BOOK REVIEWS

Phycology (4th edition). Robert Edward Lee. Cambridge: Cambridge University Press. 2008. 560 pp. ISBN 978 0 521 68277 0, US$80 (paperback); ISBN 978 0 521 86408 4, US$160 (hardback).
doi:10.1017/S0960428609990072

Phycology, the study of algae, is practised by a rather small number of professional researchers compared with other groups of living organisms, despite the fact that algae are the most important primary producers in freshwater and marine environments, and account for a significant proportion of the planet's species diversity. Algae are amazingly diverse, not only in terms of structural complexity and reproductive strategy, but also in their genetic makeup, as revealed by comparative phylogenetic analysis of DNA sequences and their ability to adapt to, and survive (and often thrive) in, virtually every ecological niche, both aquatic and terrestrial. To condense the vast body of knowledge that exists on algae into a format that is suitable for teaching students at upper-undergraduate and postgraduate levels is a major challenge. Lee is one of very few contemporary phycologists who has the time, resources, patience, perseverance and, above all, the necessary breadth of knowledge of all things algal to undertake such a project and, if the number of editions that this 'Phycology' text has seen since 1980 is taken as a performance indicator, he has been quite successful.

We are told in the Preface that this 4th edition 'maintains the format of previous editions' – a statement that I am unable to confirm, not being familiar with those earlier incarnations – 'whilst incorporating the latest information from nucleic acid sequencing studies'. While this is not entirely true – I will come back to this later with a case in point – the organisation of the book does reflect the modern notion that the diversity and evolution of major groups of plants are best explained by reducing organismal evolution and diversity to that of the chloroplast and its associated membranes. This concept, commonly known as the serial endosymbiosis theory, has become increasingly robust and beyond dispute in recent years, in part thanks to evidence obtained from gene sequencing studies. The theory provides an elegant explanation for the fact that, in some lineages of the tree of life, the chloroplasts are bounded by only two membranes, but in other lineages by three or more. To emphasise that these lineages are evolutionarily distinct (although collectively they are casually known as 'Algae', a term without taxonomic significance), the bulk of the book consists of sections covering the chloroplast-lacking prokaryotic algae (Part II), those possessing a chloroplast without surrounding membranes (III), those in possession of chloroplasts surrounded by one membrane (IV), and algae whose chloroplasts are associated with two membranes (V).

In the Introduction the reader is presented with a discussion of the basic characteristics of algae. This includes the key features at the cellular and chemical level by

which the main groups of algae differ, and is followed by a brief summary of the classification scheme used in the book. Each of the following chapters deals with a specific group of algae. The text, supplemented with a well-balanced mix of micrographs and line drawings, is generally very clear, and should not present any problems for readers with little or no previous knowledge of algal diversity. Due to space limitations it is impossible to review Lee's coverage of the various algal groups in detail. However, if the chapter on the Chlorophyta (green algae) – a group with which this reviewer is most familiar – is a representative sample, it is clear that the structural and biochemical principles on which the classification of algae is based are well explained. The only surprise in the presentation of the Chlorophyta is the absence of any reference to the Trebouxiophyceae. This is a class which is predominantly defined on the basis of the molecular phylogenetic relationships of its members, rather than on a unifying set of plesiomorphic morphological characteristics. This means that it is impossible to recognise a trebouxiophyte simply 'by eye'. The molecular genetic justification of the Trebouxiophyceae is well established, so its exclusion from the text somewhat contradicts the claim made in the Preface that the book incorporates the latest molecular genetic information.

The last chapter is devoted to 'Algae and the environment'. We are told that 'it is possible to write whole books' on this subject, so the author has selected a few topics that have generated most interest recently. The depth to which these are covered varies widely: by far the most attention is devoted to the harmful effects of algae – either through the production of toxins or the formation of large amounts of biomass (blooms) – and a discussion of the hypothesis that the mass extinction of most of the marine fauna during the late Permian was caused by toxic algae. This is followed by much shorter discussions of a number of other topics, including the production of dimethyl sulphoniopropionate (DMSP) by marine algae and its effect on the earth's climate, chemical defence mechanisms of algae, the role of phytoplankton in arctic waters, the iron enrichment experiment in the Southern Ocean which aimed to increase the removal of atmospheric carbon dioxide by marine phytoplankton, a comparison of extremely dry and cold antarctic lakes dominated by a highly specialised alga and similar environments on the planet Mars and on Jupiter's moon Europa, algal ultraviolet sunscreens and algae as a source of hydrogen fuel. I very much welcome the inclusion of these highly diverse topics in this textbook, as they are important illustrations of the roles that algae play in global ecosystems and which often remain underexposed in undergraduate phycology, limnology and marine biology courses.

This book is an ideal companion to introductory phycology and limnology courses taught at undergraduate level. Because of the wealth of information that it contains it will retain its value as a reference even if a student has opted not to pursue a career in algal research.

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