



HISTORY OF SCIENCE

CONVERSATIONS WITH GALILEO: A Fictional Dialogue Based on Biographical Facts by William R. Shea. London, UK: Watkins Media, 2019. xi + 115 pages, including notes and further reading. Hardcover; \$14.95. ISBN: 9781786782496.

Have you ever wanted to engage in an extended conversation with a famous person whose work and historical milieu you have studied carefully for many years? William R. Shea, one of the world's leading Galileo scholars, invites you to sit down, relax with a cup of coffee or a glass of wine, to engage in a conversation with Galileo. *Conversations with Galileo: A Fictional Dialogue* incorporates many of Galileo's own words taken from his works or letters. This slim book will allow you to experience how such a dialogue may have transpired.

Shea, a Canadian historian, was Galileo Professor of the History of Science at the University of Padua, Italy from 2003–2012, the very university where Galileo once taught. He has authored many books about Galileo and the Scientific Revolution. The latest, co-authored with Mariano Artigas, are *Galileo in Rome: The Rise and Fall of a Troublesome Genius* (2003) and *Galileo Observed: Science and the Politics of Belief* (2006). *Conversations with Galileo* is part of a series of books published by Watkins Media Ltd., offering conversations with luminaries such as JFK, Oscar Wilde, Casanova, Buddha, Charles Dickens and Isaac Newton.

First, a word about the format of *Conversations with Galileo*: A three-page introduction by Dava Sobel, author of *Longitude* (1995) and *Galileo's Daughter* (1999), is followed by a short (21-page) biography by Shea entitled "Galileo (1564–1642): His Life in Short." Then we are offered 13 chapters dealing with a vast range of topics. Each chapter then begins with Shea posing a leading personal question. These questions cover what, I suspect, most people would want to ask Galileo: questions about censorship, the earth as a planet, scientific failures, what do you take the Bible to say, relations with the Roman Catholic Church Congregation of the Holy Office, also known as the Roman Inquisition, and the Congregation of the Index, other church officials, and, perhaps a final question: what is your claim to fame? The Galileo I remember: the rebel, the seat-of-the-pants philosopher, the "heretic," the defender of the Copernican world-picture, and the creator of a "science of motion" (appearing in the last chapter, "His Claim to Fame") are all present.

So, what more would you want to ask? To me it was surprising to see what else Shea does in fact ask. There are conversations/chapters dealing with "Family Burdens," "Wine, Women and Song," "The Burdens of Teaching," "Moonlighting," "Mind your Horoscope," "The Plague," and "On Art and Literature." This is a

Galileo with a human face, with human foibles, jealousies, amorous interests, financial pressures and responsibilities, work-load issues, social conventions, concerns about the plague and social distancing, and literary interests. These are subjects which are usually hidden or absent in many accounts of Galileo's exploits. For instance, we learn of Galileo the lutenist and of his musical family: his father Vincenzo, his brother Michelangelo (a court musician to the grand duke of Bavaria in Munich). We meet his children: his two daughters, Virginia and Livia, who both entered a convent, and his son Vincenzo who had no scientific interests. We also learn about Galileo's life as a student. At seventeen, Galileo attended the University of Pisa to study medicine and "natural philosophy" (science in our parlance). He attended lectures for four and one-half years without acquiring a degree (which was quite common at the time) but did develop his mathematical interests. These are only a few of the personal details in Galileo's life which Shea explores in this book.

All in all, this is a delightful and inviting book, carefully constructed, written in an engaging style, and easy to read. Don't let the poorly designed cover keep you from picking it up. This is a good read for anyone wanting to get a look behind the scenes and meet an illustrious natural philosopher as he lived his rich and complex life.

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FINDING OURSELVES AFTER DARWIN: Conversations on the Image of God, Original Sin, and the Problem of Evil by Stanley P. Rosenberg (general editor) and Michael Burdett, Michael Lloyd, and Benno van den Toren (associate editors). Grand Rapids, MI: Baker Academic, 2018. vii + 375 pages. Paperback; \$34.00. ISBN: 9780801098246. Kindle; \$16.99. ISBN: 9781493406586.

Finding Ourselves after Darwin responds to questions of how humanity defines itself and understands its primeval origins in a post-Darwinian world. It does so by offering a representative selection of Christian responses to questions about the image of God, original sin, and the problem of evil raised at the interface of evolutionary science and Christian faith. This book grew out of the project "Evolution and Christian Faith" funded by BioLogos, and many contributors participated in several colloquia held at Oxford.

Finding Ourselves after Darwin is thematically and structurally coherent, unlike many similar edited volumes. Two introductory essays by general editor Stanley Rosenberg and associate editor Benno van den Toren introduce the truth-seeking and dialogue-modeling commitments of the book. Following these essays, the book is divided into three parts: (1) The Image of God and Evolution, (2) Original Sin and Evolution, and (3) Evil and Evolution. Each part features five or six

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contributors' responses to issues raised in each topic. Associate editors Michel Burdett, Benno van den Toren, and Michael Lloyd each provide introductory and conclusory comments to one of the three parts, in which they identify the part's driving questions and then summarize and interact with the material.

Discussion in part 1, *The Image of God and Evolution*, centers on the ability of four conventional models of imaging (functional, structural, relational, dynamic) to withstand challenges posed by evolution. Defending the viability of these four models takes precedence over intermittent discussion of human uniqueness, origins, and telos. Wentzel van Huysteen's introductory chapter suggests that evolutionary insights help inform a robust understanding of the human capacity for imaging. According to his "bottom-up" approach, the image of God emerged from nature through evolution; he believes we should take this into account when trying to understand the human person.

Following van Huysteen, Mark Harris shares a version of the functional model of imaging, which locates the *imago Dei* in humanity's role to be God's representative rulers on the earth. Harris uses scripture well but only marginally engages evolutionary theory since, according to him, it poses few challenges to the functional model of imaging.

Next, Aku Visala offers a strong defense for the structural theory of imaging against challenges raised by evolutionary theory. Structural theories of imaging often locate the image of God in uniquely human cognitive, moral, relational, and religious capacities; therefore, challenges to human uniqueness—such as claims that no clear dividing line exists between humans and animals—appear to threaten the viability of structural models of imaging. However, Visala shows that an appropriately modified version of the structural theory withstands these challenges by requiring no such clear dividing line (instead, humans stand apart from animals in the unique degree to which they actualize certain capacities). Visala also suggests that animals can have nonhuman souls and that animals continue to evolve in their imaging capacity; consequently, the "image of God is as much about becoming as it is about being" (p. 77). Visala advocates for an emergent dualist approach to the soul, one which embraces evolutionary insights into the way our "perceptual, conceptual, and emotional systems work" while maintaining that the soul accounts for certain phenomena evolutionary that explanations cannot account for, such as the existence of the person, human dignity, and life after death (p. 71).

Then Jay Oord presents a relational-love model of imaging in which he suggests that "living a life of love" is the essence of imaging (p. 88) and that God invites nonhuman creatures to bear God's image by imitating God's love.

Finally, Ted Peters offers a dynamic model of imaging in which humans are still evolving into the *imago Dei*. According to this model, the *imago Dei* exists not in humanity's past or present, but in humanity's future and in the person of Christ. As such, it functions as a "divine call forward" to become increasingly Christ-like (p. 96). Peters refrains from locating the *imago Dei* in humanity's past because he believes humanity's fallen state is "equiprimordial with our appearance in biological history" (p. 104) and that human nature was not fixed at some historical point but is retroactively determined by what humanity will be at the redemption. Unfortunately, Peters offers no clear definition of the *imago Dei* or explanation of its incompatibility with fallenness.

All contributors in part 1 affirm human uniqueness although some affirm it only by way of degree. In his concluding comments, editor Michael Burdett encourages readers to explore hybrid models, which allow them to affirm multifaceted understandings of imaging.

Part 2, *Original Sin and Evolution*, addresses the origins, transmission, and universality of sin. Contributors disagree whether the origins of human sinfulness should be identified with an intentional, human decision to turn away from God at a particular time in history (C. John Collins, Andrew Pinsent, and Gijsbert van den Brink) or with the inevitable realization of innate tendencies for aggression and self-assertion inherited from prehuman ancestors (Christopher Hays). Some contributors present science-compatible Fall narratives. For example, Collins proposes a "federal head" model in which two representative humans intentionally turned away from God at the headwaters of human history, bearing consequences for all humans. Hays, on the other hand, regards the historic placement of the first sin irrelevant since it was not responsible for subsequent sins. According to Hays, we can affirm the universality of sin and human culpability for sin without an originating sin.

McCoy's chapter cautions against misusing Irenaeus's theology to support theologies that dismiss a traditional Fall, which he argues is necessary to Irenaean thought. McCoy's chapter is insightful, but unless the reader is familiar with the external discussion McCoy is responding to, the chapter appears somewhat tangential to part 2's driving questions.

Contributors affirm the universality of sin, although they disagree on the mechanisms that unify humanity in sin and account for the transmission of sin: Collins suggests that unity in sin is rooted in covenant with God, Van den Toren argues that transmission of sin is inseparable from cultural evolution, and Pinsent suggests that original sin is propagated by the absence of supernatural grace (which he suggests was a pre-Fall addition to human nature).

Part 3, *Evil and Evolution*, addresses questions of why God is not culpable for animal suffering in pre-human history and why God employed violent means of creating; it highlights a variety of avenues available to affirm God's goodness in light of prehuman suffering. Only-way theodicies dominate: they include Rosenberg's view that death and decay are necessary marks of a finite world, Vince Vitale's "non-identity theodicy" (based on the idea that the existence of individuals alive today is contingent on past suffering), and Christopher Southgate's argument that the values of this world come at the expense of its disvalues. Michael Lloyd provides the only substantive free will defense, which attributes a cosmic Fall to free angelic beings, and Richard Swinburne offers an Irenaean soul-making theodicy which argues that the finite amount of suffering God allows us to endure is outweighed by the goodness of the soul-making opportunities it provides.

Part 3 benefits from the way contributors highlight lingering concerns in each other's models. Lloyd's chapter "Theodicy, Fall, and Adam" is exemplary: from only-way theodicies Lloyd calls for better defense of the unique creativity of violence, and from Augustinian nonbeing approaches he calls for a better defense of the inability of God to counteract creation's tendency toward nonbeing now if God will do so post-eschaton. However, since the format of the book does not facilitate intra-book responses, such challenges remain unaddressed. Moreover, editorial content and many contributors assume that prehuman suffering is "evil," and, although some contributors disagree, this assumption is unfortunately never explicitly contested. Nevertheless, part 3 concludes the book in a helpful way: it outlines potential solutions to concerns about evil and the goodness of creation that are discussed throughout the book.

In conclusion, part 1 provides defenses of four models of imaging—sometimes at the expense of discussion concerning human uniqueness, origins, and telos. Part 2 successfully provides a multifaceted discussion on the origins, transmission, and universality of sin. And part 3 offers theodicies that illuminate various directions forward; it also raises many unanswered questions. Ultimately, bringing a representative selection of views to the table—more so than novel ideas—is the function of this book. Editorial contributions unify *Finding Ourselves after Darwin* as an accessible, well-assembled exploration of truth. Editors, and sometimes contributors, offer epistemological guidance and identify fruitful avenues for future exploration, making the discussion one that uniquely moves the reader forward in their search for truth. Interaction between contributors, when present, adds richness to the discussion but is not consistent throughout the book. *Finding Ourselves after Darwin* is further unified by a commitment to the doctrinal core that is accompanied by various degrees of flexibility concerning the retention of theological theories that have grown up around certain doctrines.

Finding Ourselves after Darwin will help undergraduate students, pastors, and other informed Christians pursue a coherent and scientifically informed faith.

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READING GENESIS WELL: Navigating History, Poetry, Science, and Truth in Genesis 1-11 by C. John Collins. Grand Rapids, MI: Zondervan Academic, 2018. 336 pages. Paperback; \$36.99. ISBN: 9780310598572.

C. John Collins makes judicious use of C.S. Lewis throughout his book and offers a reading of the early chapters of Genesis that seeks to avoid both an ahistorical fundamentalist interpretation and a dismissive scientism that views Genesis as bad science by ignorant people. Collins identifies himself as a "religious traditionalist," and he seeks to read Genesis in ways that take seriously the original context of the author and first readers of the text. In doing so, he makes more evident the real meaning of Genesis as a rival creation story to other creation stories circulating at that time in the ancient near East. Collins has a twofold goal.

The first is to provide guidance to those who want to consider how these Bible passages relate to the findings of the sciences. The second is to establish patterns of good theological reading, patterns applicable to other texts. (p. 32)

Collins emphasizes quite rightly that to interpret a text correctly it is important to consider the context. It is context that determines whether the words, "I'm going to kill you" are a lethal threat to life or the joking retort of a friend. Genesis is not trying to do contemporary science, so to read Genesis as opposed to or in support of contemporary science is to rip Genesis from its ancient context in terms of both its literary form and its world view. The story of Genesis is not trying and failing to answer contemporary scientific questions; rather, the story of Genesis is emphasizing that, "all human beings have a common origin, a common predicament, and a common need to know God and have God's image restored in them" (p. 113).

We can understand what Genesis truly means by putting Genesis back into its ancient context. As Collins notes, "I take the purpose of Genesis to begin with opposing the origin stories of other ancient peoples by telling of one true God who made heaven and earth ..." (p. 137). Once Genesis is put back into its context, we can better appreciate the genre of the work. The language of Genesis is not scientific but poetic. Collins notes that we can communicate truths using different kinds of language. In ordinary language, we say, "You are beautiful." In scientific language, we might say, "You exhibit visible signs of youth, health, fertility, and symmetry." In poetic language, we could say, "Shall I compare thee to a summer's day? Thou art more lovely and more temperate: Rough winds do shake the darling buds of May, And summer's lease hath all too

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short a date." Imagine someone who got out a weather almanac, looked up the speed of winds last May, and replied, "Last May, the winds were unseasonably calm. No rough winds at all. Shakespeare was horrible at correctly noting the weather! What a dunce!" Of course, in writing Sonnet 18, Shakespeare was not trying and failing to compose an accurate weather report. The Bard's purposes, genre, and context are entirely different than meteorology. So, too, Genesis is not trying and failing to provide a scientific account of the origin of sun, moon, and stars—or man. To fault Genesis as a bad science is like faulting Shakespeare as a bad weather man. Collins correctly notes, "To call Genesis 'science,' whether ancient or modern is an enormous literary confusion" (p. 279).

So, if Genesis is not failing to be good science, since it is not even attempting to do science, what is Genesis about? The Genesis account is a correction to the rival stories of the ancient world. Genesis holds, in contrast to the pagan myths, that the sun, moon, and stars are not gods. The heavenly bodies exist to serve humans, to mark time. The idea that nature is not a god is an idea of signal importance, for if the created order is not divine, then the door is open for science to dissect and examine the secrets of nature. Genesis steers a middle course between a radical environmentalism (worshipping nature as divine) and a radical anti-environmentalism (domineering of nature as worthless material).

The role of humankind is also made more plain by contrasting Genesis with rival stories. Collins notes,

In the Mesopotamian stories the gods made humankind to do the work they do not wish to do, but they regret their action and decide to eliminate humanity because people have multiplied and become so noisy that the gods cannot rest (which was their original goal in making man). (p. 190)

How unlike the God of Abraham who urges human beings to be fruitful and multiply. The Greek poet Hesiod wrote, "Zeus who thunders on high made women to be an evil to mortal men, with a nurture to do evil." By contrast, Genesis proclaims both man and woman to be made in the image and likeness of God. Both man and woman fall to the serpent's temptation. Both man and woman are cared for by God after the Fall.

Reading Genesis Well is a good book, and it could be made even better. At times, there is a great deal of windup before the pitch. At other times, there is needless repetition. For example, Collins writes, "The creation narrative portrays the sun, moon, and stars as makers for the (liturgical) seasons. They are servants to help humankind worship the Maker, not masters themselves worthy of human worship" (p. 293). This is a great point, but the point is made at least three times in the text.

The organization of the text could be improved in places. For example, when Collins quotes Rudolf

Bultmann's famous assertion, "It is impossible to use the electric light and the wireless [radio] and to avail ourselves of modern medical and surgical discoveries, and at the same time to believe in the New Testament world of spirits and miracles," he does not respond to this assertion until pages later.

In places, not just form but substance can be improved. Collins quotes with approval James Packer saying, "The church no more created the canon [of scripture] than Newton created the law of gravity; recognition is not creation." But this is not quite right. The New Testament was written by early leaders of the church, such as Paul, Mark, Luke, Matthew, and John. It was the Council of Rome (p. 382) that fixed the biblical canon which was in some state of flux until then. The New Testament arose from the leaders of the early church and was cast into its current form by the leaders of the patristic church. That is much more than a mere recognition. Collins touches on the monogenism-polygenism question but does not address the dispute at sufficient length.

None of these quibbles should deter readers from profiting from Collins's research. *Reading Genesis Well* can indeed help us better understand one of the most ancient, most important, and most influential texts of all time.

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OLD-EARTH OR EVOLUTIONARY CREATION? Discussing Origins with Reasons to Believe and BioLogos by Kenneth Keathley, J. B. Stump, and Joe Aguirre, eds. Downers Grove, IL: InterVarsity Press, 2017. 256 pages. Paperback; \$28.00. ISBN: 9780830852925.

In *Old-Earth or Evolutionary Creation? Discussing Origins with Reasons to Believe and BioLogos*, the main question comes down to, "When science and faith appear to conflict, how is the apparent conflict navigated?" In other words, which gives in and changes first, scriptural interpretation or acceptance of scientific findings? We (the reviewers) hold different opinions about several of the debates and specific arguments outlined in this book. Dr. Vukov is a philosopher and practicing Roman Catholic while Dr. Burns is an agnostic atheist and a molecular biologist. Our take on issues at the intersection of science and religion is bound to be divergent.

The book is structured as a dialogue between the two aforementioned groups, Reasons to Believe (RTB) and BioLogos, and is moderated by members of the Southern Baptist Convention (SBC). The chapters each focus on a particular aspect of the science surrounding evolution and how the debating groups respond to or critique the science and/or integrate it into their faiths.

Who are BioLogos and RTB? Both groups have similar mission statements. BioLogos "invites the church and the world to see the harmony between science and

biblical faith as [they] present an evolutionary understanding of God's creation."¹ RTB's mission is similar: the organization seeks "to spread the Christian gospel by demonstrating that sound reason and scientific research ... consistently support, rather than erode, confidence in the truth of the Bible and faith in the personal, transcendent God revealed in both Scripture and nature."² In other words, both groups seek to promote science literacy among fellow Christians while also proselytizing nonbelievers. Generally speaking, however, RTB emphasizes the latter while BioLogos emphasizes the former.

RTB and BioLogos also share a common view of the "two books," that is, the book of nature and the book of scripture by which God reveals himself. This offers a starting point for their discussion. Since the "two books" are both aspects of God's revelation, they de facto cannot conflict with one another—while "they may be referring to different things ... they are not saying contrary things."³

But of course, these two books do sometimes come into conflict, at least apparently. One virtue of old-earth or evolutionary creation is that several of the questions presented in it go beyond the kinds of conflicts covered in mainstream media dialogues. Rather than "did evolution take place?" you hear "what does it mean for a literal Adam and Eve if evolution is correct?" The former question, we (and RTB and BioLogos) believe, is settled, making the latter question the more interesting one. Many denominations, after all, put quite a bit of stock in there having been a historical first pair of humans in the form of Adam and Eve. The Fall of these humans, also a historical event by these interpretations, had consequences that were passed on to each member of the succeeding generations of humans, much as how genes are passed from one generation to the next. In these interpretations of the Fall, there is therefore a theological need for a single lineage of humans. Evolutionary theory, however, rejects the idea of a single human lineage having arisen from a single couple. It is clear then that something needs to give way: either a single pair of humans, Adam and Eve, did not exist literally as described (perhaps they were instead metaphorical placeholders for a small population of early humans) or there's something untrustworthy about the genetic models of how populations evolve. BioLogos opts for the former option, RTB for the latter. BioLogos's tendency to defer more to the book of nature than is RTB's is seen throughout the book.

Consider, for example, the evolution-specific lines of evidence debated in the book's pages. The debate between the two groups across the range of scientific evidence regarding humanity's place in an evolutionary framework is taken piecemeal across the chapters: each chapter is devoted to one topic, such as fossil evidence. One unfortunate effect of this organization is that the evidence for evolution is diluted. Indeed, when

the scientific evidence regarding humanity's place in an evolutionary framework is taken as a set of convergent, predictive findings, there is a unified scientific theory into which human evolution fits quite well.

This organizational issue aside, however, we find the current field of genomics to be the most exciting body of evidence presented in the book. This body of evidence is also, perhaps, the most damning for RTB, who advocate for a "special creation" of humans, thus resisting the weight of evidence in favor of placing humans in the great causal chain of evolution by natural selection over the vast span of biological time. In this regard, RTB is simply not taking a scientific approach when arguing against the genomic evidence. At several points in the book and forth, it is highlighted that, for instance, there is approximately a zero percent chance that the human population was ever smaller than several thousand individuals. This is a known fact and all the evidence and models of population genetics agree on this. The only way around this would be to (1) invoke some form of miraculous intervention to allow for some other possibility (e.g., a single pair of humans) followed by another miracle to make the models based on evidence look otherwise or (2) suggest that the thousands of world-class evolutionary biologists, geneticists, statisticians, and bioinformaticians who build and use these models are seriously mistaken, without empirical evidence to suggest that they are.

It is fitting, then, that Francis Collins both founded BioLogos and was also the lead scientific administrator behind the Human Genome Project. Collins, we would presume, has found a way to do what RTB has not—to reconcile what the "book of nature" is telling him about creation and to use that knowledge to shape his interpretation of what is revealed by scripture. Again, what the two groups exemplify throughout their dialogue are differences in priority that are attributed to the "two books." BioLogos pushes for the incorporation of current scientific findings inside the framework of their evolving knowledge of the Christian faith, whereas RTB, by contrast, appears substantially more reluctant to accede to any alterations of their current interpretations of what they see revealed in the Bible. Both may formally recognize the two books. But RTB clearly sees the book of nature as written in a much smaller font than does BioLogos.

In their discussions, the topic of methodological naturalism (MN) also comes up with regularity. In the text, MN is defined (or rather, not defined) as "... a contingent value of most practicing scientists today" (p. 109). Colloquially, MN is simply the assumption that when you are applying a scientific test to interpret the results of an experiment, you rule out any supernatural explanations. For the methodological naturalist, you, as a scientist, should approach the cosmos as if it were composed exclusively of natural bits of matter and energy—no gods or spirits or divine interventions

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at play. Why do things this way? Well, it appears to work, and functionality alone is relatively strong evidence for its practical application as the way of doing science. It isn't that MN disproves anything supernatural. It is simply that supernatural explanations appear to be irrelevant.

There is, of course, plenty of room for disagreement about MN, and BioLogos and RTB are no exceptions. Obviously, as both are Christian groups, neither is comfortable with pure MN as the only way of viewing the universe, but they do have differences of opinion regarding its utility. J. B. Stump, writing for BioLogos, suggests that "... understanding of natural theology needs MN. It is another question, though, whether theological conclusions can be derived from purely scientific premises" (p. 111). This claim, however, is at odds with a belief that "[methodological naturalism] is not a necessary part of science" (p. 109), a view that is directly at odds with the current understanding of science as a process. What does a scientific process that incorporates the ineffable, unpredictable actions of nonnatural entities look like? Jeff Zweerink (RTB) argues that "For practical purposes, scientists must operate largely from a standpoint of methodological naturalism ... however, that does not completely exclude theological considerations" (p. 113). In RTB's view, the Bible is a source of testable scientific claims that can be assessed to reveal or support theological truths. Curiously, the two groups seem to agree on the utility of MN, but BioLogos sees it as a means of correcting their incomplete interpretations of faith while RTB sees it as a way to buttress their existing interpretations.

What is our take on the debates found in the book? It should be clear by now that we prefer BioLogos's approach to that of RTB's. But that's not to say that we agree completely with BioLogos, or indeed, with each other. One thing we do agree upon, however, is the value of intellectual humility in approaching these issues. And that also leads us to favor the approach of BioLogos. Indeed, with respect to the approaches to the integration of the science surrounding human origins and Christian faith as outlined by BioLogos and RTB, it is clear that the former is more readily able to accept their intellectual limits—or rather, accept that perhaps some of their prescientific beliefs and biblical interpretations might be mistaken or in need of revision. For some, this admission might be seen as a sign of weakness of faith and lacking in conviction. For others, this is a sign of a faith that is wholly human, an admission that no one has a perfect understanding of the revelations found in either of the "two books," and a presumption that one's position is destined to be readjusted as the two interplay.

Should you read this book? We commend the groups involved in the work (BioLogos, RTB, and the SBC) for their demonstration of vigorous intellectual engagement. It is a testament to their pursuit of knowledge

that they are able to engage in good-faith argument on these contentious topics. Reading through this work will provide believers with a wide variety of positions regarding human origins and Christianity while also covering the scientific support underpinning our understanding of human evolution. For nonbelievers, this work might be of interest to provide perspective on how believers view the topics of debate. However, it contains much material about issues along the lines of "how many angels can fit on the head of a pin"-type Christian esoterica that are typically uninteresting and unconvincing to outsiders. In this regard, the debate presented here clearly targets the faithful. If you are a Christian who is interested in challenging your perspectives on what it might mean to think deeply about human origins and faith, this book is an excellent and rigorous starting point.

Notes

¹BioLogos, "What We Believe," accessed February 18, 2019. <https://biologos.org/about-us/what-we-believe/>.

²Reasons to Believe, "Mission and Beliefs," accessed May 4, 2020, <https://reasons.org/about>.

³Kenneth Keathley, J. B. Stump, and Joe Aguirre, *Old-Earth or Evolutionary Creation? Discussing Origins with Reasons to Believe and BioLogos* (Downers Grove, IL: InterVarsity Press, 2017), 12.

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AMAZING GRACE OF QUANTUM PHYSICS by Dillard W. Faries. Eugene, OR: Pickwick Publications, 2017. 268 pages. Paperback; \$33.55. ISBN: 9781532614217.

What if beneath the world of everyday experience things were not as they seem? If all things did not really have predictable locations or follow predictable trajectories but instead only appear to because they are large enough that their true behavior is undetectable to our senses? If the cosmos did not consist of discrete particles acting independently of all others; that everything was somehow connected with everything else? Strange as these possibilities may seem, these are not "what-ifs"; according to quantum physics, they are in all likelihood how the real world actually behaves. How physics arrived at this quantum mechanical understanding—if, indeed, it may legitimately be so called—forms a major theme of Dillard Faries's *Amazing Grace of Quantum Physics*, which also seeks to unpack some of the philosophical and theological implications of the quantum mechanics (QM) shockingly counterintuitive picture of reality.

Amazing Grace of Quantum Physics consists of an introduction, 18 chapters, an epilogue, and two appendices, but is perhaps better thought of as involving three main somewhat loosely overlapping parts. The first involves introductory material and consists of the introduction

and first chapter. The former introduces the main themes and offers a précis of the book. The latter surveys the main categories of classical physics that were radically challenged by QM, such as determinism and locality.

The second section roughly comprises chapters 2–10 and unpacks the main historical episodes that culminated in the development of QM, beginning with the discovery of radioactivity and culminating in competing equivalent mathematical formulations of quantum phenomena and the Copenhagen interpretation in the 1920s. Unlike other books on QM, this account focuses on how physicists, ranging from Benjamin Thompson, Michael Faraday, and James Maxwell to Max Planck, Albert Einstein, Louis de Broglie, Wolfgang Pauli, Erwin Schrödinger, Werner Heisenberg, Niels Bohr, and others, offered new understandings of reality that developed, problematized, and ultimately challenged classical Newtonian physics. This is central to Faries's narrative since the classical physics that was overthrown both arose from and misinformed Western theology before it descended into a sterile deism in the wake of Humean skepticism. Thus a theme of this section is that the overthrow of classical physics by QM is good news for Christian theism.

The final section comprises chapters 11–18 and the epilogue; it carries forward the story of QM to the present day. These chapters seek to explain QM's counterintuitive and somewhat paradoxical picture of reality, suggesting a number of implications for Christian thought along the way. This section focuses on a number of issues. These include the difficulty of relating the mathematical results of QM to physical reality so that they can be interpreted in the Copenhagen sense as probabilities or, less commonly, more deterministically in de Broglie-Bohm interpretation. Other issues include indeterminacy and the EPR paradox, Bell's inequality and the impossibility of agreement between QM and local reality, and the observer effect. Along with Fermat's principle of least time, which suggests that waves somehow know the shortest path to take, Faries argues that these open up possibilities to interpret reality as purposeful and consistent with Christian theism, which Faries demonstrates by offering his own tentative interpretation of QM. He ends by inviting the reader to do the same.

On one level *Amazing Grace of Quantum Physics* is a serious book in the sense of offering the quantum physics as consistent with a theology of mystery in which there is room for meaningful free will and divine action. However, as Faries himself explains, he is neither a theologian nor a philosopher. This shows, in that he does little to systematically develop a theology of mystery and does not interact with the extensive recent work in the history and philosophy of physics or with the science and religion literature on quantum indeterminacy and divine action (or issues such as the scope and limits

of natural theology). Instead, he prefers to offer his own sweeping suggestions and, in the case of divine action, build directly from the insights of William Pollard that have formed the backdrop to such discussions since the 1950s. So, in the end, *Amazing Grace of Quantum Physics* is perhaps best taken as a physicist who is a Christian explaining that he sees room for consonance between Christianity and science in the world of quantum physics.

Amazing Grace of Quantum Physics suffers from a number of flaws. The most flagrant is Faries's tendency to skip key details and insert entertaining but distracting tangents in the midst of otherwise cogent explanations. This, coupled with his tendency to allow loose analogies or hints to stand in for arguments, tends to obscure rather than illuminate what Faries is trying to convey. I often found myself having to insert key details or connections from my own knowledge, make assumptions about what exactly he was referring to, and, in a few cases, supply a missing argument. Nevertheless, between my own understanding of QM and because Faries ultimately gets around to explaining everything by the end of the book, both the physics he was trying to explain and the shape of his argument had become clear.

The book will be of value mainly to professional physicists and teachers of physics. In contrast those who are unversed in the basics of quantum physics or have little prior knowledge about its history are likely to find some parts impossible to follow (or, worse, acquire a superficial and incorrect understanding). Instead, these readers should start by reading a more accessible introduction. Some readers might also be alienated by Faries's casual jabs at Calvinism or his unnecessary use of an offensive racial slur to vivify the personality of Werner Heisenberg (which may have been done in ignorance as the slur is not a common one).

Nevertheless, those who are able to overlook the limitations of *Amazing Grace of Quantum Physics* will find value in its pages. It is one of the few works that seeks to offer a fairly robust overview of quantum physics along with nuggets of encouragement and pregnant hints. Here I offer two of particular note. The first is Faries's invocation of mystery as a useful but largely unexplored category in science-faith discourse, at least in the evangelical circles of which Faries is a part. The second is akin to John Polkinghorne's earlier and more theologically and philosophically sophisticated exploration of the similarities between theology and physics in his *Quantum Physics and Theology: An Unexpected Kinship* (Yale University Press, 2007), in which Polkinghorne demonstrates consonance between the search for reality through physics and theology. Faries does something similar at one point in this section, offering that Christians should not feel overly anxious in the absence of a complete and unassailable understanding of how to relate science and Christian theology. In Christianity,

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as in quantum physics, for the time being, we can be confident resting in what we know, even when there appear to be paradoxes or explanations that seem partial, tentative, and generative of new questions as well as answers.

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THE WORLD ACCORDING TO PHYSICS by Jim Al-Khalili. Princeton, NJ: Princeton University Press, 2020. 336 pages. Hardcover; \$16.95. ISBN: 9780691182308.

The World According to Physics is Jim Al-Khalili's "ode to physics" (p. vii). While Al-Khalili has been publishing popular science for over twenty years, this is his first attempt to provide the layperson a cohesive overview of physics as a whole, linking together relativity, quantum mechanics, and thermodynamics into one unified (or rather, not yet unified) picture of the cosmos. "Ode" is appropriate, for the author's unrelenting adoration of his subject is apparent throughout; this is a child's dream fulfilled, and in many ways is a broader summa of the world according to the mature Al-Khalili, bringing together not only physics, but also his views on truth, society, and our future.

Khalili opens with a discussion of how the human mind craves narrative. Yet science has displaced much of the old myths and religions:

Contrary to what some people might argue, the scientific method is not just another way of looking at the world, nor is it just another cultural ideology or belief system. It is the way we learn about nature through trial and error, through experimentation and observation, through being prepared to replace ideas that turn out to be wrong or incomplete with better ones, and through seeing patterns in nature and beauty in the mathematical equations that describe these patterns. All the while we deepen our understanding and get closer to that "truth" – the way the world really is. (p. 2)

While physics is not just another "story," it does have a cosmic scale that gives it a captivating wonder of its own, providing the basis for chapter 2 ("Scale"). Physics encompasses the infinitely small (e.g., subatomic particles) as well as the infinitely large (e.g., the expansion of spacetime at the farthest reaches of existence). Further, its scope is not merely all of space but all of time as well, getting within decimal points of the first instant after the big bang, while providing prophetic approximations of how the cosmos might end. While Al-Khalili does not play his cards this early, his later chapters (pp. 242-43 in particular) will reveal that this extensive scope establishes physics as the most fundamental discipline, the reigning queen of the sciences.

The deeper project begins in chapter 3 ("Space and Time"). Al-Khalili wishes to display the underlying skeleton that comprise the unification project of

physics, charting each merger until the final matchup is made (similar to a playoff line-up, where 16 teams soon become 8, then 4, then 2, then 1). Just as Newton wedded heaven and Earth through gravity, Einstein wedded space and time, explaining a diversity of phenomena with ever-simpler equations. While Al-Khalili's popular explanations of special and general relativity are merely adequate, his grasp of the broader narrative of unification in which these theories stand is incredibly useful, helping the layman see the trajectory of the book and physics as a whole, even when they cannot understand each individual step.

While chapter 3 unified space and time, chapter 4 ("Energy and Matter") unifies the energy and mass which warp said spacetime. Yet the unifications of relativity hit a snag when they come to "The Quantum World" (chapter 5) and to "Thermodynamics and the Arrow of Time" (chapter 6). While Einstein seems to rule over the kingdom of all things great, quantum mechanics rules over all things small, and no one has managed to negotiate a treaty just yet. Things do not work "down there" as they do "up here"; the laws of the macro are not the laws of the micro. Further, thermodynamics suggests that there is a directionality to time—for things move toward greater entropy—yet it is unclear how this can be made consistent with relativistic time or the conceptual reversibility of time in the quantum world.

Al-Khalili then moves in chapter 7 ("Unification") to possible reconciliations of these issues. He does an admirable job of explaining how the electromagnetic and weak nuclear forces were unified into the electroweak force, as well as explaining the ongoing attempt to unify the strong force with the electroweak force in a grand unified theory. This would leave only the holy grail: the attempt to unify gravity with the other three forces. String theory attempted such a unification by appealing to ten dimensions, yet by the 1990s there were five different string theories, which themselves needed to be unified, spawning M Theory (which required an additional eleventh dimension). An opposing contender soon arrived in loop quantum gravity. While string theory posits a quantum particle (the graviton) that exists within spacetime, loop quantum gravity inverts the order, making space more fundamental than a quantized particle within space, and so quantizing spacetime itself. These quanta of space are then "looped" together, determining the shape of spacetime.

Having unveiled the best approximations at a unified theory in physics today, Al-Khalili then ventures in chapter 8 to evaluate the subsequent state of the subject. He expresses frustration that no definitive proof has adjudicated between possible theories of everything, and that such unification seems further away now than it did thirty years ago. Even major discoveries, such as the Higgs boson, have mostly confirmed what we already suspected for decades, rather than

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.

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Indeed, apart from its “something for everyone” approach, the book’s true strength lies in its recognition of communication as a central focus of science. Yes, too many scientists forget the scientific method’s all-important final step: to share one’s findings. “The need to communicate well in science is not appreciated as much as it should be” (p. 110). The authors urge that scientists should be able to explain their work—what they do and why it matters—to parents or other family members. They further advise dedication of large blocks of time to writing. “Easy reading is damn hard writing” (p. 144).

However, the authors’ mostly thorough exploration of communication leaves one huge boulder unturned, which exposes the book’s central weakness. Much is made of the importance of scientists explaining their findings to other scientists, but in today’s world it is just as crucial for scientists to communicate the relevance of their findings to critics outside science. How should one explain research to skeptics and deniers who question the legitimacy of scientific findings, let alone the need for science in the first place? Is a better poster, or even more data, really the best way to handle vaccination doubters and climate change deniers? Regrettably, the authors barely touch on this topic.

My second criticism of the book involves a different focus. Although the authors pointedly wished to steer clear of anything smacking of philosophy (or even academic debate), I found myself at times wishing they would have at least acknowledged some of the numerous and important philosophical ideas concerning the proper undertaking of science. For example, one of the topics they mention throughout the book, both directly and indirectly, involves how one knows when one has collected sufficient data to test one’s hypothesis and justify conclusions. Unfortunately, this is never dealt with in depth or head on, with the result that some of the advice becomes contradictory (“Be thorough and don’t take shortcuts” versus “Don’t be a perfectionist”). How much trust should we put in our findings and conclusions? How do we know if they are true? How do we know when to stop doing replicates of experiments—do we base the decision on statistical inference alone? or on something more? I appreciate that the authors sought to provide practical guidance rather than venturing into potentially pedantic territory, but even simple recognition of such issues, with references as to where to explore further, would be a big boon to scientists of all levels in search of self-improvement. There is also virtually no mention of faith.

How to Be a Better Scientist is fun to read. It will provoke smiles, raise eyebrows, and bring useful rewards. Overall, there is much to recommend here, but like the best of science, there remains a never-ending list of further questions to be addressed.

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TECHNOLOGY

THE AGE OF AI: Artificial Intelligence and the Future of Humanity by Jason Thacker. Grand Rapids, MI: Zondervan Thrive, 2020. 192 pages. Hardcover; \$22.99. ISBN: 9780310357643.

There are not yet many books that engage with artificial intelligence theologically. Jason Thacker’s *The Age of AI: Artificial Intelligence and the Future of Humanity*, written for a general audience, provides an important start to much-needed theological discussions about autonomous and intelligent technologies. As an early effort in this complex interdisciplinary dialogue, this book deserves credit for its initial exploratory efforts. Thacker’s book also points to the larger and more complex territory requiring further exploration.

Thacker, creative director at the Ethics and Religious Liberty Commission of the Southern Baptist Convention and project lead for their “Artificial Intelligence: An Evangelical Statement of Principles,” is eager to draw attention to the pervasive and disruptive presence of artificial intelligence in our lives. While some may be distracted by images of AI that are speculative—the utopian Commander Data or the dystopian Terminator—many have not given much thought to the actual forms of AI that are part of our lives already, such as recommendation systems and digital assistants. “AI is everywhere,” Thacker says; “And we aren’t prepared.” To help the unprepared understand AI, Thacker provides an orientation to current AI developments and explores the wide-ranging impacts of these on self-understanding, medicine, family, work, war, privacy, and the future. Along the way, he recalls biblical wisdom about old moral problems and imperatives, such as what the Ten Commandments prohibit and what Micah 6:8 prescribes (doing justice, loving mercy, and journeying attentively with God). He also offers a number of familiar biblical assurances, such as not being afraid and trusting in God.

All of this is helpful, to an extent. Thacker’s major conclusions about AI are that we should not let our creations—our artificial agents—supersede human agency, and that we should not place too much hope in technology, for it alone cannot save us. Both of these are important points, although neither is very controversial nor necessarily theological: transparency is called for in many AI ethical frameworks, and we are well into a period of technological disenchantment.

Thacker starts *The Age of AI* by asking two significant questions. First, what does it mean to be human? Thacker looks to Genesis 1, which states—three times—that God created humans in the image of God. Clearly, this is an important theological claim; it is also a very complex one. There are various interpretations of what it means to be created in the image of God, and this is only the first chapter of the biblical narrative. Thacker

emphasizes a functional interpretation of Genesis 1: We are called to work to glorify God. Elsewhere, however, Thacker shifts to a more essentialist interpretation that emphasizes human dignity. He asserts that our dignity does not come from what we do and that “nothing in this world defines us” (p. 117). But what about the work we are called to do in and for the world?

Another challenge of beginning in Genesis 1 is what happens in Genesis 3—humanity’s rebellion against God. Thacker claims that “the image of God in us was not lost” (p. 19), though he does not address the extent to which this image was corrupted. For Christians, what is most important is Jesus’s redemption and transformation of that fallen image. What does the image of God in Christ, the new Adam, reveal about the future of humanity?

Questions raised by Thacker’s answer to his first question carry over into his answer to his second question, what is technology (including AI)? For Thacker, technology itself is morally neutral: “What’s sinful isn’t the sword but how people choose to use it” (p. 20). Given Isaiah’s eschatological image of swords beaten into plowshares, many would argue that the sword is part of a system of weaponry and warfare that is immoral and must come to an end. Going beyond Isaiah, Jacques Ellul concluded that the biblical city, as an image of the technological society, must ultimately be destroyed: the city is an autonomous, multi-agent system with a diabolical power that exceeds the power of the human agents who created it. (Ellul almost seems to suggest that there is something like a rogue AI in the Bible!) Ellul goes too far with this, missing the good in the city and the transformative power of new creation over sinful systems, but he rightly points to the deformative power of technology. Thacker acknowledges that technology profoundly changes us and our world, positively and negatively, but he seems to suggest that humans can easily remain in control of and essentially unchanged by it.

Thacker’s emphasis on Genesis, “where everything began,” appears to close off any discussion about evolution and its insights into the role of technology in our emergence as a species. Indeed, the archeological record reveals that the use of simple stone tools shaped ancient human bodies and brains. Technology not only preceded the arrival of *Homo sapiens*, it shaped our understanding of what a human being is in form and function. Furthermore, throughout human history, technology has continued to change us fundamentally. Consider, for example, Walter Ong’s insight that the technology of writing restructured consciousness. From the perspective of evolution and cultural development, technologies have been shaping and changing what we are from the beginning.

Thacker critiques Max Tegmark and Yuval Noah Harari for conflating evolution and cultural development, but that misses their interest in how humans might continue

to outrun natural selection through innovation—a path our species has been on for many millennia, at least since the agricultural revolution and the creation of the complex artificial environments we call cities. As controversial as they may be, Tegmark and Harari point to how a deeper historical and philosophical understanding of technology enables us to explore questions about the holistic transformation of humans and human agency.

Thacker’s view of technology encourages pursuing “technological innovation to help push back the effects of the fall” (p. 70). He worries that we might be tempted to “transcend our natural limitations,” although it is not clear how far we are permitted to push back against the corrupted creation. He also fears “the people of God buying the lie that we are nothing more than machines and that somehow AI will usher in a utopian age” (p. 182). Educating people to resist being reduced to the status of machines (or data or algorithms) should be a learning outcome in any class or discussion about AI. As for ushering in a utopian age, this is one way of describing (in a kingdom-of-God sense) the Christian vocation: participating with God in the new creation. And perhaps AI has a role in this.

Thacker is absolutely right that we need a foundational understanding of who we are and of what technology is, and his answers provoke a number of questions for further exploration. The Bible reflects a rich interplay between human technological and spiritual development, from Edenic agriculture through Babelian urban agencies. And, as a technology itself, the Bible participates in these developments through its origin, nature, and function to mediate divine agency that transforms human agency. The biblical narrative makes it clear that we are not going back to the primordial garden in Genesis; we are moving toward the eschatological city, New Jerusalem, imaged in Revelation—“and what we will be has not yet been revealed” (1 John 3:2). How we understand the relationship between technological transformation and the transformation of all things through the new creation deserves much more attention within Christian theology.

With AI, it is clear that we are facing an even more profound restructuring of our lives and world—and of our selves. Rather than looking back to the *imago Dei* corrupted in the beginning, Christians might find it more generative to look to the *imago Christi*. As N.T. Wright powerfully argues in *History and Eschatology: Jesus and the Promise of Natural Theology* (SPCK, 2019), the new creation inaugurated through the resurrection of Jesus provides a radically new perspective on creation. This includes us and our artificial creations. While Thacker believes “nothing will ever change fundamental aspects of the universe” (p. 168), some of us may imagine AI participating in the new creation.

For someone just beginning to think about AI and Christianity, *The Age of AI* might be a good place to

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start. But more needs to be read and written to explore the theological and technological questions this book raises.

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2084: Artificial Intelligence and the Future of Humanity by John C. Lennox. Grand Rapids, MI: Zondervan Reflective, 2020. 124 pages. Hardcover; \$19.99. ISBN: 9780310109563.

Oxford mathematician and science philosopher John C. Lennox has been active in Christian apologetics for more than ten years. Best known, perhaps, for his debates with Richard Dawkins, Christopher Hitchens, Michael Shermer, and others (many of these debates are readily available online), Lennox has written numerous books defending the rationality of Christian faith. Many of his books address relationships between science and Christianity, such as his 2009 release: *God's Undertaker: Has Science Buried God?*

Lennox firmly believes that science and faith are compatible, as demonstrated by his easy way of integrating knowledge from science and theology. He often uses argument from design logic for God's existence. From his mathematical perspective, he points to the improbability of biogenesis to argue for the direct, non-evolutionary creation of life by God. As a result, he is often associated with advocates of intelligent design (ID). While the merits of ID with respect to creation matters are contested, it is indispensable when considering a future that will be (intelligently?) designed and built by human society. This is the central focus of *2084*, its title a leap forward from George Orwell's *1984*.

In chapters 1–3, Lennox cites many secular writers, utopian and dystopian, to highlight future possibilities. Their work accords with the assertion that artificial intelligence (AI) is of central importance; "AI will inevitably affect us all," so it is of interest not only to developers, but also to "philosophers, ethicists, theologians, cultural commentators, novelists, and artists" (p. 16).

But what is AI? Lennox offers his answer in two parts. Part one, chapters 4–5, examines "narrow" AI: computer systems designed to fulfill specific tasks, such as analyzing vast amounts of data or assisting in diagnosing illnesses. Narrow AI is operational now, providing great benefits to society, and its future potential is even greater. Unfortunately, like most technologies, it can also be corrupted by human sin. Lennox is not a Luddite, but he is realistic about AI's risks, and he lauds Christians involved in developing AI, such as Rosalind Picard at MIT.

Part two, chapters 6–7, describes the wider hopes some people have for AI, such as fundamental changes to human life. Indeed, transhumanists believe AI will

eventually solve *all* the problems that beset human beings, including the "technical" problem (p. 85) of death itself. This hope is based on the development of Artificial General Intelligence (AGI): a conscious, self-improving, *superintelligent* computer system. Human creativity would, in effect, bestow life on a technological artifact, just as God breathed life into the dust of the earth in Adam. These aspirations reveal, according to Lennox, a hope to become gods, the realization of the false promise of the serpent in Genesis 3.

In chapter 8, Lennox interprets such utopian hopes as rejecting God and his promises. He notes the irony "that those who are seeking to create a superintelligence do not realize that there is good evidence that a superintelligence, *the* superintelligence, already exists: God the Creator and Sustainer of the heavens and the earth" (p. 117). By rejecting the creator, the creatures made in God's image are diminished and at risk of being made "useless" (p. 128).

From a traditional Christian perspective, chapters 1–8 (more than half the book) provide a good overview of AI as the cornerstone of transhumanism. Anyone unfamiliar with such matters will benefit from the account Lennox offers. Nevertheless, he skips over many of the details to get to his main interest: chapters 9–13, in which he develops his theological and eschatological perspectives on AI and its potential impacts.

Lennox is neither a preterist nor a post-millennial. Instead, he integrates the apocalyptic passages of Daniel, 2 Thessalonians, and Revelation to visualize what lawless progress in AI could produce. Ultimately, Lennox connects dystopian views of advanced technology, especially AGI, to the apocalyptic "beasts" in Daniel and Revelation. The mysteries of the apocalyptic genre do not concern Lennox; he is confident that the full meaning of such mysteries will become apparent as events unfold (p. 205). In the meantime, the prophecies encourage believers to be watchful and to guard against deception. With this call for watchfulness, Lennox moves to his conclusion: "There is no way to a glorious future that bypasses the problem of human sin, and the only one who has offered a viable solution to that problem is Jesus Christ, who faced it head-on on the cross" (p. 227).

For too long, many Christians have focused exclusively on matters of human origins, but the *future* of human life is ignored. Yes, all Christians look for the return of Christ, but what of the time between now and then? It seems that few believers are even aware of the challenges they will face later this century. By examining the future from a biblical perspective, Lennox offers an important corrective.

Christians will disagree over the future of human life, just as they do about human origins. In *2084*, Lennox offers his views of the future, in accordance with his

reading of scripture. His conclusions will satisfy some readers—and dissatisfy others—but *2084* will certainly inform them of AI and its importance. As believers ponder the future, by God’s grace the church can remain true to its mission, finding answers to tough questions by searching the scriptures in light of the doctrines they reveal.

Reviewed by David Winyard, Associate Professor of Engineering, Grace College, Winona Lake, IN 46590.

HUMBLE PI: When Math Goes Wrong in the Real World by Matt Parker. New York: Riverhead Books, 2020. 336 pages. Hardcover; \$27.00. ISBN: 9780593084687.

Humble Pi delivers a veritable potpourri of mathematical mistakes in the real world, as the title suggests. Consequently, the book may be of interest to a wide variety of readers. Mathematics educators who are looking for reasons why their students should pay attention in class will find plenty of examples to convince even the most skeptical student that mathematical mistakes can have real-world consequences. Meanwhile, readers who struggled in math class may be happy to see that even the supposed experts suffer the consequences of their own miscalculations. While the book is predominantly written in a light-hearted tone that makes it relatively easy to read for a broad audience, it occasionally is somber when real lives are put in danger due to the math going wrong.

The author, Matt Parker, is likely more well known as a YouTube mathematician. His channel “Stand-up Maths” has half a million subscribers and sixty million views. Parker’s attempt to channel his high energy, “math is fun” persona into the written word is a challenging task, but he mostly delivers. For example, the page numbers count down until they reach 0, causing an error so the next page is numbered 4,294,967,295. This seemingly random large number happens to be $2^{32} - 1$; reading the rest of the book will explain why. The chapters count up from 0, except for a small chapter 9.49 which follows the chapter on rounding. Parker adds levity at the meta level as well as in the writing itself which builds on itself effectively. For this reason, readers who already are familiar with Parker’s work on YouTube will likely catch some extra inside jokes. However, to be clear, the book is not simply fan fiction; it is a well-researched and thorough account of mathematical mistakes in various contexts and should appeal to a wide audience.

The content of the book is organized into chapters based on the types of mistakes: losing track of time, counting errors, geometry gone awry, unit conversions, and statistics, to name a few. If one chapter fails to capture interest, the next one delivers something fresh. While this feature is mostly true, it fails in one way. So many of the mistakes come down to computer programming errors. At the core, there is a mathematical idea

at play, but the mistake comes from improperly coding that idea into a computer. The author did research a rich set of mathematical mistakes, but often it was not the mathematics that failed but the programming. As a mathematician, I was hoping for more mistakes that felt like mathematics itself going wrong. Yet I suspect that for most readers this is a distinction without a difference.

While the author is not writing explicitly from a Christian perspective, that does not mean that the book is therefore neutral or without perspective. Parker finds a deep joy in the doing of mathematics, a latent aspect of creation awaiting cultivation; he may not express it this way, but the joy is unmistakable. Many of the errors depicted in the book have led to the loss, or near loss, of human lives, sometimes in the hundreds. In a way, this book deeply values life, and one possible outcome would be that people could be more aware of mitigating such errors. In the final chapter, titled “So, What Have We Learned from Our Mistakes?,” Parker writes:

I’ve done a lot of research from accident-investigation reports that were publicly released, but that generally happens only when there is a very obvious disaster. Many more, quiet mathematical mistakes are probably swept under the rug. Because we all make mistakes. Relentlessly. And that is nothing to be feared. Many people I speak to say that, when they were at school, they were put off mathematics because they simply didn’t get it. But half the challenge of learning math is accepting that you may not be naturally good at it, but if you put the effort in, you can learn it. As far as I’m aware, the only quote from me that has been made into a poster by teachers and put up in the classrooms is: “Mathematicians aren’t people who find math easy; they’re people who enjoy how hard it is.” (p. 7)

This is a book which outlines mathematical mistakes in the hope that it could prevent some future mistakes; this hope is laudable, and it provides some levity along the way, which is sorely needed in 2020. However, the example of the UK government refusing to change the picture of an incorrect soccer ball on their signs suggests that many mathematical mistakes are likely to be commonplace.

Finally, it should be noted that the book is not only about mistakes, it also provides lots of “Wow, I didn’t know that!” moments. Did you know that a year of “seasons” and a year of the earth’s orbit are not the same thing? The book is peppered with vignettes such as this that keep the reader wanting more. In the end, the book is entertaining, includes a lot of fresh examples of math in the real world that STEM educators might find helpful, and is written for a broad audience. The fact that mathematics goes wrong in the modern world mostly in connection with computers is important to note; that there are so many ways for it to go wrong is fascinating.

Reviewed by Thomas J. Clark, Department of Mathematics and Statistics, Dordt University, Sioux Center, IA 51250. ●

Animals Are an Integral Part of Healthy Agriculture

Thank you to Dorothy Boorse for the review in the June issue of *Perspectives on Science and Christian Faith* (vol. 72, no. 2 [2020]: 112) of the book *Beyond Stewardship: New Approaches to Creation Care*, ed. David Paul Warners and Matthew Kuperus Heun. I have this book (currently on loan to a friend) and found it a very stimulating and thought-provoking collection that has me rethinking my use of terms such as stewardship and natural resources. It would be great for a small group study.

I do have a couple of concerns, including advocacy to remove animals from agriculture. I strongly believe that agriculture needs to transition from an industrial paradigm to an ecological paradigm. Healthy ecosystems, including agricultural ecosystems, have animals as an integral part (and I am not referring to live-stock factory operations). For example, water quality is a major issue in my home state of Iowa. There are a range of remediation techniques available, but the more perennial vegetation that is on the landscape, the better. Although there is exciting and encouraging experimental work with perennial grains, notably Kernza, currently the kinds of perennial vegetation from which an agriculturist can earn money are largely forage crops, which means livestock. Also, my former officemate, who works with farmers, says that fertilizers that meet organic standards are essentially manures. At least one study found that integrating crops and livestock increased beneficial insectivorous birds without increasing granivorous birds, suggesting that such agricultural systems may benefit natural pest control without increasing the risk of bird damage to crops.¹ There is a need for theologians and theoretical ecologists to interact with those who make their living from Creation (i.e., farmers, ranchers, owners of working forests) and those who directly work with them (i.e., county agents, state agency personnel, scientists at land grant universities).

Note

¹Olivia M. Smith et al., "Highly Diversified Crop-Livestock Farming Systems Reshape Wild Bird Communities," *Ecological Applications* 30, no. 2 (2019): e20231.

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