

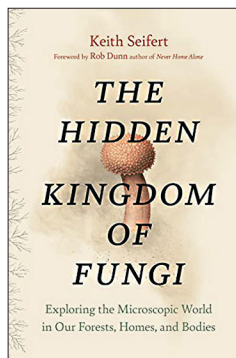
OTHER

The Hidden Kingdom of Fungi: Exploring the Microscopic World in our Forests, Homes, and Bodies

By Keith Seifert. 2022. Greystone Books. 280 pages, 34.95 CAD, Hardcover.

Most people think of fungi as toadstools or mushrooms seen in gardens or forests and perhaps the moulds growing in showers or bathtubs. Occasionally, someone will opt out of having mushrooms as a pizza topping, but little additional thought is given to these strange organisms. Personally, I've had a long-standing interest in fungi, spanning back to my childhood when I would

scour the countryside with my *Non-Flowering Plants* field guide (Shuttleworth and Zim 1967) in hand, trying to figure out the various mushrooms I encountered. Keith Seifert has written an impressive book to broaden our perception of fungi and foster a new level



of appreciation for them.

Seifert's *The Hidden Kingdom of Fungi* is divided into three major parts. Part 1, The Hidden Kingdom, includes two chapters, Life in the Colonies: Fungal Evolution and Life on the Commons: from Mutualism to Parasitism to Biological Invasion. Part 2, The Fungal Planet, has five chapters, Forests: Seeing the Fungi for the Trees; Farming: the Seventh-Olddest Profession; Fermentation: Food, Drink, and Compost; The Secret House: Fungi and the Built Environment; and Holobiont: the Mycobiome and the Human Body. Part 3, The Mycelial Revolution, has two final chapters, Mycotechnology: Fungi for the People and Thirty Thousand Feet: Fungi and the Sustainable Planet. Also included is a foreword by Rob Dunn (a writer and biologist whose work has included studying fungi and bacteria in houses), a note about names, an introduction, acknowledgements, an appendix of fungal classification including the kingdoms of

Mycota and fungal-like Stramenopiles, notes, literature cited, and an index.

The book communicates well that fungi are everywhere—we breathe in fungal spores constantly, our bodies are breeding grounds for yeasts, and the global environment supports a vast microbiome where fungi play a critical role. Some of my favourite chapters were in Part 2. Fungi play a daily role in our lives, from farming to fermentation. In Chapter 5, the author states that generally towns and cities originated with the invention of agriculture, which provided a steady source of food. However, an alternative point of view is that cities arose to guarantee a reliable source of alcohol. Humans stumbled on the fermentation process—likely from eating fermented fruit on shrubs and trees—and wanted to mass-produce it. In fact, alcohol production using Brewer’s Yeast (*Saccharomyces cerevisiae*) appears to have occurred before using this same yeast species to bake bread. The use of fungi in food production is everywhere, from cheese and soy sauce to chocolate, tea, and coffee.

Chapter 6, The Secret House, was an eye-opener. Our houses harbour more species of fungi than once assumed. Fungal spores float in the air, make up most of the dust on our furniture, collect in the carpet, and slowly decompose the two-by-fours in our walls. Moist environments, like kitchens, bathrooms, basements, and crawl spaces, support hundreds of fungal species. Living in homes with high concentrations of fungal spores may lead to a variety of health issues, including allergies and asthma. The author tested a central vacuum system sample from his house and discovered that the sample contained over 600 fungal species! Most of the species arrived indoors from the yard, but others originated from spoiling food, soil fungi tracked in on shoes, and the expected dust fungi. The presence of conifer endophytes was a puzzle until the author recalled the annual festivities involving a Christmas tree.

Humans are in constant contact with fungi; our bodies may be home to more fungal species than we will ever realize. We are essentially walking ecosystems. Some of the more commonly known signs of fungi living on our bodies include dandruff (caused by a yeast-like fungus called *Malassezia*), and athlete’s foot, jock itch, and ringworm, which can all be caused by up to 40 different types of fungal species, but most often by just one, *Trichophyton rubrum*. We buy creams and other medications to treat these fungal ailments only to have the irritations return. Humans and fungi are closely related, so typically what is toxic to fungi is also toxic to us. Hence, most fungal infections return after a couple weeks post-treatment because not all the fungal cells are eradicated, which allows them to grow and spread again.

Fungi, however, have proven to be incredibly helpful. One of the best examples of scientific serendipity involved Alexander Fleming and his breakthrough while studying enzymes and bacterial infections in his laboratory (see Fleming 1929). After returning from a family holiday, he examined an old culture of the pathogenic skin bacterium *Staphylococcus aureus* that had been accidentally contaminated with a green mould colony. He noticed that the interface between the mould and the cream-coloured bacterium was now clear agar on the gel plate. The clear (rather than green) agar meant that something was killing the bacterium. Fleming named the bacterium-killing substance penicillin. Since then, various fungal species have been used to treat bacterial infections, launching the age of antibiotics.

With the good comes the bad, unfortunately. Since 1980, about 100 species of frogs, toads, and salamanders have gone extinct, largely due to chytridiomycosis, an infectious disease caused by the fungus *Batrachochytrium dendrobatidis*, or Bd. The disease is about 90% fatal and may lead to an “amphibian apocalypse” (p. 207). In addition to Bd, another fungal species, *Batrachochytrium salamandrivorans*, or Bsal, was found in Europe infecting European Fire Salamander (*Salamandra salamandra*). Apparently, the disease originated in southeastern Asia. It has not yet spread to North America, where 40% of the world’s salamander species occur. Our understanding of Bd and Bsal has only just begun, and hopefully we can curb the spread of these deadly fungal diseases and an eventual “apocalypse”.

In the last chapter, the author provides a summary (p. 218) worth repeating as we bear witness to the extraordinary biodiversity fungi provide:

Reconsidering our attitude towards fungi is an important part of modifying our actions. I hope more people will become curious about our microscopic neighbors—or at least less suspicious or fearful of them. Fungi are among our closest relatives, and we are already deeply embedded with them. We should work with them a lot more than we do now. The future is fungal. It is also bacterial, algal, protistan, viral, buggy, wormy—full of all sorts of creatures, the big and beautiful, the small and ugly. Most of the life forms around us were here long before we arrived and will remain long after we are gone. Let’s learn what we can from them and hope for a long, rich journey together.

With the author’s hopeful words, I recommend *The Hidden Kingdom of Fungi* as an inspiring vehicle of exploration and intrigue. Understanding that we

share this planet with millions of incredibly fascinating life forms is the first step in becoming thoughtful stewards of the planet.

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