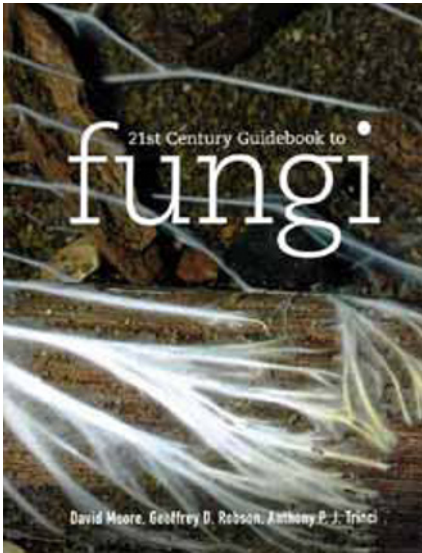


21st Century Guidebook to Fungi. By David Moore, Geoffrey D. Robson & Anthony P. J. Trinci. 2011. ISBN 978-1-107-00676-8 (hdbk), 978-0-521-18695-7 (pbk). Pp. xii + 627, illustr., CD. Cambridge University Press, Cambridge, UK. Price £ 80, US\$ 135 (hdbk), £ 40, US\$ 65 (pbk).



A modern mycological textbook for use in advanced university courses has been much needed, as there have already been so many advances in our understanding of their genetics, development, and relationships this century. This book grew out of courses the authors have taught at the University of Manchester for many years. It aims to capture the excitement, and present a new look, of fungi as they are now understood in a “systems biology” framework, emphasizing interactions with other organisms, adopting an integrated rather than a reductionist approach, utilizing modelling and bioinformatics when appropriate - and enhancing accessibility by an accompanying CD not just with the entire text, but also hyperlinks to both key websites and cited references.

The 18 chapters are organized into six parts: Nature and origin of fungi; Fungal cell biology; Fungal genetics and diversity; Biochemistry and developmental biology of fungi; Fungi as saprotrophs, symbionts and pathogens; and Fungal biotechnology and bioinformatics. All are well-illustrated by line drawings, half-tones, tables, and “resource boxes”, and are accompanied by a list of “references and further reading”. Coloured versions of the photographs are provided in two bound-in signatures and on the CD, though the quality of the printed ones is not optimal. Also, while there is a note to say in

the main text if an illustration is also in the coloured sections, no precise indication is provided which hinders their location.

While most points that might be expected to be in a modern text of fungi are there, the balance of coverage reflects the research interests of the authors, and also the types of courses where fungi might still constitute a unit in a UK university today. More attention is consequently accorded to developmental, physiological, and industrial aspects (including mass-culture and fermenter design), for example, rather than classification, biogeography, and community ecology. However, although the overview of the fungi and their classification only have 40 pages in the main body of the book, and much of that occupied by photographs, there is an Appendix which includes descriptions down to order with example genera indicated. On the ecological side, it is great on ecosystem processes, but has little on community ecology, and no section on biogeography. The coverage of uses of fungi is particularly extensive and informative, and also well-illustrated, but surprisingly there was no section devoted to biodeterioration and challenge-testing which are so important in manufacturing. Student appeal might be enhanced by some perhaps rather unexpected features, such as that on the origin of the universe and of Earth, detailed treatments of cheese manufacture and ripening, and headings like “Ten ways to make a mushroom”. A detailed discussion of a *Clitocybe nebularis* colony arising under paving slabs at David Moore’s home garden is novel approach to the teaching of fungal development and structure, but did it really merit 10 pages of colour plates?

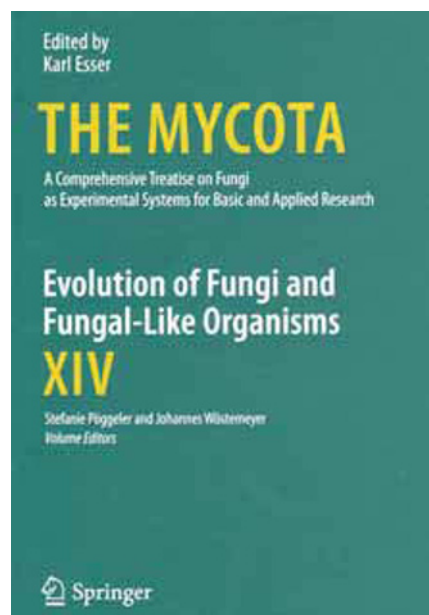
A major innovation and “plus” for this work is the CD. The imbedded hyperlinks are not just to an extraordinary number of websites, but to all cited original papers with DOI numbers. The CD uses Firefox and I was most impressed by the speed at which links were made. While not all papers will be open-access and available for free download, at least their abstracts can be found; and a click on a book title or chapter can take you directly to the publisher’s sales page. Those

fortunate to be located at institutions with electronic subscriptions to journals that are not open access, however, will quickly reach the full-texts. This ability to link students directly from a textbook to primary research papers is really exciting and sure to enthuse. It will also be a great short-cut for mycologists in general who have access to the CD. I can imagine the CD being carried around in many a student’s bag, not least as even the paperback version of the book weighs just over 1.9 kg.

I particularly liked the line drawings incorporating colour explaining ultrastructural and developmental features. The quality of the colour photographs on the CD is superb, but the versions in the volume would have benefitted from being printed to higher specifications. For the systematist there are inevitably some minor irritations, for instance the indication of *Pneumocystis carinii* and *P. jirovecii* as synonyms (p. 30) when they are actually distinct species, a *Coprinus* that did not get changed to *Coprinopsis* (Fig 11.2) through most were changed where appropriate, and use of the kingdom name *Chromista* over *Straminipila* on the grounds of priority of publication, a criterion that does not apply above the rank of family. However, such small points are more than compensated for by a second Appendix which provides a splendid account of the terminology of mycological structures from mycelia to sporophores, and including conidiogenesis patterns, and types of asci, basidia, hyphae, sporophores, and tissues.

No two groups of authors are ever likely to concur about just what should go into an advanced student text, and what the balance between the various topics should be. There can be no doubt, however, that this will be great as a main text for mycology courses at advanced degree and masters levels, and also a valuable sourcebook for up-to-date information on diverse aspects for the subject. The authors can be proud of this achievement, which has the potential to enthuse and inspire a new generation of experimental mycologists. I cannot commend it too highly, and am recommending on the postgraduate courses to which I contribute.

Evolution of Fungi and Fungal-like Organisms. Edited by Stefanie Pöggeler & Johannes Wöstemeyer. 2011. ISBN 978-3-642-19973-8. Pp. xix + 345, figs 60, col. 10. Heidelberg, Germany: Springer. [The Mycota Vol. XIV. Edited by Karl Esser.] Price £ 180, 199.95 €, US\$ 269.



There have been so many insights into the evolution of fungi since the two *Systematics and Evolution* books in *The Mycota* (Vol. VII A & B, McLaughlin DJ, McLaughlin EG, Lemke PA, eds, 2001), that a volume addressing this topic was a natural extension of the series. Essentially, this is a mixture of 12 in-depth topical and scholarly reviews on different aspects of an enormous topic arranged in four groups.

The first concern the 'Evolutionary roots of fungi', where there is a detailed and welcome discussion of the position of the *Fungi* within *Opisthokonta* (Carr & Baldaup) which they accept as including *Rozella* – which is now placed in phylum *Cryptomycota* (see *IMA Fungus* 2: 173–175, 2011). Opisthokonts other than *Fungi* are referred to as *Holozoa*, and as sister to *Fungi* and also outside *Holozoa* are a group of amoeboid protists which were unfamiliar to me (*Nucleariida*) and are yet to be included in multigene phylogenies along with microsporidians and other *Fungi*. The situation with *Microsporidia* is lucidly explained by Williams & Keeling, who consider that these mitochondrion-deficient organisms may have acquired an ADP/ATP transferase by horizontal gene transfer from bacteria which enables them to exploit ATP in animal hosts. The

impact of environmental DNA analyses on the concept of the fungal kingdom is discussed by Jones & Richards; they explain gene-library and 454 amplicon sequencing approaches and report in particular on their studies of sequences from marine and freshwater habitats and the discovery and visualization of *Cryptomycota*.

Three chapters are included under 'Evolution of signalling in fungi and fungal-like organisms'. The phrase 'fungal-like' is particularly appropriate as the first concerns dictyostelids, which are now placed in the amoebozoans as a sister group to the opisthokonts. *Dictyostelium discoideum* has been the subject of penetrating studies since Kenneth B. Raper started to investigate it in the 1940s and these still make the pages of *Nature* today. Schaap provides a review which also covers the relationships of social amoebae, and a diagrammatic phylogenetic tree showing the evolution of 20 morphological features which many working on true fungi will wish they could emulate for 'their' model taxa. Studies on *Saccharomyces cerevisiae* surely most closely approach those on *Dictyostelium*, and Pöggeler reviews the occurrence and functions of pheromones and pheromone receptors in both this yeast and diverse filamentous ascomycetes where pheromone genes have also been found in both homo- and heterothallic species. A particularly detailed and welcome review of mating types and sexuality types in basidiomycetes by Kües, James & Heitman follows, ranging from rusts and smuts to different orders of tremelloid fungi and agarics; the new term 'unipolar' is coined for homothallic reproduction involving a single mating type producing meiotic progeny.

The largest section concerns the 'Evolution of mutualistic systems and metabolism in fungi'. Schüßler & Walker, trace the origins of *Glomeromycota* from the earliest fossils > 460 Myr ago and discuss their role in the evolution of land plants as well as providing an overview of the taxonomy of the group. Schmitt addresses sporophore evolution in ascomycetes, including lichenized groups, and the

now well-established development of similar ascomata in diverse orders and classes – but not the currently contentious issue of whether the earliest filamentous ascomycetes were lichenized and subsequent loss of the ability to form lichens. The results of genomic analysis in *Dothideomycetes* are reviewed by Hane, Williams & Oliver now data on three representatives are available, all plant pathogens (*Leptosphaeria maculans*, *Mycosphaerella graminicola*, and *Phaeosphaeria nodorum*); the extent of the data is impressive, and includes mitochondrial DNA and evidence of horizontal transfer of pathogenicity genes. The last two contributions in this section concern the evolution of particular groups of genes or gene families. Those involved in 'secondary metabolism' are treated by Teichert & Nowrousian, principally polyketide synthase (*pkS*) genes, but also covered are peptides, alkaloids, terpenes and melanins – the latter being treated in more depth than I have noted elsewhere. Genes involved in carbonic anhydrase enzyme production in fungal-like as well as fungal organisms are reviewed by Elleuche; these encode five unrelated classes of enzymes, and plant-type β -carbonic anhydroses in filamentous ascomycetes is linked to gene duplication following separation from yeasts.

The final section, 'Evolutionary mechanisms and trends', has just two chapters. The first, by Whittle & Johannesson, returns to the evolution of mating-type loci and chromosomes, but this time in *Neurospora tetrasperma* – and so might have been placed in the second section of the book. In a similar way, the second, on the evolution of special metabolisms by Schimek, could have been placed in the third group with that covering *pkS* genes. It is, however, much more wide-ranging in the range of compounds covered and serves as a comprehensive introduction to this fascinating aspect of fungi.

I can appreciate that the editors had difficult choices to make in deciding what to include in a volume of this title. I was excited at the prospect of the title,

and found some of the contributions illuminating, but was left feeling frustrated by what was not there. Examples include: the overall fossil record (including a discussion of the enigmatic gigantic *Prototaxites* now increasingly featured in fungal texts), the nature of the first filamentous fungi on land, the evolution of ectomycorrhizas and expansion of forests, convergent evolution in basidiomes, co-

speciation with animals (including insects) and plants, biogeography and speciation through genetic drift, evolution in mitotic fungi, cryptic speciation, species concepts, etc. Perhaps some of these topics will be covered in future in the six additional volumes which Karl Esser indicates are to come in an addendum to the series Preface (p. xi)? Availability will remain a problem because of the cost, though an *e*-book

version can also be purchased. However, I really must concur with the sentiments expressed by Frank Odds (2004) when reviewing Volume XII that “Perhaps *The Mycota* could form the embryo for a new review journal in mycology?” Surely that would be the best way to make such scholarly reviews more widely available.

Odds F (2004) [Book review.] Medical mycology. *The Mycota*. XII. *Human Fungal Pathogens*. *Mycological Research* 108: 463–464.

Metagenomics: current innovations and future trends. Edited by Diana Marco. 2011. ISBN 978-1-904455-87-5. Pp. xii + 296, col. pl. 1. Caister Academic Press, Norfolk, UK. Price £ 159, US\$ 319.



Metagenomics, the comparison of entire communities from the genomes of the constituent organisms, is exciting cutting-edge research with respect to the exploration of phylogenetic and functional genetic diversity in particular ecological niches. The approach is very much technique-driven, as possibilities expand as instrumentation and protocols develop. So far, the majority of studies have focussed on bacterial groups and viruses, but the approach is increasingly being taken up by fungal ecologists fortunate to have access to the necessary equipment – and generating some

illuminating results, especially with respect to phylogenetic diversity.

In entering a new field or using a new technology, topical syntheses can be viewed as equivalent to a crash-course. This text has 15 chapters, only one developed to fungi (see below), with the rest centred on either techniques or bacterial groups or viruses in particular communities. The value of this text for mycologists is that it presents state-of-the-art information on the methods and their limitations, and has examples of actual applications in other groups that might be mirrored in future mycological investigations.

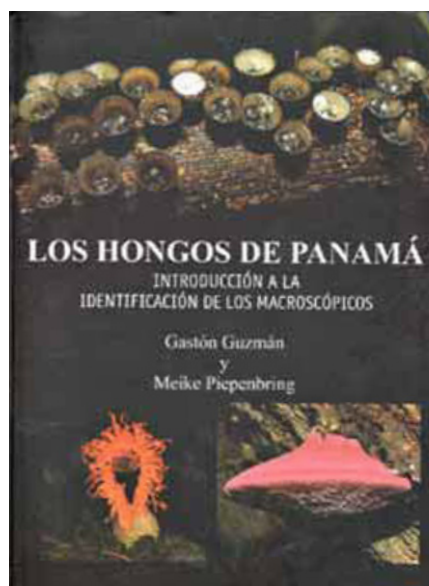
The chapter on current approaches (Meiring *et al.*, pp. 1–19) is especially informative, explaining the theory and practice of both sequence-driven and function-driven approaches and how they relate to the complementary metaproteomics and metabolomics. There is a separate chapter on next-generation sequencing and the use of 454 and other sophisticated machines (Walshaw *et al.*, pp. 63–88) which I found to be a most illuminating introduction to the protocols and procedure of this much talked-about methodology. That on microarrays (van Norstrand *et al.*, 265–288) was similarly most helpful, and includes a section on GeoChips (functional gene arrays) which were new to me. Other chapters cover topics such as bacterial genealogy, viruses,

the human microbiome, sequencing from uncultured single cells (using flow cytometry for their separation), bioremediation, host engineering and enzyme discovery, non-fungal plant pathogens.

The single fungal chapter concerns arbuscular mycorrhizal fungi, and has been prepared by Paola Bonfante’s group in Turin (Bianciotto *et al.*, pp. 161–178). This includes an overview of all studies using metagenomic approaches to date, from the pioneering work by Alastair Fitter’s group in 1998–99). The practical relevance is clear in view of the large numbers of species that would otherwise have remained unrecognized by reliance on non-molecular approaches. By the end of September 2009, there was a staggering 12 274 “uncultured” AM fungal genomes recognized for which there was no link to described morphospecies. The issue of overestimations due to artefacts arising from the fragmentation of genomes is flagged up here, and perhaps might have benefited from more discussion in some others as this is so critically important to estimates of actual organismal diversity derived.

In summary, if you are a mycologist contemplating adopting, or even already using, metagenomic and next-generation sequencing technologies, this work should be consulted when designing work programmes or interpreting the mass of generated data.

Los Hongos de Panamá: introducción a la identificación de los macroscópicos. By Gastón Guzmán & Meike Piepenbring. 2011. ISBN 978-607-7579-21-2. Pp. xiv + 372, figs 710 (most col.), tables 3. Xalapa, Mexico: Instituto de Ecología A.C. Price: Not indicated.



December 2010 was the centenary of the arrival of the first scientific expedition of the Smithsonian Institution to Panamá, and what better way to mark the event than by a splendidly illustrated work on fungi. Meike Piepenbring, who is based at the J. W. Goethe Universität in Frankfurt but also holds a position in the Universidad Autónoma de Chiriquí in Panamá, is well-known for her detailed and on-going investigations into the diversity of fungi of all kinds that occur in Panamá. Here she has joined forces with Gastón Guzmán, who has, and continues to, so energetically

promote mycology in the region.

It was pleasing to see a broad interpretation of macroscopic fungi adopted, encompassing not only larger basidiomycetes and discomycetes, but also a range of slime-moulds, pyrenomycetes, and lichens. In all, 226 species are treated in detail, with discussions of their microscopic as well as macroscopic features, differences from similar taxa, and references to pertinent literature; they are arranged alphabetically which facilitates their location. The colour photographs include some close-ups showing diagnostic features such as gill types, or slices through them to show the arrangement of perithecia in a stroma (that of *Hypoxylon haematostroma* on p. 136 is a striking example). According to the Abstract (p. ii), over 700 species are covered to some extent. There is a series of 13 keys to genera, and in some cases species, based on the gross morphology of the sporophores, an introduction including microscopic characters which is well-illustrated by clear line drawings, a glossary, taxonomic arrangement of taxa discussed, an appendix which includes further observations on 29 genera or groups of species (with especially informative discussions of several gasteroid groups), a taxonomic index which lists synonyms under treated species, and a main index

including entries by species epithet.

This lavishly illustrated book should do much to encourage both students and citizen scientists to take a deeper interest in fungi. While it is in Spanish, it is nevertheless easy to use by Anglophones with knowledge of a few key words and mycological terms. I just wish it had been available when I visited Barro Colorado Island in 1995, and was so fascinated by the array of *Xylaria* species sprouting from logs – 11 receive full treatment here, several of which I had not seen colour photographs of before. While the colour reproduction and quality of some of the photographs might have been better, and the taxonomy is in some cases conservative (e.g. the retention of *Coprinus* for *C. cinereus* and *C. stercoreus*), this production represents a tremendous achievement of which the authors can be justly proud.

The production of this book was made possible through the support of the Smithsonian Tropical Research Institute (STRI) in Panamá and eight other bodies. Only 500 copies have been printed, so if you work on, or are interested in, Central and South American fungi, it would be advisable to endeavour to secure a copy soon as it is sure to prove very popular in the region.

Champignons Comestibles des Forêts denses d'Afrique Centrale: taxonomie et identification. By Hugues E. Ndong, Jérôme Degreef & André De Kesel. 2011. ISSN 1784-1283 (hd copy), 1784-1291 (online PDF). Pp. viii+ 253, figs 151 (many col.), tables 1, backpocket. Brussels, Belgium: Royal Belgian Institute of Natural Sciences. [ABC Taxa Vol. 10.] Price: Free (developing countries), 15.45 € (other countries).



This work is one of series aimed at accelerating taxonomic capacity building in developing countries, and the first on fungi. The aim is to provide sufficiently detailed state of the art treatments to enable recipients to embark on the taxonomy of the group treated. Consequently, almost one third of the book is devoted to background information: current knowledge, ethnomycology, preparation for a collecting trip, field and laboratory requisites, collection, documentation, photography, description, microscopic preparations, measurements, preservation, and herbarium formation. In order to facilitate detailed descriptions there is a detailed account of anatomical and morphological features

illustrated by fine line drawings. A great deal of care has been taken to make sure a beginner would find all he or she needs to start to make contributions to the field, though a section on nomenclature could have been a useful addition. Inside the back cover, is a pocket including a sample recording card for descriptive information, where pertinent characters can be quickly circled to facilitate the rapid processing of specimens.

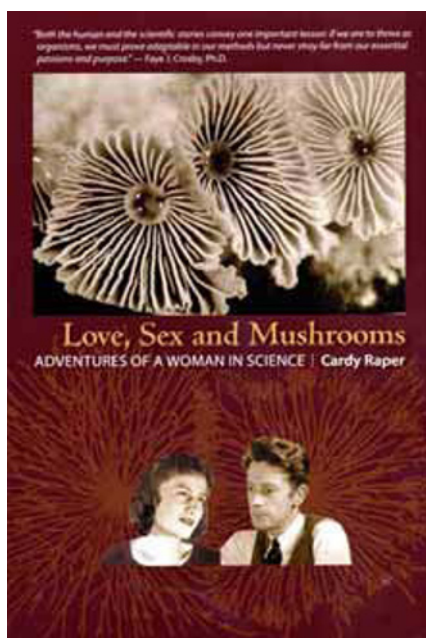
Accounts of 62 edible species follow, most with a text page facing a figure which includes well-executed coloured illustrations of intact sporophores and vertical sections, and also drawings of key microscopic features. In some cases photographs of fresh specimens

are also provided. The species are drawn from a wide range of genera, amongst which are *Amanita*, *Auricularia*, *Cantharellus*, *Cookeina*, *Lactarius*, *Marasmius*, *Polyporus*, *Russula*, *Schizophyllum*, and *Termitomyces*. The text has detailed macro- and microscopic descriptive data, information on ecology and distribution, and notes discussing the separation from similar taxa – but surprisingly not on preparation or taste. A comprehensive glossary is provided, and the reference list is extensive.

The authors, all who have experience of working in the region, have clearly put an immense amount of thought into the volume and it deserves to be widely distributed in central Africa. On the back cover, Bart Buyck states that the book should occupy prime position in the libraries of mycologists, particularly for the full introduction and practical approach; I totally concur with his sentiments. The concept of making this work freely available in developing countries can only

be applauded and was made possible by the foresight of the Belgian Development Cooperation. That is an aspect of capacity building which is too often overlooked in aid programmes. My one sadness is that the text is entirely in French, as an English translation would be so valuable for use in the non-Francophone countries in the region; it would be tremendous if additional funds to do that could be found.

Love, Sex and Mushrooms: adventures of a woman in science. By Cardy Raper. 2011. ISBN 978-0-615-43440-7. Pp. xii + 254, illustr. Burlington, VE: C. Raper. Price: US\$ 18.95.



This is a very personal, and in parts emotive, account of aspects of both the personal and professional life of Cardy Raper, the wife of the renowned fungal geneticist John R. Raper (1911–1974)¹ and well-known for his monograph on the genetics of

sexuality in macromycetes (Raper 1966). She recounts the trials she has experienced in establishing herself as a respected fungal geneticist in her own right, in an academic climate which often seemed to conspire against female scientists. She also documents the tedious and often frustrating attempts to obtain samples of hormones involved in the sexual behaviour of *Achlya*, and to obtain isolates of elusive mating types before their work changed its focus to *Schizophyllum commune* – a change in course largely due to graduate student Haig Papazian arriving from London. There are insights into her experiences as a faculty wife in the USA and as a mother, and into her personal life and relationship problems that she had to contend with. There are also, perhaps sometimes tongue-in-cheek, asides about other mycological luminaries she encountered or who influenced her, such as Karl Esser and Dirk Wessels. The actual science is not described in detail, however, though there are tantalizing tid-bits here and there; not being a fungal geneticist, I would have found citations and discussions

of actual papers illuminating (those by Cardy are, however, listed on her website, <http://cardyraper.com>).

Cardy comes over as a person determined to succeed and full of enthusiasm for her chosen area of science. This autobiography demonstrates that a scientific path can be long and hard, and that is something as true now as it was during Cardy's struggling years – especially when tenure is now so difficult to secure in many countries. The preliminary pages include comments from two distinguished fungal geneticists, Lorna Casselton and Peter Day. Lorna's ends with the phrase "This is the personal account of an exceptional scientist", and Peter's with the remark that she lived up to the slogan of a Harvard band, "*Illegitimum non carborundrum*: don't let the bastards grind you down". It could be seen either as a cautionary tale or as an inspiration to aspiring researchers, and of course will also be of interest to those wishing to know more of both John and Cardy's backgrounds.

¹Brother of Kenneth B. Raper (1908–1987).

Raper JR (1966) *Genetics of Sexuality in Higher Fungi*. New York: Ronald Press.