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Joela Jacobs and Agnes Malinowska (eds). *Microbium: The Neglected Lives of Micro-Matter*

Brooklyn, NY: Punctum Books, 2023.
ISBN 9781685711702, 148pp.
https://doi.org/10.53288/0396.1.00 Open Access e-book.

This collection of essays deals with microscopic living things in a way that stresses the metaphors that swirl around them. The idea was first explored as a panel at a literature conference and then crafted over several years as the authors honed their work to create a cohesive whole. This is what sets this volume apart from many collections and makes it particularly appealing. The eight chapters deal with small life in categories, some of which are unlikely to be found today in a purely scientific work. The first is called 'Animalcules', a word coined by Antoine van Leeuwenhoek in the late seventeenth century to describe the tiny but complex structures he observed with his microscope. Ada Smailbegović interprets the term to mean what we now call protists, one-celled nucleated organisms that are themselves the result of ancient bacteria that fused to form these sophisticated cells. This is one example of many in the book stressing the theme of life forms living within or around each other and having close interrelationships. The idea of individual life is questioned again and again.

A biologist might not have included a chapter on corals in *Microbium*, because they can grow so large, but they do spend the early portions of

PLANT PERSPECTIVES - 2025: 258–261
DOI:10.3197/WHPPP.63876246815896

their lives as one-celled organisms. A pollen grain is small though it's not really an organism – rather it's the part of a flowering plant containing male sex cells. And protozoa are, as the author Dani Lamorte admits in her chapter on them, 'linguistic organisms' because it's a term now known to be a catchall including microorganisms belonging to a variety of different groups. It's a good example of a word that persists in the cultural imagination after its use scientifically has all but disappeared. These three fit into this volume because they're all physically small and have powerful impacts on our culture in many ways, from pollen's sexual connotations to the protozoan amoeba as a symbol of formless life that can devour other forms, to coral's role in creating almost mystical underwater realms.

Not surprisingly, because of the book's strong ties to literature, each chapter explores metaphors. Dani Lamorte is the lone artist included and she deals in visual metaphors. She writes about protozoa and in particular amoeba, one-celled organisms that many of us were introduced to in high school biology lab. They are perfect for such a purpose because their shape changing is visually intriguing and definitely fits into the old view of protozoa as tiny animals. An amoeba can engulf a smaller cell, turning the experience into a tale of predation. Lamorte uses Lynda Benglis's works in poured latex to explore the idea of formlessness as something uncontrollable and therefore threatening.

Comparison is fundamental to human thought. We learn by comparing the known with the unknown. This is especially evident in exploring an unseen world that was only found with the aid of lenses, and so is relatively new to human experience. Novelty drove discoverers like van Leeuwenhoek to explain these clearly living, moving things as small animals, or in the case of Robert Hooke as cells, small rooms. But this was only the beginning of the use of comparisons to describe and make sense of microorganisms, to view them in relation to what humans could see and also to explain their behaviours in human terms. Bacteria and viruses invade bodies and some even 'eat away' at tissue. The microscopic hyphae or threads of fungi can infiltrate wood and destroy it.

All these and other comparisons are explored in *Microbium* in a way that's appealing to those whose interests are far from the literary. Many works of prose and poetry are cited, in some essays more than others, but never to the point of losing the central message that understanding how we think about microbes will help us to question how we interact with other life forms and to consider what it is to be human. This is

evident in Damien Bright's chapter on corals. After their free-living early life, they attach permanently to a surface and grow to create multicellular and often massive structures in aquatic environments attracting many other organisms. Coral reefs are wonderful examples of the interplay among life forms, with many symbiotic relationships involved from the beneficial and mutualistic to the parasitic. If the environment changes, as with today's warming climate, benign interactions can turn destructive, something also obvious in human terms.

Another case of intimate associations is described in Helga Braunbeck's contribution on lichen, a form of life that is intrinsically relational. Microscopic algae or bacteria that photosynthesise – sometimes both – live within fungi and provide energy from the sun. This allows fungi to grow in environments that have little nutritional value, like tree bark or rock, rather dry habitats ordinarily inconducive to their symbionts. Lichen, though they grow slowly in size to become visible to the naked eye and seem inert, can have a powerful effect on rock structures. Acids washed out of them by rain slowly erodes rock so they are a force in geologic change. This brings up topics that arise several times in *Microbium*: space and time.

Microbes experience space very differently from larger organisms. As humans, we measure scale in terms of our own size, and usually little appreciate how differently a mouse, for example, encounters the world. More different still is it for a lichen in a very small and confined realm. To appreciate these other forms of life, we have to disorient ourselves and think in new ways about time and space. While lichen grow much more slowly than we do, they may be the longest living of life forms, some apparently being over 4,000 years old. Bacteria, though unseen, make up more of the mass of living things than any other form of life.

Even though these facts have been known for some time, they seemingly have failed to make a significant dent in our collective consciousness, which still considers humans as the earth's rulers and controllers. The authors of *Microbium* are attempting to destabilise those assumptions, a very tall order, but a necessary one if we are to find a way to continue inhabiting an earth increasingly assaulted in so many ways. This is the message at the heart of the book and is approached in a variety of ingenious ways that contribute to keeping the reader engaged. By the end we are left with the unsettling feeling that we have ignored a large part of the living world around us, that we suffer not just from a

lack of awareness of plants, a topic now familiar to many of us, but also lack of awareness of the very small.

The message is not just that microbes are unsung heroes building huge underwater structures, crushing rocks, and influencing environments, but that their negative effects have shaped how we think and act. The last chapter is on viruses. Written by Raymond Malewitz, it fittingly focuses on Covid-19 and some literary works that grew out of the pandemic. The conference that spawned *Microbium* was held in 2018, so its inception predates the pandemic and its sequelae. But it could not help but influence the authors who were painfully aware of the massive effects that can be produced by the absolute smallest form of life, one on the edge of non-life. Malewitz describes how viruses entered our cultural imagination long before Covid with such ideas as a computer virus. This is very much related to the medical concept we are now so familiar with of viral load, the amount of virus that needs to be present to produce symptoms of an infection.

Microbium is fascinating and readable with enough science content to make the arguments understandable. As a biologist, I've long appreciated the power of microbes, but now I have a greater admiration for the power of metaphors that have arisen from that world and have been used to describe and make sense of it. I now see how our ideas about microscopic life influence how we think about the larger culture. The book's major message is that we cannot ignore this unseen world if we are to change the world we inhabit for the better. I would highly recommend it even for high school and college students so they become more aware, early in their lives, that they live with a host of organisms that are unseen but significant creators of their world.

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