

photographs and line sketches. While not on the scale of Ulloa & Hanlin's (2006) dictionary in Spanish (reviewed in MYCOTAXON 102: 431-434, 2006), this little glossary is sure to be a boon to the new generation of Portuguese-speaking mycologists on both sides of the Atlantic.

Fidalgo O & Fidalgo MEPK (1967) DICCIONARIO MICOLOGICO. Rickia, suppl. 2: 1-252.

Ulloa M & Hanlin RT (2006) NUEVO DICCIONARIO ILLUSTRADO DE MICOLOGIA. American Phytopathological Society Press, St Paul, MN.

→ **Tesoros de nuestros montes: trufas de Andalucía.** By Baldomero Moreno Arroyo, Javier Fernández Gómez & Elena Pulido Calmaestra. 2005. Consejería de Medio Ambiente, Junta de Andalucía, Avenida Manuel Siurot 50, ES-41071 Sevilla, Spain (<http://www.juntadeandalucia.es/medioambiente/sitWeb/contactar/>). ISBN 84-96329-68-2. Price 24 €.

"Sumptuous" immediately came to mind when I first paged through this hefty book. Its large size (50 x 27 cm), high quality paper, the magnificent, full color illustrations gracing most of its pages, and even the endpapers that feature a beautiful enlargement of the patterned gleba of a *Tuber* species are consonant with its title, "TREASURES OF OUR MOUNTAINS: TRUFFLES OF ANDALUCÍA." It even has a fabric bookmark sewn into the binding, a feature not often seen in books published after the 19th century. The list price is amazingly low for books of this quality, which nowadays commonly sell for 100 US\$ or more. That said, let us consider the content.

The book is divided into six parts. After 14 pages of title, table of contents, acknowledgments, etc., Part 1 consists of about 90 pages of introduction with ten chapters: what truffles are; truffles in the world; the truffles of Andalucía; anatomy, composition and biological cycle; the union of the three kingdoms (plants, fungi and animals); the truffle in the Andalusian mediterranean woodlands; use and value of truffles, how truffles are hunted; truffle cultivation: harmony between nature and economics; and conservation of wild truffles. Part 2 of about 200 pages is the guide to the 81 species found to date in Andalucía, including an illustrated description of all species except *Zygomycota* and *Glomeromycota*, together with a listing of species with synonyms, and keys to the accepted species. Finally, Parts 3-6 are respectively a glossary of technical terms, a bibliography, a list of abbreviations used, and a species index.

Part 1: Introduction: about truffles

Chapter 1, "What are truffles," opens with a dramatic painting of lightning, tree roots, mycorrhizae and truffles to introduce truffles in history, including ancient speculations (myths) about their origin. A new one to me is that they come from the testicles of Adonis, buried and multiplied by The Furies. Indeed, one Spanish term for a truffle is "turma de tierra," literally a testicle of the earth (we'll return to "turma" later). The relationship of hypogeous to epigeous

fungi is briefly noted. Chapter 2 deals with truffles around the world, "truffles" here referring to all hypogeous fungi. The authors make the interesting point that most knowledge about truffles has been developed in the 30 % of Earth's land surface, that lying between 30° and 60° N. The well-known truffles of the southern African Kalahari Desert are not mentioned. Speciation endemic to various continents is briefly discussed. Chapter 3 introduces the truffles of Andalucía, noting the excellence of oaks as mycorrhizal hosts, and listing more than 40 species associated with oaks. These chapters are brief, intended to alert readers to these considerations but not deal with them in detail.

Chapter 4, on anatomy, composition, and the biological cycle of truffles, initiates the details of truffle anatomy. The text is sparse but more is not needed, because each anatomical structure important in taxonomy is splendidly illustrated by outstanding, crisp, color photographs. The peridial warts of *Tuber aestivum* are shown with commendable clarity. Spores, asci, and basidia are similarly excellent, with examples of both light and scanning electron micrographs. The chapter continues with a truncated discussion of nutritional components of selected species, and a well illustrated, readily understandable, explanation of the tree — mycorrhiza — primordium — truffle — mycophagist — tree cycle. This is followed by Chapter 5 on the "union of the three kingdoms": plant, fungus, and animal. Spore dispersal by animals, including insects and snails, is noted.

An overview of ecology and distribution of truffles in the mediterranean woodlands of Andalucía is presented in Chapter 6. Soils, vegetation, soil fauna, and their relationships to truffle occurrence are described and, no longer surprisingly, wonderfully illustrated by color photographs and paintings. Chapter 7 reviews the use and exploitation of truffles in medicine, gastronomy, and the emergent mycotourism engendered by the mystique of truffles and other edible fungi. Truffle hunting is reviewed in Chapter 8, from pigs and dogs to truffle flies, use of plant indicators, and probing the soil with a pointed stall to electronic truffle "sniffers." The authors do not believe that electronics will replace the amazing diligence and precision of dogs.

Chapter 9 is titled "the cultivation of the truffle: harmony between nature and economics." The discussion of truffle cultivation is general and not meant to replace the many detailed handbooks on the topic. The term "turmicultura," i.e. truffles of the semi-arid mediterranean matorral (shrublands) and forb/grasslands, is introduced to differentiate them from "Truficultura," referring to species associated with forest trees. As noted above, the term "turma" has a double meaning, so it does not translate readily into other languages. In this book, any truffle associated with mediterranean shrublands is termed a "turma." A turma named for a person, e.g. *Elaphomyces trappei*, is given the common name "turma de Trappe": I was uncertain whether to be pleased or

apprehensive, given how The Furies treated Adonis. In any event, the authors point out that mycorrhization with turmas can be incorporated into programs of using shrubs for erosion control to produce double benefits. A brief discussion of that concludes the chapter.

Moreno Arroyo has long been concerned about conservation and sustainability wild edible fungi. The book treats this topic in considerable detail, with emphasis on truffles. The chapter reflects the considerable thought he has given to the topic; it laid the foundation for the 1st world Conference on the Conservation and Sustainable Use of Wild Fungi in 2007 at Cordoba, which he organized with his colleagues under auspices of the Consejería de Medio Ambiente (Junta de Andalud 2007a). One product of the conference was the "Fungi of the Earth: Declaration of Cordoba" approved by participants (Consejería de Medio Ambiente, Junta de Andalud 2007b). The Chapter includes a four-page action plan, and the Declaration itself is reproduced in MYCOLOGICAL RESEARCH 112: 485-486 (2008). These documents deserve study by all concerned about the conservation and sustainable use of wild fungi.

Part 2: Guide to species

This part, comprising more than half of the book, begins with an outline of the classification (phylum, order, family, genus) of the 81 taxa described and illustrated in the ensuing pages. Unfortunately, herein lies the major weakness of this otherwise commendable book. The taxonomy and nomenclature are based on the 1995 edition of AINSWORTH & BISBY'S DICTIONARY OF THE FUNGI (Hawksworth et al. 1995). That edition was issued just as molecular tools were coming into widespread use in phylogenetic analysis, and even as it appeared it was becoming out of date, especially at the ranks of family and above. Consequently, the taxonomy used by Montero Arroyo and his colleagues is woefully dated back to the early days of fungal molecular phylogeny. In fairness to the authors, much of the new phylogenetic evidence (as presented in Spatafora et al. 2007) was published after the book went to press. Nonetheless, most of the changes for hypogeous fungi were published by 2003, which I guess would have been the last year in which corrections could have been made to the book's manuscript.

This problem does not affect keying out of the genera and species, except that they are organized by phylum, order, and family in the keys. Consequently, the key user bounces needlessly amongst obsolete names of orders and families to get to the name of the specimen in hand. The following tabulation presents updates - as of early 2009 - for those who want to annotate their copy. Genera that need their order and/or family assignments corrected are listed in the order presented on pp. 103-105 of the book (genera with correct order and family assignments are excluded from this tabulation). Currently accepted names of genera, orders, and families are in boldface in the tabulation, obsolete

names are in standard font in parentheses followed by an the corrected name in boldface. Names that are correct in the alone in boldface.

Glomeromycota (only the order is given in the book's outline of classification)

Glomus: (*Zygomycota*) → *Glomeromycota*; (*Glomales*) → *Glomerales*;
(*Glomaceae*) → *Glomeraceae*

Ascomycota (all *Pezizales*)

Balsamia: (*Balsamiaceae*) → *Helvellaceae*

Picoa: (*Otidea*) → *Pyronemataceae*

Choiromyces: (*Helvellaceae*) → *Tuberaceae*

Fischerula: (*Helvellaceae*) → *Morchellaceae*

Hydnotrya: (*Helvellaceae*) → *Discinaceae*

Genabea: (*Otidea*) → *Pyronemataceae*

Genea: (*Otidea*) → *Pyronemataceae*

Geopora: (*Otidea*) → *Pyronemataceae*

Hydnocystis: (*Otidea*) → *Pyronemataceae*

Labyrinthomyces: (*Otidea*) → *Tuberaceae*

Delastria: (*Terfeziaceae*) → *Pezizaceae*

Pachyphloeus: (*Terfeziaceae*) → *Pezizaceae*

Terfezia: (*Terfeziaceae*) → *Pezizaceae*

Basidiomycota

(Endoptychum) → *Chlorophyllum*; *Agaricales*; (*Secotiaceae*) → *Agaricaceae*

Gautieria: (*Gautieriales*) → *Gomphales*; *Gautieriaceae*

Gastrosporium: (*Hymenogastrales*) → *Phallales*;

(*Gastrosporiaceae*) → *Clathraceae* (?)

Chondrogaster: (*Hymenogastrales*) → *Hysterangiales*;

(*Hymenogastraceae*) → *Mesophelliaceae*

Descomyces: (*Hymenogastrales*) → *Agaricales*;

(*Hymenogastraceae*) → *Bolbitiaceae*

Hymenogaster: (*Hymenogastrales*) → *Agaricales*; *Hymenogastraceae*

(*Octavianina*) → *Octaviania*: (*Hymenogastrales*) → *Boletales*;

Octavianinaceae → *Boletaceae*

Sclerogaster: (*Hymenogastrales*) → *Geastrales*;

(*Octavianinaceae*) → *Sclerogastraceae*

Wakefieldia: (*Hymenogastrales*) → *Boletales* (?);

(*Octavianinaceae*) → *Boletaceae* (?)

Melanogaster: (*Melanogastrales*) → *Boletales*;

(*Melanogastraceae*) → *Paxillaceae*

Hysterangium: (*Phallales*) → *Hysterangiales*; *Hysterangiaceae*

Phallogaster: (*Phallales*) → *Hysterangiales*;

(*Hysterangiaceae*) → *Phallogastraceae*

Gymnomyces: *Russulales*; (*Elasmomycetaceae*) → *Russulaceae*

(*Zelleromyces*) → *Arcangeliiella*: (*Elasmomycetaceae*) → *Russulaceae*

After the outline of classification, come the descriptions of individual species. Each hypogeous (as opposed to "subhypogeous") species is illustrated by a superb color photo of sporocarps with surface and cross-sectional views, spores, representative plant associates, and a map of its known distribution in Andalusia. Macro- and microscopic characters are adequately described in the text. Habitat, fruiting season, and distribution are briefly discussed, followed by some general observations. Most species are given two full pages, one of which is the sporocarp photo. A line drawing of sporocarps is also presented; because the drawing adds little or no information to that provided by the color photograph, that space might have been better used for additional text.

Six "New" taxa are given four pages each, thereby allowing additional color photos of both macro- and micro characters. The introduction to the guide states that "For new taxa a Latin diagnosis is included as is required," and that is indeed done. Close inspection, however, reveals that none of these species are newly described in this book. All were validly published in journal articles between 1998 and 2002, so the Latin diagnoses in the book are superfluous.

"Subhypogeous" taxa are treated separately, and include substipitate sequestrates or partly submerged ascomycetes such as *Sarcosphaera* and several *Geopora* species. Each of these is allotted one page with a color photograph of sporocarps. The text material covers the same ground as for the hypogeous taxa.

For the most part, species identifications and nomenclature appear to be good, although I question a few. These problems are due more to a lack of adequate generic monographs and a need for molecular data than to any lack of diligence by the book's authors. *Choiromyces gangliformis* is actually an immature specimen of *C. meandriformis*, the latter name having priority. Molecular studies have shown few hypogeous species overlap between North America and Europe, even though some are morphologically similar. With that in mind, I question the identifications of *Genea compacta* and *G. thaxteri*, both first described from North America. *G. compacta* was originally described as brown and lacking peridial hairs, whereas the collection from Andalusia is blackish brown to black and has peridial hairs; it may actually be *G. pulchra*. *G. thaxteri* from Andalusia is dark brown to blackish and has slightly larger spores than the brown type from North America. The book's illustration of *Geopora cooperi* shows minute peridial warts, a feature lacking in specimens from North America where the species was originally described. These Andalusian collections need restudy. The book's *Rhizopogon roseolus* actually conforms to the quite different *R. vulgaris*, INDEX: FUNGORUM notwithstanding.

I noticed a few errors in author citations: "*Hysterangium clathroides* Vittad. var. *clathroides* Vidal" should drop "Vidal," as the varietal epithet is an antonym, i.e., the name of the type variety with is automatically fixed by the species name. Occasional other errors here and there are trivial.

A list of synonyms for each species follows the descriptions, and in turn is followed by the keys, which are easy enough to use. The nomenclatural confusion at order and family ranks as noted above does not interfere with the use of the key so long as they are ignored.

Parts 3 - 6

These parts consist of a glossary, bibliography, list of abbreviations, and index to species, respectively. All are useful, but literature citations from after 1999 are scarce, reflecting in part the lack of attention to molecular advances in our understanding of phylogeny of hypogeous fungi.

Conclusions

At its very reasonable price, this book is worthy for the beautiful illustrations alone. Beyond that, the introductory chapters overview the range of truffle phenomena: history, traditions, biology, ecology, uses, harvesting, cultivation, conservation and sustainability, and taxonomy. I am far from fluent in Spanish, but with a Spanish-English dictionary at hand I found the text easy to read. The authors are particularly thoughtful about conservation, sustainability, use of some species as mycorrhizal inoculum in erosion control programs, and the importance of public education in all these activities. Although the focus is on truffles of Andalusia, it well represents the hypogeous mycobiota of the mediterranean oak woodlands and semi-arid shrublands. Its primary flaw, the outdated nomenclature above the genus level, needs to be recognized, but does not impede use of the book for species identification. I hope the authors will be able to issue a revised and corrected edition in the not too distant future.

Consejería de Medio Ambiente, Junta de Andalucía (2007a) 1st WORLD CONFERENCE ON THE CONSERVATION AND SUSTAINABLE USE OF WILD FUNGI: TECHNICAL PRESENTATIONS AND POSTERS. Consejería de Medio Ambiente, Córdoba.

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