



BIOLOGY

I CONTAIN MULTITUDES: The Microbes within Us and a Grand View of Life by Ed Yong. New York: HarperCollins, 2016. 368 pages. Hardcover; \$27.99. ISBN: 9780062368591.

In 1675, Antonie van Leeuwenhoek looked through a two-millimeter-thick sphere of glass at a puddle of rainwater. What he saw, he called “animalcules,” and he became the first person ever to see them. Today, we know these “animalcules” as microbes. In his book, *I Contain Multitudes*, science writer Ed Yong chronicles the history-to-date of microbiology by telling the stories of people just like van Leeuwenhoek, “the people who thought to look.”

Ironically (or perhaps not), van Leeuwenhoek is also the man who documented the first account of antiseptics by adding wine vinegar to one of his collections and noting that the animalcules fell dead. But before antibiotics came many other notable discoveries—and discoverers—in microbiology. Yong takes his readers on a time hop, paying visits to some of the key players in our understanding of the microbial world. And they are not always human.

The first one is, though, and he is the reason I picked up this book. Rob Knight, a pioneer in the field of microbiome research, is mentioned on page 2. Knight is the director of the UC San Diego Center for Microbiome Innovation (I have recently joined his team as their Communication Officer). Although I have an advanced degree in microbiology, I needed a bit of a refresher. This book provided just that. Yong uses historical anecdotes and imaginative descriptions to introduce his readers to extraordinary examples of just how ubiquitous microbes are.

In 1941, for example, we meet “the squiggly worm,” as it is known to the Navy. *Hydroides elegans* is a worm that builds its tubular house on the hulls of ships, and relies on bacterial cues to tell it where to settle. In 2005, we meet a group of corals in the northern waters of the Line Islands that rely on the algae that live inside their cells for nutrients. *Wolbachia*, a microbe that was first discovered in 1924, is one player that makes multiple guest appearances.

According to Yong (and, it would seem, science), microbes make us who we are. He cites examples of microbes that influence the development of guts and bones, blood vessels, the immune system, and the brain. Could it be that God, in his creativity, uses microbes as tools—colored pencils if you will—in the making of each of his children, his masterpieces?

As we know, though, microbes are not always good. In fact, Yong notes that the predominant view of microbes is as disease-causing agents. The rabies virus infects the nervous system and makes its carriers violent and aggressive, and the brain parasite *Toxoplasma gondii* is another puppetmaster. It can sexually reproduce only in a cat; if it gets into a rat, it suppresses the rodent’s natural fear of cat odors and replaces it with something like sexual attraction. The rat scurries toward nearby cats, with fatal results. Could these be effects of the Fall? These questions provide food-for-thought for Christians who are interested in the study of origins as well as in the history and advancement of science. In these types, this book finds an ideal audience.

Indeed, each example of cooperation Yong cites is tinged with conflict, manipulation, and deceit, even outside the microbial world. Take the relationship between acacia trees and ants. The trees rely on the ants to defend them from weeds, pests, and grazers. In return, they give their bodyguards sugary snacks to eat and hollow thorns to live in. It looks like an equitable relationship, until you realize that the tree laces its food with an enzyme that stops the ants from digesting other sources of sugar. The ants are indentured servants, Yong says.

Whether creatures know it or not, we are all constantly managing the relationships with our microbes. Yong highlights examples including the frontal part of the mammalian gut, which contains a layer of epithelial cells that spray the lining with antimicrobial peptides so that microbes cannot settle there. If any microbes successfully evade the antimicrobial bullets and cross the epithelium, there is a host of immune cells on the other side lying to swallow them. The cells are not just sitting in wait, Yong says. Some of them reach through the epithelium to check for microbes on the other side.

Have you heard of HMOs? Human milk oligosaccharides. They are the third-biggest part of a human mother’s milk, but babies cannot digest them. The sugars pass through the stomach and small intestine undigested, and land in the large intestine where most of the gut bacteria live. What if HMOs are not food for the baby at all? What if the mother is feeding her child’s microbes?

Yong suggests that we adopt a more holistic view of biological life, one that redefines what it means to be an individual and emphasizes the indivisibility of microbes from animal life. (While the book calls this notion into question, it leaves little room for readers to question Darwin’s theory of evolution.)

Do you like sushi—the kind wrapped in seaweed? Did you know that the reason you can eat it is because your gut microbes acquired a gene (through horizontal gene transfer, or HGT) from marine microbes that were already good at digesting seaweed?

Scientists have discovered that genes also move from microbes into their host animal's genome, although Yong points out that their mere presence does not necessarily make them important: "Just because someone has a guitar in their room doesn't make them Slash."

That is not always the case though. Some animals, such as scorpions, mites, sea anemones, oysters, and water fleas, have used horizontally transferred genes to defend themselves against parasites.

Scientists are now building their own microbial minions, Yong says, citing examples of bacteria engineered to eliminate cancer cells or to go after pathogens. But, in the end, it would seem that God's design is superior:

With all our intelligence and technology, [we] positively struggle to create new antibiotics ... but simple animals like ticks and sea anemones can make their own, instantly achieving what we need many rounds of research and development to do. (p. 200)

The book starts and ends with the same dizzying shift in perspective, reminding readers of the reach of science, from the first looking glass to microbial minions. For Christians, this book reminds us of God's infinite character—infinite large, infinitely small, and infinitely creative.

In summary, Yong uses historical anecdotes and imaginative descriptions to introduce readers to key players in our understanding of the microbial world. From the squiggly worm to corals, Yong chronicles example after fascinating example of the ubiquitous presence of microbes and the roles they play in sustaining life, or in taking it. This book finds an ideal audience in the layperson who is fascinated by science and nature, and in Christians who want to see for themselves evidence of God's design, right down to his signature in a cell.

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ENVIRONMENT

MAKING THE MOST OF THE ANTHROPOCENE: Facing the Future by Mark Denny. Baltimore, MD: Johns Hopkins University Press, 2017. 224 pages. Hardcover; \$24.95. ISBN: 9781421423005.

The idea of the Anthropocene is, I have to admit, a disturbing one. Modern humans have changed the planet to such an extent that future scientists will see human influence everywhere they look, even in the remotest places: in the geologic record (due to nuclear tests), in the fossil record (due to rampant relocation of species), in ice cores (due to climate change), and in sediments (due to pollution by chemicals, nutrients, plastics, etc.). Given that human fingerprints are now all over everything, how then should we live? This, asked in the collective sense, is the driving question behind Mark Denny's *Making the Most of the Anthropocene*.

Of course, to chart a course for the future, either personal or collective, we would need some predictions about the challenges we will be facing, so that we can be prepared to meet them when they arrive. But how predictable is the future, really? Denny's book digs into this problem with, as he claims, "shtick," although if I had to pick a Yiddish term to describe his approach, I would have chosen "chutzpah." Taking a realpolitik approach to human nature, Denny argues that humanity will not be able to mount an adequate defense against, for example, climate change, due to our collective willingness to cheat when it comes to protecting the common good, and to follow narrow paths of self-interest rather than cooperate. Certainly the past 25 years of US history, with its glaring lack of action to address climate change, not to mention millennia of Jewish and Christian teachings on the fallenness of human nature, suggest that he is correct. Denny lumps these human failings under the term "collective stupidity," while you or I might use "original sin" to describe the same tendencies.

Is this another example of an elite member of the intelligentsia looking down on Joe Average? The "shtick" of this book is that Denny spins his dark tale with disarming humor and cleverness, without a shred of anger or bitterness. In this day and age, Denny's humane tone makes reading his book feel good for the soul, like a day at the spa—in spite of where he is taking you. It is a bit like enjoying an entertaining, Byzantine bus tour of a city and realizing part way through that you are being kidnapped. In reality, Denny is using all of his powers of persuasion—charm, logic, data, experience—to make his readers think differently, perhaps more realistically, about the future.

Climate activists sometimes say that only hope will motivate us to take action. Denial on the one hand, or gloom-and-doom on the other, are immobilizing. But Denny is trying to offer reality, not motivation, a little like the jaded author of the biblical book of Ecclesiastes. Each chapter is a shock to the system