

genuinely pushing the envelope. Yet while he has given plenty of reason to be sceptical, Al-Khalili then lists recent developments that show that plausible models of quantum gravity continue to come forward, for example, Witten's M-Theory or Maldacena's gauge/gravity duality. Further, physics continues to make substantial technological contributions to daily life. This leads naturally into chapter 9 ("The Usefulness of Physics"). Particular attention is paid to the future possibilities of quantum computing for physics, medicine, AI, and a whole host of other multi-disciplinary simulations and processes that quantum superpositions would allow (for superpositions enable a greater degree of complexity in contrast to binary).

Al-Khalili concludes with a final chapter ("Thinking like a Physicist") about how physics and the scientific method can and should help govern public discourse. In this chapter, the true aim of his project comes to light, suggesting he is not providing a picture of the world according to physics, but the world as it simply is:

One day we may find a new theory of quantum gravity, but it will never predict that my ball will take twice or half as long as Newton's equation of motion predicts. That is an absolute truth about the world. There is no philosophical argument, no amount of meditation, no spiritual awakening or religious experience, or gut instinct or political ideology that could ever have told me that a ball dropped from a height of five metres would take one second to hit the ground. But science can tell me. (p. 276)

While Al-Khalili claimed in the preface that he would try to avoid metaphysical questions (p. xiii), he inevitably (and at times, self-consciously) stumbles back upon them, making ontological claims about the world-in-itself. Indeed, even his quest for unification is arguably based on a philosophical presupposition that unity is more fundamental than diversity, a tradition which came to fruition in Neoplatonism and Christian monotheism. While Al-Khalili acknowledges the need for philosophy and science to communicate (p. xiv), in practice he seems to treat philosophy as a useful tool for science when it hits a roadblock (e.g., for unpacking the implications of quantum mechanics) rather than a discipline in its own right that has the ability to question the underlying epistemic and ontological assumptions of science itself. As such, while his manner is more open and humble than your average humanist/materialist (he was elected president of the British Humanist Association in 2012), his actual beliefs do not seem to have absorbed much at all of the philosophical or theological complexity required for the sorts of claims he is making:

The human condition is bountiful beyond measure. We have invented art and poetry and music; we have created religions and political systems; we have built societies, cultures, and empires so rich and complex that no mere mathematical formula could ever encapsulate them. But, if we want to know where we come from, where the atoms in our bodies were

formed—the "why" and "how" of the world and universe we inhabit—then physics is the path to a true understanding of reality. And with this understanding, we can shape our world and our destiny. (p. 281)

Ultimately, if one wants a helpful primer on physics, Al-Khalili provides a passionate and serviceable introduction. While his explanations of some topics were perhaps too much for newcomers, his weaving together of subjects often treated in isolation helps get things back on track, providing a grander narrative for lost readers to latch on to. Yet, if one is looking to see how this narrative fares as an all-encompassing account of the "why" and "how" of our world, then there are superior accounts available on the market. Indeed, thousands of years of writing and prayer have already sought out and encountered the One at the heart of creation.

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## SCIENTIFIC VOCATION

**THE PERFECT PREDATOR: A Scientist's Race to Save Her Husband from a Deadly Superbug** by Steffanie Strathdee and Thomas Patterson. New York: Hachette Books, 2019. 311 pages, plus reference and index. Hardcover; \$29.00. ISBN: 9780316418089.

I have never been a fan of nonfiction, and although I love biology, I do not have much experience reading about it outside of textbooks. If you had asked me a few months ago, I would have said a book at the intersection of these genres sounded likely to be lethargically paced, overly detailed, and boring. However, Steffanie Strathdee and Tom Patterson's memoir/medical thriller *The Perfect Predator* changed my mind. The married coauthors share the story of the nine months when Patterson was near death from a formidable antibiotic-resistant bacterial infection. When his situation appeared hopeless, Strathdee enlisted a team of scientists to resurrect a treatment long forgotten by modern medicine: phage therapy. Christians will find much to admire in the selflessness and community displayed by the country-wide team that put together this novel treatment, and any reader will be inspired by the story of compassion and risk-taking to beat the odds. The story is both emotionally engaging and readable, despite all the science, and it draws much-needed attention to the antibiotic resistance crisis and the life-saving potential of phage therapy.

Strathdee, the primary narrator, sets our scene in Egypt, where the couple was on vacation in November of 2015. After a long day of sight-seeing, Patterson came down with what they assumed was a stomach bug. But by the time he had been taken to an Egyptian clinic, medevacked to Germany, and finally transferred back home to a US San Diego hospital, it turned out to be an infection with one of the most dangerous antibiotic-resistant bacteria in the world. Luckily for Patterson, though,

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Strathdee is a determined epidemiologist as well as a devoted wife. As the doctors' list of options dwindled, she started to do her own research.

She stumbled upon the mostly forgotten technique of phage therapy—using bacteriophages to kill the bacteria that were causing an infection. Viruses and their hosts are precisely matched, so the right virus could be the “perfect predator” to kill even the deadliest bacteria. With the rise of antibiotics in the mid-twentieth century, phage therapy disappeared into the background of medical research. However, antibiotics were proving useless against Patterson's infection. Desperate, Strathdee decided to take a chance on phage therapy, untested as it might be. She enlisted phage researchers from across the country in a race against time to save her husband's life.

Even though the main attraction of the book, phage therapy, does not come into play until halfway through, it never feels like a slog to get to “the interesting part.” Strathdee makes those nine long months eventful, and the vulnerability in her writing ensures that we are with her through all the hope and heartache along the way. Readers who enjoy memoirs will feel at home with this book. The science might sound formidable, but the authors ensure that their audience does not need a background in medicine or microbiology. Their readable descriptions provide everything necessary to understand what is going on, whether it is a quick definition of sepsis or a crash course on the history of penicillin.

Strathdee writes with humility; her narrative intentionally and thoroughly highlights all the help she received. Doctors and phage researchers from across the world contributed to Patterson's care. She notes the remarkable collaboration as a picture of global medicine, but I think Christians will also recognize it as a picture of selfless community. So many people dropped what they were doing to save a total stranger, from the researchers who worked overtime to isolate phages, to the FDA officials who fast-tracked the approval paperwork through the system. They demonstrate a lot of the virtues that the body of Christ should exemplify, including compassion, unity, and selflessness.

It is no wonder there were so many people involved, because the path to the phage cocktail that saved Patterson's life was long and convoluted. It took almost half the book before the idea of phages even comes into the picture. Once the idea was introduced, I expected every chapter to be the chapter that they finally start treating Patterson. But Strathdee is too thorough a writer for everything to be over so simply. Her narrative walks the reader through the many, many steps of getting the phages from a culture plate to Patterson. Deciding which phages to use, transporting the phages, getting the necessary paperwork and approval, preparing them at the pharmacy, determining dosages, choosing a method and location of administration—the

list goes on. I was getting impatient that the book was so slow, until it occurred to me how agonizing it would be to endure all this waiting in real life, like Patterson's family and care team did. After all, I know what they did not: Tom survives.

That occasional feeling of slowness is this book's only flaw. One thing that contributes to it is the lack of increasing stakes. If this were a novel, the stakes would have to get higher as the plot progressed, but Patterson's life had been on the line since they were in Frankfurt. It has been life-or-death since the beginning, so there is nowhere to go. Of course, this is not the authors' fault. Strathdee does her best to create a sense of urgency by the way she describes her emotional experience. We can feel her becoming more desperate the longer Patterson spends in the hospital.

Another authorial choice that helps the stakes was the inclusion of the “interludes.” These short anecdotes are told from Patterson's perspective. While his wife and care team searched for a cure, he wandered in a surreal world of threatening, acid-trip imagery. Even unconsciousness did not protect him from suffering. These interludes remind us of the stakes from his perspective as well as from Strathdee's. Not only could Strathdee lose her husband, but Patterson could die alone and hopeless in the agonizing wilderness of his hallucinations.

However, the authors are aware that the stakes are high for more than the two of them. They do not stop the story after reporting that the phages were successful, and Patterson survived. In the last chapter, they present a larger perspective on the significance of his landmark case. First of all, it is an excellent example of global collaboration and medicine. But more than that, Patterson's case brings much-needed attention to phage therapy's potential. It is a promising and personalizable treatment that has been too long overlooked. Research is needed to explore its efficacy and, if the studies are favorable, to regulate it so that it can save lives on a large scale.

This will not happen, however, until there is more awareness of the antibiotic resistance crisis that demands solutions such as phage therapy. Strathdee is an epidemiologist, and even she did not realize the magnitude of the problem until it nearly killed her husband. Precedent suggests that crises are often what push medicine forward. As the authors point out, WWII and the AIDS epidemic both stimulated advances in medicine and access to treatments. Now is the time, with the resistance crisis causing antibiotics to become less and less effective, to pursue new approaches and to bring phage therapy back out of the shadows.

All in all, I found *The Perfect Predator* to be a fascinating combination of science and storytelling. Strathdee and

Patterson are considerate, compassionate writers, and they do an excellent job of avoiding the traps that could make this book dull. I would recommend it especially to those who work in health care, but it is also relevant and accessible to laypeople. Christians in particular might connect to the kind of selfless community displayed by the phage researchers. This book combines the best of the genres it spans. It is a lucid description of a remarkable achievement in medical science, but it is also the very human story of a woman fighting to save her husband. Whether phage therapy turns out to be the future or not, *The Perfect Predator* definitely made a medical memoir convert out of me.

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**HOW TO BE A BETTER SCIENTIST** by Andrew C. Johnson and John P. Sumpter. New York: Routledge, 2019. 247 pages, index. Paperback; \$23.95. ISBN: 9781138731295.

It is hard to imagine the need for yet another offering in the crowded field of generalized science books. This is especially true in the case of Johnson and Sumpter's broad *How to Be a Better Scientist*, which lacks an obvious audience or niche. However, the authors largely achieve their stated aim of producing a book that is not only accessible but also relevant to aspiring and established scientists alike, including those at every career stage—from beginning students to seasoned principal investigators (PIs). The tone of the slim volume is light and leavened with great dollops of humor, yet the topics are so well mined that occasional nuggets of wisdom make the book even more interesting and appealing.

Breadth rules over depth, with chapters covering everything from how to choose a graduate school sponsor and research project, to how to secure grant funding and to design a conference poster. The individual chapters and the overall organization span the range from planning experiments and seeking jobs, to making the most of scientific meetings and social media, but the overall view is from the proverbial 30,000 feet rather than close up. The vocabulary is simple, the mood informal and breezy rather than stuffy or preachy, and the writing mostly crisp and to the point. Each chapter ends with a handy concluding checklist reiterating major “take-home” messages.

Late-career scientists might appreciate the practical advice on keeping a busy lab running effectively while supervising students and postdocs. Nonetheless, it is hard to imagine that most of the “hands-on,” step-by-step advice provided here (such as how to create and present a conference talk, how to plan and submit a manuscript, and where to seek funding) would not already be well known to experienced scientists, even if it might be nice for them to skim the chapters and see the world of scientific investigation through the fresh

eyes of newbies. Indeed, most of the practical advice dispensed here is aimed squarely at the beginning, or even aspiring, scientist. Still, the authors make clear that even a late-stage scientist's career is best considered a “work in progress,” and there is practical advice for more-seasoned scientists, including how to deal with collaborators, funders, administrators, and media.

The authors offer appropriate examples to support their arguments, such as the discovery that gastric ulcers are caused not by stress but by pathogenic bacteria, demonstrating that while it is difficult to overturn conventional wisdom, scientific data typically achieve this effect in the end. Occasional references are provided, but readers are generally left on their own to hunt down sources for further reading. However, the focus is largely on practical advice. Readers are urged to join ResearchGate, to use many subheadings in their writing, and to use figures in place of words in explaining results.

Still, this is by no means a technical book. The authors make clear in their foreword that they never intended to write a technical book or to engage in philosophical exploration or description of any or all particular branches of scientific investigation. Instead, Johnson and Sumpter draw on their many years of combined experience as professional scientists, including publication of numerous articles and supervision of dozens of graduate students, in seeking to halt the spread of what they characterize as “poor science”: boring or impenetrable writing, lackluster talks, unfocused projects, and (worst of all, in their view) unhappy scientists. The authors write of witnessing many aspiring scientists abandon their career goals due not only to an unfortunate inability to do good science but also to an exasperating inability to find fulfillment and joy in their work.

One of the major themes of the book—handled often and well—is that science is a brutal battleground that poses great psychological perils for its practitioners. The authors make clear that recurring setbacks and frustrations play a huge role in how scientific findings, and individual scientists themselves, advance. They also make clear that such frustration is not anomalous but instead routine. There are multiple detailed sections on how to handle criticism and rejection, and even an entire chapter on “When Things Are Not Going Well” (sample advice: “Do not try to work yourself out of trouble”). It is both refreshing and admirably constructive for Johnson and Sumpter to advocate, indeed urge, that scientists of all ages and experiences take solid steps to protect their time, sanity, lifestyle, and emotional health. Again and again, the authors recommend that scientists find a balanced life outside the lab. They argue that to become a better scientist, one must become a better person. The focus on scientific integrity and, in particular, on admitting mistakes and telling one's story with honesty and transparency, is commendable.