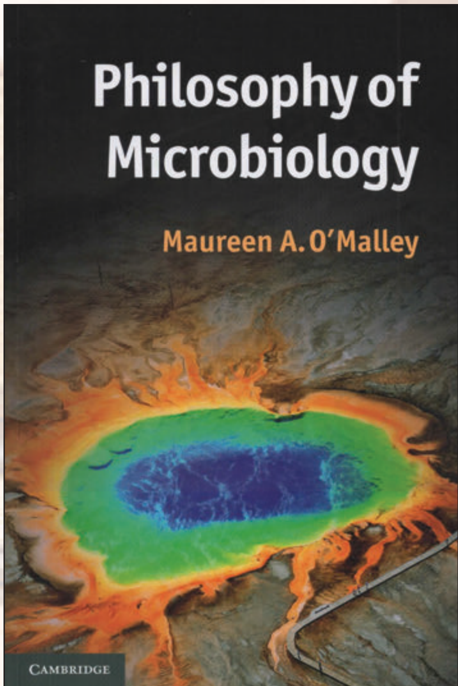
Bookshelf Fungi



Philosophy of Microbiology

Maureen A. O'Malley

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Probably the two college courses that I've enjoyed teaching the most have been Microbiology and Evolutionary Biology. Half the discussion during Microbiology lecture centers on evolution… evolution of single-celled organisms, of course, but multi-celled creatures too. Microbes are great models for the discussion of evolution. And it is for this reason that about half the discussion during Evolutionary Biology class is on the topic of microbes. *Philosophy of Microbiology* by Maureen A. O'Malley is like the part of the Venn Diagram where the two circles, one for Microbiology and one for Evolutionary Biology, overlap. Each chapter in this excellent and concisely written (well, most of it is concise, see brief quibbles below) book starts out with an important topic of Microbiology, provides a brief overview and historical perspective, and then follows with a discussion of the latest how's and why's, all of which would have resulted in the early microbiological pioneers' brilliant heads spinning!

Maureen A. O'Malley is a philosopher of biology and teaches at the University of Sydney. Her thesis is that the field of biological philosophy has pretty much ignored prokaryotes (single-celled organisms without membrane-bound organelles—the bacteria and archaea), perceiving them as being unsophisticated and not very advanced, evolutionarily. They cannot compete with much more sophisticated and elegant "higher" kingdoms of life. Microbes are dull, very small, their diversity poorly known, and they don't even reproduce sexually, thus they couldn't have a whole lot to excite genetically or otherwise, right? Wrong! All those old dogmas are now starting to go out the window as newer and more sophisticated tools for research come to the fore.

O'Malley centers her book on four main features of microbes, each poking a finger in the eye of dogma. First is microbial biomass and diversity. Most life on planet Earth is microbial. Most, as in sheer numbers as well as diversity. There is almost no place on Earth that you cannot go without finding microbes; your own body is more bacterial cells than your own cells—many times more, in fact. That we don't have descriptions and formal names for 99.9% of microbes on planet Earth is simply due to the fact that we currently cannot culture and see them on a Petri plate. Molecular methods are beginning to pull back the veil on these missing life forms. Another feature of microbes is their tendency to coexist in mutually beneficial relationships with pretty much all other organisms—single-celled and multicellular. O'Malley also deftly explores microbial influence on the major evolutionary transitions, as well as their ability to impact planetary processes.

Some of the author's best discussions involve topics that, at arm's length, seem the most fundamental and simplistic. *How do you define a microbe?* Biology 101 stuff, right? Not so fast. Turns out, today we know a lot more about microbes than was known a few centuries ago when the field got started. For example, a common criterion for microbial life forms is living as a single cell. Except that most microbes don't live solitarily. They usually live in large collectives or biofilms or colonies in their habitat. (They don't necessarily form true systems or tissues, as in multicellular organisms.) Then there's the problem of viruses and their ilk. Living, not living? (Depends on whom you ask.) And remember the archaea? I remember their "discovery" vividly, as that was when I was an undergrad. (OK, there were species of "archaeabacteria" as they were then known, from further back but those were pretty much all oddball extremophilic types known only from strange out-of-the-way places.) It was not all that long ago that the archaea were an ancient and not so significant group of bacteria… then we started to find more and more species. And discovered they weren't older than bacteria after all. Indeed, we now know they're much more like us (animals) than bacteria. In fact very recent research hints that it may have been an archaean cell that engulfed a proteobacterium, leading to the common ancestor of all eukaryotic cells. (The proteobacteria was/is/are the mitochondria of modern-day eukaryote cells.)

The argument over which kingdom (or should it be domains?) in which to place all the prokaryotes is not likely to be settled anytime soon. Fungi have long suffered from the same identity crisis as there are single- and multi-celled forms. As late as the 1980s some researchers have argued the kingdom Fungi was an artificial group. Advanced molecular tools have quelled those arguments … but led to the discovery of Cryptomycota and Microspora… and new discussions of just what a "fungus" is. Similarly, discoveries are coming to light almost daily about our own microbiota and microbiome (the bacterial world that lives on and within each of us) that calls into question just what it means to be a human.

What is a species? What is sexual reproduction? All the most basic concepts of Biology, right? When applied to bacteria, things are different. (All the while keep telling yourself, "this is not 'strange,' or an exception to any rule." Most life on the planet is microbial, thus the microbial way is more typical than we would suppose.) That bacteria do not sexually reproduce (and that is open for debate), does not mean they go without genetic diversity. Turns out DNA is coming and going (termed "lateral gene transfer" or LGT) from many (most? all?) the individuals in a community. And recent findings are showing that "eukaryotes are involved in LGT, in some capacities as well: plant-to-fungi, fungi-to-plant, and fungi-to-fungi transfers are all known to occur even if the mechanisms are not yet understood well."

I did have one quibble regarding O'Malley's overly simplistic discussion of sexual reproduction, its role in bringing about genetic diversity, and how bacteria obviate the need for sexual reproduction (vis–à–vis LGT and some other genetic tricks). The benefits of sexual reproduction in organisms are not solely of genetic diversity. Hamilton and Axelrod brilliantly showed that sexual reproduction is highly advantageous (and thus highly selected for) for ridding the next generation of cellular parasites (e.g. in animals, when the sperm cell fuses with the egg cell, all the cellular parasites and other "baggage" of the male is left behind, outside the egg). But that's a minor quibble. Another was the very lengthy discussion of magnetotaxis in the very first chapter. (Magnetotaxis is the capacity of some bacteria to use the earth's magnetic field to move away from regions with an excessively high concentration of oxygen. The philosophical question is then whether the magnetotaxis forms part of their perception of the world.) Another minor quibble. My biggest beef with *Philosophy of Microbiology*, and it's not a deal-breaker, was the lack of due given microbes to the current Era of Genomics we're now entering. Basic biology, taxonomic, medical, genetic, agricultural … so many disciplines of biological research have exploded in just the last few decades and it's all due to brand new tools for investigating and tinkering with the DNA of organisms. And just about all of this has come about because of the informational and physiological simplicity of microbes. This was hardly discussed. Barely a mention of PCR (and no mention at all of its colorfully famous inventor Kary Mullis).

These few minor shortcomings aside, *Philosophy of Microbiology* presents some fascinating—at times astounding—discussions of a world all around us. But a world that most of us never get to see.

-Britt A. Bunyard

An Illustrated Guide to the Coprophilous Ascomycetes of Australia

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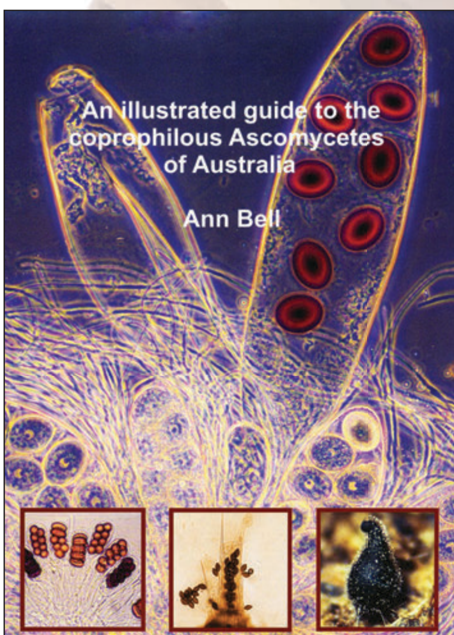
After his retirement in 1962 from his position with the Commonwealth Mycological Institute at Kew Gardens, Major Harry Dade moved to Australia and began a study of coprophilous (dung-inhabiting) fungi that was to last until his death in 1978. His research, which focused on the ascomycetes, produced a collection of over 2000 microscope slides and associated notebooks containing his observations, drawings, and comments. This collection was brought to the attention of Ann Bell, who had been studying the same sorts of fungi in New Zealand and she subsequently spent several years reviewing and studying Dade's materials. This book was written as a tribute to Dade and his work and incorporates many of his comments and illustrations (including his "Dungscape" painting, which follows the title page) alongside Bell's own observations.



Somewhat confusingly, the book is not divided into chapters—instead the sections run together, with all headings of the same style. It opens with a review of Dade's life, focusing heavily on his retirement years in Australia. A description of Bell's research methods follows, augmented with information on Dade's methods where appropriate. A picture key, using black and white drawings, allows the user to determine whether a particular fungus belongs to the discomycetes, plectomycetes, or pyrenomycetes, the three groups of fungi covered by the book. The discomycetes are introduced with a colored picture key to the genera, the plectomycetes by a key to the species, and the pyrenomycetes by a black and white picture key to the genera.

Each of these main groups is discussed in general and then the included genera are described and discussed. A key to species is provided for each multi-species genus and each species is illustrated with large clear line drawings, some colored. These figures are grouped together following the text. Some species also are illustrated with color microphotographs taken by Dan Mahoney, Bell's husband, and puzzlingly placed, along with the Dungscape, between the title page and table of contents. Text descriptions of the species are not provided. Because most of the dung ascos produce rather small fruitbodies, the keys emphasize microscopic characters. They are