens, some of which are deserving of separate chapters in themselves given the recent advances in knowledge, e.g. biogeography, phytosociology, thallial dimorphism (photosymbiodemes, etc.), and lichenicolous fungi. Treated in more depth here are the associations between lichens and animals, both invertebrates and vertebrates.

Volume II closes with three chapters on cellular interactions (Section 7). Firstly, Bubrick examines the effects of lichenization on the photobiont, especially the loss of filamentous habit, and ultrastructural changes in cell wall and thylakoid organization. The complementing chapter on the mycobiont by Galun explains the ultrastructural effects, e.g. presence of concentric bodies and the composition and structure of cell walls. Finally, Galun reviews the processes of lichenization from observations made in nature and in axenic culture.

Volume III opens with chapters (Section 9) on the chemical constituents of lichens. Secondary metabolic products, arguably more important for the taxonomy of lichens than for their biology, are well-studied and reviewed elsewhere and a fairly synoptic treatment is given here by Galun and Shomer-Ilan. Less well-studied are storage products about which Gorin et al. provide a welcome review. The two short chapters by Czeżuga on carotenoids and phycobiloproteins (found in cyanophilic lichens) will hopefully stimulate interest in these

substances, whose potential importance should not be neglected by systematists.

The next section (which should surely have gone in Volume I) has a single, but important chapter in which Hafellner outlines the modern principles of classification and presents a synopsis of the main taxonomic groups.

The interaction of lichens and pollutants is a subject area with a massive literature and numerous reviews, and is thus given a comparatively modest coverage by Galun and Ronen.

Lichens have been used by man for many purposes other than as biomonitors for pollution, and such uses are the subjects of Section 12. Lichenometry can be a valuable tool in geomorphology and archaeology, but needs to be employed with great care. The principles are simple, but the practice less so; the comprehensive review of the technique by Innes includes many pertinent recommendations. The varied medicinal and other economic uses of lichens are drawn together by David Richardson. A great deal of myth and speculation surrounds the extent of the effects that saxicolous lichens have on their substrata. In his chapter on this subject, Jones clearly shows that lichens do indeed significantly alter rock surfaces and consequently contribute to the mineral matter in developing soils.

The successful cultivation of lichens or their isolated bionta is an essential prerequisite to many studies of lichen physiology, ontogeny and morphogenesis. In the final section (13), Bubrick reviews the methods of cultivation and also provides recipes of growing media, and a list of photobionts available from culture collections.

These three volumes are an undoubted valuable contribution to lichenology and its progress, but why three volumes with independent indexes? Surely the 625 pages would have been contained in one volume, with a single, comprehensive index. Also, the order in which several of the chapters appear leaves me bewildered. These volumes are packed with invaluable information and references for the active scientist, and although entitled a 'Handbook' they are unlikely to be so. Their exorbitant price will place them, sadly, beyond the reach of most scientists outside of major institutes with large book-purchasing budgets.

I hope I am being overly pessimistic, as a great deal of hard endeavour has gone into the production of these volumes, especially by the editor, Professor Galun, who must be heartily congratulated.

Brian J. Coppins  
Royal Botanic Garden Edinburgh



## Book Review

*Endocytobiology IV*. Edited by P. Nardon, V. Gianinazzi-Pearson, A.M. Grenier, L. Margulis and D.C. Smith. Proceedings of the 4th International Colloquium on Endocytobiology and Symbiosis, Villeurbanne, France, 4-8 July 1989. Institut National de la Recherche Agronomique, INRA Service des Publications, Versailles Cedex. 612 pp, 450 F, ISBN 2-7380-0241-2.

This book contains the proceedings of an international meeting organized by the International Society of Endocytobiology (ISE) in collaboration with the National Institute for Agronomic Research and with the National Institute for Applied Science of Lyon.

As the title indicates, the publication deals with the role of symbiosis in evolution, cytological, physiological and genetical interactions between host and endocellular symbionts, with origin and evolution of organelles and their relations with the nuclear genome, and with mitochondria, chloroplast and other organelles in their relations with the nuclear genome.

The publication is divided into four chapters, beginning with an overview definition and examination of the concept of symbiosis by D.C. Smith who provided a re-examination of symbiosis in the light of new findings and possibilities offered by scientific progress. The proceedings contain a diverse mixture of theoretical, practical, educational and technological papers included in several chapters drawn from the spectrum of different topics. The number of studies of several aspects of symbiosis is increasing now more than at any other time in its long history, and the practical utilization of symbiosis in both fundamental and applied studies has exceeded by far the visions of even the most enthusiastic of the early researchers. To a certain degree, the experimental exploitation of symbiosis in plants and protoctists is handicapped by the element of empiricism which is currently an integral part of analytical logic.

Chapter I includes papers on symbiosis in plants and is divided into three sub-chapters: symbiosis with *Rhizobium*, *Agrobacterium* and *Frankia*; Mycorrhizae and Lichens. Many aspects and methods of biochemistry and physiology are covered and may be useful for plant scientists and ecologists wishing to become involved in this form of research.

Chapter II presents twelve papers dealing with symbiosis with protoctins. I found this mixture of articles stimulating reading.

Chapter III deals with mutualism and parasitism in animals and is divided into four sub-chapters: Marine and fresh water symbiosis, deep-sea symbiosis, arthropod symbiosis - bacteria and viruses as symbionts, and parasitism. In this chapter papers demonstrate great diversity of the subject. Each sub-chapter provides a comprehensive overview of mutualism and parasitism in

animals. The host-symbiont interface, the existence symbiosis-specific proteins and their function are covered.

The very important Chapter IV, Evolution, is divided in two sub-chapters: Origin, interaction and evolution of mitochondria, plasts, endulipodia, lysosomes and other organelles, and Origin and evolution of the eucaryote cell and role of symbiosis in evolution. The importance of symbiosis in cell evolution was one of the most interesting theories in the past but it seems that the discussion has reached its climax.

The papers in the book vary in length and in quality, but more than eighty percent of the articles are of very high scientific quality. Many articles are well-illustrated and exceptionally easy to read which is unusual for Proceedings compiled by many authors. The book contains much fundamental and very special information, especially with regard to different aspects of symbiosis. Many important ideas were introduced succinctly and sharpened with relevant experimental data, useful and interesting for those wishing to acquaint themselves with some recent information on the study programs of endocytobiology and symbiosis. In conclusion, this book can be recommended for purchase by individuals and by libraries.

Václav Mejstřík  
Czechoslovak Academy of Sciences  
Na sádkách 7, 370 05 České Budějovice  
Czechoslovakia



TEL AVIV UNIVERSITY אוניברסיטת תל-אביב

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FACULTY OF LIFE SCIENCES  
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Prof. Bernard Epel  
Botany Department  
Tel-Aviv University  
Tel-Aviv, 69978  
Israel.