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Book Review

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I Contain Multitudes: The Microbes within Us and a Grander View of Life. By Ed Yong. HarperCollins Publishers, New York, New York. 2016. 357 pp. ISBN-13: 978-0062368591, ISBN-10: 0062368591. US $18.15.

Brooke Watson

The microbiome is having a moment. Since the germ theory of disease took prominence in the mid-1800s, microbes have oft been cast as one-track ruthless killers, the reputation of innumerable species tarnished by a tiny fraction of human pathogens. A growing understanding of microbiology has allowed more complexity into this narrative, even outside of scientific circles. Common knowledge of microbial roles has expanded to incorporate harmless, mutualistic, and even actively protective roles, as researchers dating back to van Leeuwenhoek have long maintained. In some cases, this public recasting has overcorrected, casting microbial probiotic supplements as the secret to weight loss, the cure for cancer, and all but the elixir of life.

Of course, neither the role of the killer nor that of the savior fit. No single role could describe a community of more than trillions, or even a single species in different settings. "Simple narratives, though satisfying, are often wrong," writes Ed Yong in *I Contain Multitudes: The Microbes within Us and a Grander View of Life*. This work dives into the diverse and complex world of microbiome research at the perfect time, injecting both a strain of measured scientific caution and an exploration of other animal species into an oversimplified and anthropocentric microbiome narrative.

Thankfully, Yong spends little time hyping or disparaging prebiotics, probiotics, or antibiotics. He spends little time focusing on human medicine at all. Instead, he jumps from bobtail squids to termite guts, teasing out the distinctions, systems, and relationships between bacteria, viruses, fungi, and parasites that have shaped a small fraction of animal biology.

The 10-chapter book traces the history of microbiology through the eyes of the scientists driving it forward. Each chapter identifies a theme—how microbes digest food, guide immune systems, infiltrate genomes, or speed horizontal gene transfer—and explores it with a diverse suite of examples, predominantly from the animal kingdom. Throughout, the narrative glides from description of biotic processes to evolutionary theory to historical debates that segmented the field. The scientific process may be the work's main protagonist, and the biologists, virologists, ecologists, doctors, veterinarians, and bioinformaticians who employ it are celebrated.

Each deep dive into a species or relationship begins with a specific research group exploring it. Yong questions researchers in their labs or in the field, and facts are backed by peer-reviewed citations. Often, the fact-checking process involves new interviews with scientists with competing theories, and Yong frequently ventures into the weeds of niche academic debates on "holobionts" or genetic modification of mosquitos. With each depiction, Yong manages to capture both the childlike fascination and the measured scien-

tific caution that grip most scientists when talking about their work.

Make no mistake, this book is written for lay audiences. Readers wanting just the facts might be frustrated by the first-person pronouns and occasionally lyrical rhetoric, and those bored by anecdote may grow distracted after myriad descriptions of a wide variety of relationships and phenomena. An all-encompassing work on microbial life would be a tall order, and Yong makes no attempt at a comprehensive theory of these many disparate kingdoms and domains. For gripping scientific storytelling without too much hype, however, *I Contain Multitudes* is as strong as any book published in 2016. Within the narrative, Yong's overarching themes of complexity, systems thinking, and ecology may spark a lightbulb in many an academician's work.

Those working in wildlife diseases, unsurprisingly, are often the first health practitioners to embrace an ecosystem perspective. Veterinarians have in large part led the One Health movement, recognizing and respecting the indelible links between human, animal, and environmental health. Theoretical and applied work in wildlife diseases builds upon the understanding that disturbed ecosystems, whether inside or outside of the body, promote disease transmission and spread.

"Our planet has entered the Anthropocene—a new geological epoch when humanity's influence is causing global climate change, the loss of wild spaces, and a drastic decline in the richness of life," writes Yong. Stratigraphic debates aside, it is clear that humans can no longer choose whether to interfere with nature or not. We can interact to conserve wild spaces and species, or we can let urban expansion and development consume them, but in this age of globalization, not choosing is a deliberate choice. From a systems perspective, it's not hard to see that disturbances in the biomes and microbiomes of wildlife will ripple through to humans, for better or worse.

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