

experience of the volume will be typical of many: however interesting the papers in a volume such as this, only a few (three in my case) have any direct relevance to my work. As far as I can see, it is not possible to buy individual articles from this volume online, so anyone whose institution does not subscribe to the series will have to decide whether to buy the whole volume or to track down the articles via search engines. It took just a couple of minutes to find the first two papers I hunted for on ResearchGate, from where I could send reprint requests to the authors. I suspect that, with a little more effort, I could have tracked down most of the others too. That illustrates an unfortunate truth: the publishing model for volumes such as this has not kept pace with the realities of the 21st century. That is ironic, because a celebration of the career of a successful scientist is, in effect, recognition of someone who most definitely *had* kept pace with a changing world.

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**Syllabus of Plant Families. A. Engler's Syllabus der Pflanzenfamilien, 13th edition. Part 2/1: Photoautotrophic Eukaryotic Algae. Glaucocystophyta, Cryptophyta, Dinophyta/Dinozoa, Haptophyta, Heterokontophyta/Ochrophyta, Chlorarachniophyta/Cercozoa, Euglenophyta/Euglenozoa, Chlorophyta, Streptophyta p.p.** W. Frey (ed.). Stuttgart: Borntraeger Science Publishers. 2015. 324 pp., 67 figures. ISBN 978 3 443 01083 6. 89 € (hardback).  
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This is a multiauthor work edited by Wolfgang Frey. The authors of chapters are Wolfgang Hofbauer (Glaucocystophyta, Eustigmatophyceae); Hiroshi Kawai and Takeshi Nakayama (Introduction to Heterokontobionta p.p., Cryptophyta, Dinophyta, Haptophyta, and Heterokontophyta [except diatoms, Phaeophyceae and Eustigmatophyceae], Chlorarachniophyta, Euglenophyta); Eileen Cox (diatoms); Bruno de Reviers, Florence Rousseau and Thomas Silberfeld (Phaeophyceae); Jiří Neustupa (Chlorophyta, Streptophyta p.p. [except Ulvophyceae, Charophyceae], Trentepohliales); Frederik Leliaert, Juan Lopez-Bautista and Olivier de Clerck (Ulvophyceae, except Trentepohliales); Frederik Leliaert (Palmophyllales); and Irmgard Blindow and Michael Schudack (Charophyceae). The green algae (Chlorophyta + Streptophyta p.p.) account for 111 of the 301 pages of taxon accounts.

Part 2/1 in the revised 'Engler & Prantl Pflanzenfamilien' covers the groups traditionally referred to as 'algae'. Well, not quite all of them because, for some reason (page limits?), the red algae have been left to part 2/2, whereas the prokaryotic 'blue-green algae' have been put in part 1/1, together with a motley collection of eukaryotic groups traditionally classified as 'fungi'. These seem curious decisions. If the idea was to provide a coherent systematic account (which one might assume would be the intention in a 'syllabus of plant families'), why separate the oomycete fungi (in part 1) from their autotrophic cousins in the heterokont classes (part 2/1), or the

streptophyte green algae (part 2/1) from their ‘higher’ relatives (bryophytes and non-seed-bearing vascular plants, in part 3)? Again, why are the heterotrophic Dinophyta included but the heterotrophic Cercozoa omitted, leaving the Chlorarachniophyta as the only group of Cercozoa included? Alternatively, if the idea was to maintain an essentially physiological approach (i.e. to maintain the concept of ‘plantness’, which is of course still valuable ecologically and is inherent in the international codes of nomenclature that govern the naming of taxa, even though ‘plants’ and ‘algae’ are not monophyletic groups), why separate the free-living blue-green algae from their endosymbiotic relatives, the chloroplasts of eukaryotic autotrophs, and why include any exclusively heterotrophic groups?

But although I think that the organisation and coverage of the present volume could have been better and certainly needed better explanation, the truth is that there is no easy way to deal with the ‘algae’. Whereas the green land plants (bryophytes + tracheophytes) are a monophyletic group that can be classified hierarchically and the subgroups named according to the rules of a single international code (for ‘algae, fungi and plants’), the various kinds of green, blue-green, red, yellow and brown algae are in many cases less related to each other than to phagotrophic or osmotrophic organisms traditionally regarded as ‘animals’ (including ‘protozoa’) or ‘fungi’. Furthermore, although as noted in the Introduction (p. 1), “the last three decades provided revolutionary new insights into the diversity and phylogeny of organisms on earth”, there are still cases in which the affinities of major algal groups (phyla, classes) are uncertain. For example, the positions of the Cryptophyta and Haptophyta are not yet clear (as noted in this book on pp. 24 and 52, respectively), and relationships among the heterokontophyte classes are less well understood than is implied in the present volume in Fig. 7-2 (p. 63), which is based principally on a paper by Yang *et al.* (2012) but has been reproduced without the bootstrap and Bayesian support values. In fact, although there is evidence for three groupings within the heterokontophytes (the SI clade, comprising Raphidophyceae, Chrysomerothryxaceae, Aureanophyceae, Xanthophyceae, Schizocladophyceae, Phaeophyceae and Phaeothamniothryxaceae; the SII clade, comprising Eustigmatophyceae, Chrysophyceae [including Synurothryxaceae], Pinguicophyceae, Synchronophyceae and Picophyceae; and the SIII clade, comprising Pelagophyceae, Dictyochophyceae, Bacillariophyceae and Bolidophyceae), relationships within each clade are still unclear (see Yang *et al.*, 2012, fig. 1 and discussion). At lower levels too, knowledge is very patchy.

Of course, taxonomists almost always claim that their own group needs better study (otherwise their job is done!), but this really is true for the microalgae. So, when Frey writes (in the preface to the present volume, p. v) “the authors hope to have created an up-to-date overview of families and genera that will serve as reference for a long time”, we must hope that they will quickly be disappointed: the current state of ‘algal’ (and protist) classification is certainly better (i.e. based on and reflecting considerable advances in our knowledge of diversity and relationships) than it was even 20 years ago, but it is still woefully inadequate. Although taxonomists working on some

groups of metazoa or ‘higher’ plants are often within a whisker of having a complete catalogue of species and devote considerable effort to amassing impressive molecular and morphological datasets for revising generic and infrageneric classifications yet again, for many microalgal genera not even one gene sequence is available, let alone the data that might establish whether genera and families are monophyletic, and our knowledge of species-level diversity probably underestimates the true extent by an order of magnitude.

It is in fact this lack of understanding that convinces me that the present volume of the *Syllabus of Plant Families* is worthwhile, despite what I think are major inadequacies. It is important that the volume simply exists, not so much to catalogue what is known, but to remind people that there is a huge diversity of groups and species that are not green land plants and are often ignored in contemporary university education and research funding. Indeed, this volume of the *Syllabus* is probably most valuable as an illustration of what is *not* known, and the very impenetrability of the volume (see below) is in some ways perhaps a benefit, because it gives some idea of the complexities of dealing with the ‘algae’. These organisms are not easy. Whereas land plants all adhere to more or less the same life cycle rules (alternation of haploid and diploid generations), have similar cell structure (with two membranes around their chloroplasts, thylakoids stacked into grana, monotonously similar light-harvesting machinery, mitochondria with cristae, smooth flagella [where present] asymmetrically inserted, etc.) and cell division (via a phragmoplast), not to mention the ubiquitous cuticle, the ‘algae’ vary in every respect. Nothing can be assumed.

Besides demonstrating the variety and complexities of ‘algae’, the *Synopsis* lists genera and places them in a hierarchy, gives an indication of species numbers (I could not find an explanation of how these were obtained; it must have involved a lot of online searches), and provides an entry to the taxonomic literature on each group. These data are useful and are difficult to find elsewhere. The accounts of the brown algae are particularly helpful, because a list of ‘key references’ is given for each family. It is a pity that this excellent practice was not adopted for all the groups covered in the volume.

The principal difficulties of this book are navigation and the depth of understanding that one has to have before it becomes truly useful. Navigation is difficult because no overview is given of what we know, or think we know, about the phylogeny of eukaryotes. For this, readers will have to go elsewhere and learn about the ‘supergroups’ and the extent to which these are supported by various strands of molecular and cytological or morphological evidence; a useful beginning might be to read Burki’s (2014) summary – published more or less simultaneously with the completion of the text for the *Synopsis*. Without this, it is impossible to get a clear picture of how the organisms contained in the present volume relate to each other and, more importantly, to non-photosynthetic groups. Another approach might be to look at the provisional classifications of the protists by Adl *et al.* (2005, 2012).

The depth of understanding necessary to make sense of the *Synopsis* can be illustrated by taking a few examples. The Peridinales are one of the groups of

dinoflagellates in which the amphiesmal vesicles (!) contain plates of cellulose (so they are referred to as ‘armoured’). The number, arrangement and shape of these plates are important characters for family, genus and species distinctions, and some of the main characteristics of plate arrangement can be expressed as a formula – the ‘tabulation’. So, for example, the tabulation for the Peridiniaceae (p. 40) is (Po, X) 4', 3a, 7'', 5–6c, 5–6s, 5''', 2'''. I wonder what this can possibly mean to anyone who is not already well educated about dinoflagellates. There is no explanation in the *Synopsis*. The reader will have to use textbooks or online resources to learn about tabulation, perhaps the very readable explanation on the Tree of Life Web Project site (Hoppenrath & Saldarriaga, 2008). I wonder too how many botanical readers will know how to recognise a pseudoconoid and rhoptries (in perkinsids and Psammosa)? Will they understand cryptostomata or haplostichous, oligostichous and polystichous thallus construction in brown algae? One of the strengths of some earlier editions of the *Pflanzenfamilien* was the extensive introduction provided for major groups, which gave a basis for understanding the family and genus descriptions. An example, well illustrated and still of some value, is Georg Karsten's (1928) introduction to the diatoms, which contained an account of diatom biology and morphology running to over 90 pages. In contrast, in what is the most comprehensive and readable introduction to any group in the present volume, Eileen Cox's account of the diatoms is given 9 pages. The *Synopsis* has no glossary. There is no subject index.

The *Synopsis* is nicely printed and sturdily bound. Attractive and instructive colour plates are included for many of the groups covered. There are some editorial lapses and a surprising number of spelling errors, which I would have thought could have been eliminated rather easily by running the whole text through a spellchecker. The formatting of the text (in particular, use of small type for notes and indentation of paragraphs) is sometimes inconsistent and this can hinder easy reading. There is an index to taxa.

In summary: this is not a book that can be read and used on its own. It is valuable as a reminder to phycologists and non-phycologists alike that algal classification is messy and difficult, and it contains information on genera and families that is rarely brought together and must have been hard to assemble; the authors of the various chapters are experts in their field and the classifications that they have documented are a good statement of the current position. A huge amount of information is summarised in this small volume. However, no one (neither the publisher, nor the editor, nor the authors) seems to have thought sufficiently clearly about the intended readership and their needs. For most people, the taxon descriptions and overviews will become understandable only after extensive background reading. The *Handbook of Protists* (edited by Archibald *et al.*, due August 2017) may be a helpful adjunct, and a good algal textbook too (possibilities are van den Hoek *et al.*, 1995; Lee, 2008; and Graham *et al.*, 2009). If a further edition of the *Synopsis* is prepared, it must provide more comprehensive introductions to the groups covered, including explanations of the terms and concepts used. Furthermore, although I and many others prefer ‘real’ books to pdfs and online literature, the *Synopsis* is in many ways ideal material for the Web,

because hyperlinks would allow cross linking of terms to glossary entries, and searching and updating would be easy.

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**Nepal: an Introduction to the Natural History, Ecology and Human Environment of the Himalayas. A Companion to the *Flora of Nepal*.** G. Miehe, C. Pendry & R. Chaudhary (eds). Edinburgh: Royal Botanic Garden Edinburgh. 2015. 576 pp. ISBN 978 1 910877 02 9. £70 (hardback).

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The Himalayas are the greatest mountain range on Earth. This mountain system, which includes the world's highest peaks, including Mount Everest, is the largest