Biology

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Environment

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

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

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

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

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

and a pleasant surprise, containing unvarnished attempts at truth-telling that contrast starkly, in content and tone, with everything else you have read.

In the end, Denny argues that we need to use all the tools available—science, technology, diplomacy, and our very limited supply of wisdom—to avoid the worst effects of climate change. For example, he recommends that we nurture and develop, rather than reject, the "technological monster" of nuclear power, in spite of our disappointments with it (three accidents so far). Don't like nuclear power? He demonstrates the human brain's general inability to understand risks in a one-page chapter entitled "You Suck at Statistics."

It is stunts like this that make reading *Making the Most of the Anthropocene* so enjoyable. Many of Denny's chapter-essays are fascinating, opinionated, and subversive. Love, peace, and granola, anyone (chap. 31)? While at first they seem loosely connected to each other, eventually they form a web. Why does it matter that "Nobody Understands Economics" (chap. 35)? Economic scenarios are a larger uncertainty in next-century climate projections than the scientific uncertainty in climate models, and this has been true for many years.

Denny has written at least nine previous books about science for a general audience, and his ability to avoid jargon and hold the reader's attention while still getting the science right rarely wavers in this one. The only error I noted in the entire book had to do with details of the history of the discovery of the ozone hole by members of the British Antarctic Survey—a minor issue that does not substantially detract from the overall achievement. In this book, Denny has expanded his scope to cover a lot more than science, and readers will benefit from his ambition.

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Ethics

LOSING SUSAN: Brain Disease, the Priest's Wife, and the God Who Gives and Takes Away by Victor Lee Austin. Grand Rapids, MI: Brazos Press, 2016. 150 pages. Paperback; $17.99. ISBN: 9781587434075.

Victor Lee Austin's *Losing Susan* is a difficult book to classify. One could potentially find it shelved in bookstores under biography, medical ethics, caregiving, death and dying, spirituality, or theology. It would not be out of place in any of these sections. *Losing Susan* can also be a difficult book to read. The very title of the book gestures toward the unflinchingly honest and often painful account of a husband attempting to care for his wife in the face of terminal brain disease. The "In Memoriam" page with which the book begins signals to the reader from the outset that there will be no fairy tale ending to this story. The shadow of death hangs over everything. Even the depiction of the joyous courtship and marriage of the Austins ends on a foreboding note with the observation, "It would be fifteen years before her tumor was found" (p. 21). However, darkness is not the couple's only companion. There is another strange, often silent, character who accompanies Susan and Victor as they journey through the valley of the shadow of death: "the one everyone calls God" (p. 10). It is the God "who gives and takes away," whose presence sustains Victor and whose sheer ineffability gives rise to this priest and theologian's most raw and piercing reflections.

The book is simply divided into three chapters, entitled, "The Beginning," "The Middle," and "The End." "The Beginning" traces the initial meeting between Victor and Susan, the blossoming of their friendship while walking together to church during college, their courtship, and the early years of their marriage. Set to the soundtrack of the Song of Songs, the opening chapter is the story of a man who has been given the desire of his heart and has the opportunity to delight in the embodied presence of his bride. In the person of Susan, we encounter a woman of deep faith, with an aptitude for hospitality and for organically integrating the habits and practices of the Christian faith into the ongoing life of the home. A gifted writer, Susan stands as a true intellectual equal and spiritual partner to her husband.

Susan's first seizures led to the detection of her brain tumor and marked the beginning of her descent into illness. "The Middle" depicts this period of almost twenty years during which Victor would come increasingly to serve as caregiver to his wife. While this period is not bereft of grace or moments of joy, the burden of being a caregiver to a spouse whose health is failing takes its toll. Austin is racked by the guilt of not recognizing particular symptoms earlier. He experiences the agony of having to treat his life partner and mother of his children as a child herself. He is plagued by the anxiety that is brought on by the feeling of being out of control and not knowing how to respond to Susan's condition.

The occurrence of a grand mal seizure in July of 2011 marks the beginning of "The End," which traces the last year and a half of Susan's life. Amidst the forthright description of the travail and anguish that accompanied such things as selecting a nursing home

and signing a "do not resuscitate" order, Austin is also able to write movingly about finding joy in the midst of caring for a now-incontinent spouse. The relational journey which began as a type of Song of Songs existence now moves into the territory of the book of Job. While Austin refers to Job as "the best book in the Bible" (p. 135), it is ultimately the crucified Christ screaming out in prayer to God who is given the last word. *Losing Susan* then concludes with a hauntingly beautiful midrash on the crucifixion and resurrection of Christ written by Susan Austin entitled, "To Plumb the Depths of God's Love."

In some ways, *Losing Susan* could be seen as an indictment of a medical system that now treats conditions, rather than patients. While Austin is thankful for the medical treatment that Susan has received, his first-person account of the bewilderment that he often experienced as a medical layperson attempting to navigate the labyrinthine realities of the medical bureaucracy in his efforts to secure the best care of his wife should be required reading for all healthcare professionals. The darkness of this largely inhumane, and often inept, healthcare system was punctuated by glimmers of light in the form of particular nurses, therapists, and doctors, who took the time to genuinely care for Susan, advocate for her needs, and listen to her family.

In keeping with Austin's conviction that there are three major *dramatis personae* in this story, theological reflections are skillfully woven throughout the book. As one might expect, there are significant discussions of the gift of love, faithfulness, and the problem of evil. However, Austin's telling of the story also allows him to reflect upon other less obvious theological themes, including how we come to know God, the relation of free will and providence, the doctrine of the Trinity, and prevenient grace, to name just a few. The centrality of the embodied character of human existence is a recurring theme throughout the book. Also present are important practical reflections upon the comfort found in the liturgy, the importance of pastoral visitors for the sick and their families, and the experience of being sustained by the prayers of the community of faith.

This short but poignant book will find an obvious audience among caregivers, health professionals, ethicists, and theologians. Beyond that, it commends itself to all people of faith who are ultimately pressed with the painful question of the seeming absence of the God who has drawn so uncomfortably near to us in the flesh of the crucified Jesus.

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History of Science

REVOLUTIONARY SCIENCE: Transformation and Turmoil in the Age of the Guillotine by Steve Jones. New York: Pegasus, 2017. 353 pages. Hardcover; $27.95. ISBN: 9781681773094.

Have you ever wondered why so many Paris Metro stations carry the names of French scientists and intellectuals? *Revolutionary Science* is a book that may give a partial explanation. The book surveys the rich scientific landscape of the French capital and details the contributions of many late eighteenth-century scientists, aristocrats, and radicals who lived during the French Revolution. The book is written by John Stephen Jones, former Head of the Department of Genetics, Evolution and Environment at University College, London. He has also been a BBC television presenter and has won the 1996 Royal Society Michael Faraday prize "for his numerous wide-ranging contributions to the public understanding of science," or to use the French term that I am confident Jones would prefer, *"vulgarisation scientifique."* Jones is in love with France, particularly Paris.

Paris was the world capital of science at the time of the French Revolution. Jones creates an elegant and stimulating narrative recounting the many scientific discoveries made by Enlightenment-era French scientists, radicals, and intellectuals. At the same time, Jones wants the reader to become aware that these same persons were also deeply involved in civic and business affairs. We think, naturally, of their efforts to develop a system of weights and measures, of Antoine Lavoisier's chemical and physiological investigations, of the development of modern cartography, of the many discoveries in electricity—such as the unit for electrical current by Andre-Marie Ampere, of the study of metabolism by Lavoisier and Laplace, of the investigation of venereal disease or the introduction of new food-stuffs—such as the potato by Parmentier—into the French cuisine. But, Jones reminds us, Lavoisier was also a munitions expert and tax-collector; Lagrange, founder of the decimal system of measurement, was President of the Senate later in life; and E. I. du Pont de Nemours was both a chemist (expert in explosives) and founder of the world's largest chemical company after he fled to the United States.

In many ways this is an unusual history of science book. Ostensibly a book about science in revolutionary France, it wanders in ways that cleverly illuminate later developments. During any specific wandering, we are offered fascinating historical tidbits of information. One word of warning: it would

help to have a French dictionary at hand. For example, in chapter 1, "The Wall of the Farmers-General": the wall, which was a tax-collection site for farmers bringing their produce into Paris, was derided by French citizens in the extremely clever epigram, *"Le mur murant Paris rend Paris murmurant"* [The wall surrounding Paris renders Paris murmuring or, stronger yet, growling] (p. 34).

The third chapter is representative of the format of the book and the structural flow of each chapter: Begin with an arresting title ("Let Them Eat Chips"), provide a journalist's eye for detail, and then weave the details about the person's life, cultural, civic, and scientific efforts and influence into a compelling story. Marie Antoinette may have uttered the famous phrase "Let them eat cake" to hungry and revolutionary French citizens. Jones, however, introduces us to Antoine Parmentier, trained as a medical chemist and later the chief apothecary to the Napoleonic armies. Parmentier first planted potatoes in the King's royal garden and then promoted them so avidly that the potato came to play an important role in the French diet.

This narrative strategy is faithfully followed in other chapters. For example, chapter 2, "From Ash to Ash," is devoted to the role of the element nitrogen in development of explosives from saltpetre to TNT, with attention paid to such luminaries as Lavoisier, DuPont, and Alfred Nobel. Chapter 7, "A Degree of Latitude," introduces us to the world of measurement (metrology) alive in Paris. It details the shaky foundations of the metric system as well as efforts to establish the Paris meridian. The last two chapters (8 and 9), "President Jefferson's Moose," and "Handing It On," introduce us to such biological luminaries as Buffon, Saint-Hilaire, Cuvier, and Lamarck. However, one looks in vain for a discussion of religion/science themes. These themes are rather muted, even when Lamarck or Darwin are on offer.

This is the American edition of *Revolutionary Science* and it carries a different title than the original British title: *No Need for Geniuses: Revolutionary Science in the Age of the Guillotine*. Jones's original title comes from an apocryphal comment made by one of the judges at the execution of Lavoisier (the tax-collector) by the guillotine. In fact, in the prelude (p. 32) and conclusion (p. 343), Jones claims that you are reading a book with that title. More rigorous editing was in order. The book would also benefit from more explanatory notes and a bibliography, though one should keep in mind that Jones did not aim to write an academic historical treatise. There is also another factual error on p. 68, where Jones states that the arrangement of the chemical periodic table is based on the atomic weights of the elements, rather than on their atomic number (that is, the number of protons in the nucleus).

All in all, this is a pleasurable book to read, giving an English-speaking reader a much better insight into the lives of many of these French administrative scientists (see p. 338). Many of them ended up as martyrs to the Terror. Those who survived, after pragmatically testing the winds of change, would later occupy many influential civic roles.

Reviewed by Arie Leegwater, Calvin College, Grand Rapids, MI 49546.

ESSENTIAL READINGS IN MEDICINE AND RELIGION by Gary B. Ferngren and Ekaterina N. Lomperis. Baltimore, MD: Johns Hopkins University Press, 2017. 278 pages. Paperback; $32.95. ISBN: 9781421422909.

Essential Readings in Medicine and Religion is a companion piece to Ferngren's 2014 book, *Medicine and Religion* (see my review in *PSCF* 66, no. 4 [2014]: 256–258), and "supplies a collection of texts and places them in their respective contexts in order to specifically address the historical relationships between medicine and religion." The authors are knowledgeable about this subject: Ferngren is both a professor of history at Oregon State University and a professor of the history of medicine at First Moscow State Medical University; Lomperis is a PhD candidate in theology at the University of Chicago and holds a junior fellow position at the Martin Marty Center for the Advanced Study of Religion. In a manner similar to *Medicine and Religion*, this book provides a historical overview of human history at the intersection of medicine and faith over several millennia. The book has a straightforward format over its eight chapters. The authors provide an overview of a historical period; this is then followed by a series of writings from that geographic region and time. The authors provide histories of each period that are easy to read, and I believe the chosen writings are pertinent and illuminating.

The book begins in the Ancient Near East, composed of ancient Egypt and Mesopotamia (including Israel) in which disease was attributed to actions of the gods (as retributive), to demons and sorcerers, or to a consequence of natural mechanisms (such as fractures). Early human writings in this region of the world described disease processes related to sin, which required forgiveness from a deity. It is fascinating to realize that such thoughts are still present in many aspects of human culture 3,000–4,000 years later. An introduction to Greek literature follows in which the professionalism of medicine is first codi-

fied from the writings of Hippocrates. Although Hippocrates had nonphysiologic-based beliefs that continued to hold sway for many centuries (such as the belief in "four humors"), he and his surrounding culture concentrated on the natural aspects of disease. Using a physician to cure disease was deemed essential ("Prayer indeed is good, but while calling on the gods man should himself lend a hand"), and the codification of medical professionalism began to occur via writings such as the Hippocratic Oath.

The authors then continue with a chapter on the Roman medical beliefs, in which a significant change occurred. Initially, the healing arts were colloquial, involving the male head of the household using folk remedies; however, over time Greek influences developed medical professionalism as early as the 200s BCE. The authors point out that although religious cults existed to cure disease, a naturalistic approach to therapy was emphasized. As Sophocles said: "No good physician chants incantations over a malady that needs the knife." Greek and Roman culture influenced Western thought in which individuals over the centuries have subsequently used medical professionals for healing of disease, as compared to the use of alternative spiritual/religious techniques.

Next the authors explore Christianity and medicine. They point out that Jesus performed exorcisms in the Gospels, but he also performed separate healing miracles. Thereafter, early Christians attributed disease to God, demons, or natural processes, but they also tended to minimize the association of sin with disease. Although at times persecuted, early Christians in Rome cared for the sick and buried the dead during times of plague throughout the empire. They were instrumental in the initial development of the idea of a hospital in 372 CE to care for the poor, sick, and orphaned. As a physician, I found it interesting to read the accounts of early hospitals, including those written by Jerome who wrote about Fabiola, founder of the first hospital in Rome in 390 CE, in that such institutions provide parallels to modern hospital care.

The authors follow with "The Middle Ages" and this period's emphasis on "library medicine," which included reading authoritative texts while ignoring any semblance of experimentation to improve care and outcomes. This chapter, in particular, has relevance to modern medical science, in which there is a growing concern that the understanding of translational science (the so-called "bench-to-bedside" phenomenon) has become a lost skill among physicians.[1] During this period, medical education shifted from monasteries to universities, a change with effects lasting to our current times. The chapter that follows ("Islam") is extremely beneficial, as that culture brought forth many innovations that are still used in modern medicine, including the importance of physical medicine, medical ethics, and "medical encyclopedism" that has some parallels to modern medical journals.

The chapter on "The Early Modern Period" emphasizes the influence of both the Protestant and Catholic reformations in relation to medical theory. Specifically, old ideas were reevaluated for relevance. Martin Luther believed society should use medicine but also believed that it should be recognized solely as a gift from God. Andreas Carlstadt recommended the detachment of the spiritual from bodily influences, such as food and medicine, while instead yielding to the will of God. These disparate ideas have influenced current false notions about medicine. The idea of reevaluating or reforming medical therapies based on the scientific method is extremely valid; however, movements that have entered the realm of pseudo-science, such as homeopathy and the anti-vaccination movement, have continued to be disastrous. The book ends with "The Nineteenth through the Twenty-First Centuries," the "modern" approach to the medicine and faith intersection. The authors discuss the growing influence of secularism, the use of faith-based organizations to provide medical outreach, the belief of some Pentecostals that only unbelievers use medicine, and the continuing ethical and moral issues raised by advanced medical technologies, including genomic medicine.

Overall, this book is very good, and I would recommend it to anyone who has an interest in faith-medicine issues. As a physician, I interact with families who would prefer to use prayer over medicine, and although this issue can be difficult to discuss in the clinic and hospital setting, I think understanding the historical background of such ideas can provide insight for further patient-family-physician conversations to improve care. Additionally, the book's format of providing a historical overview of a time period followed by relevant writings is extremely helpful, and this book may be most beneficial as a reference.

I found a minimal number of weaknesses in the book. I would have preferred more writings from China and India, which have had a significant influence on the field of medicine. Moreover, I think the book would have benefited from even more modern writings, especially with regard to theology and the genome, as well as theology in relation to medical ethics—extreme prematurity care, use of biologic agents, healthcare costs, and end-of-life care come

to mind. However, more writings can be included in future editions. I would highly recommend this book to anyone who is interested in the relationship between faith and medicine as it stretches across human existence.

[1]A. Schafer, ed., *The Vanishing Physician Scientist?* (Ithaca, NY: Cornell University Press, 2009).

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Origins

EVOLUTION: Scripture and Nature Say Yes! by Denis O. Lamoureux. Grand Rapids, MI: Zondervan, 2016. 196 pages. Paperback; $16.99. ISBN: 9780310526445.

The title of Denis Lamoureux's newest book says more than a reader might get from a first glance. A first glance might suggest that this is simply one more book arguing that scripture, properly understood, does not preclude a belief that living things arose through the natural process of evolution. *Evolution: Scripture and Nature Say Yes!* does make that argument, but the title also reveals Lamoureux's deep commitment to learning from both scripture and nature. He argues that "[t]ogether these two divine books provide an integrated revelation of our Creator, his creation, and us" (p. 181) and that Christians who limit themselves to one or the other will find their understanding of God, creation, and themselves to be incomplete.

Lamoureux unfolds this argument by first disassembling the belief that Christians must choose between science and faith—between evolution and Christianity. He does not dismantle this common approach to science and faith without leaving the reader with another option. He opens "Two Divine Books" in chapter two, offering an alternative to biblical concordism and including excellent examples of scientific findings that support evolutionary theory. In chapter three, he provides language that more clearly defines beliefs and belief systems. He clearly explains what it means for evolution to be a scientific theory. He distinguishes between purposeless and purposeful creation. He concludes chapter three by offering a new way to think about the relationship between science and faith that is free from an "either/or" dichotomy (p. 60).

Chapter four delves into a discussion of design. Again, Lamoureux provides helpful and important distinctions and definitions. He distinguishes between Intelligent Design Theory and the general concept of intelligent design. He also lays out his understanding of special revelation and general revelation. He argues that "creation offers a divine message that is active, understandable, non-verbal, never ending, universal, revelatory, rejectable, and makes humans accountable" (p. 73). He carefully avoids overextending the limits of creation's witness when he makes it clear that "though the physical world clearly reveals that there is design, it does not tell us precisely who the Intelligent Designer is" (p. 83).

The idea that the Bible contains ancient science is the focus of chapter five. Lamoureux's theological and biblical argument for accommodation is compelling and helpful. He includes examples of ancient science from botany, human reproduction, taxonomy, astronomy, and geology. I think readers would find it difficult to finish reading this chapter and not agree with his conclusion that the Bible is not a book of science, but rather a book that "convicts us of our sinfulness and reveals that Jesus can restore our relationship with God" (p. 112).

I found the last chapters of this book quite helpful. Chapter six lays out various positions along the Young Earth Creation/Dysteleological Evolution continuum. Chapter seven considers the historical example of Galileo to illustrate how both scripture and science can be misused, and makes a compelling case for complementary roles for scripture and science.

Chapter eight discusses Darwin's personal struggle with religion. Lamoureux cites Darwin's own words to dispel the perception that Darwin was a steadfast atheist. Some readers may find comfort in learning that Darwin's questions about faith mirror their own. The book ends with a personal chapter in which Lamoureux narrates moving stories of students who have shared with him their struggles with an either/or worldview.

Lamoureux, who holds PhDs in both biology and theology in addition to a doctor of dental surgery degree, has a remarkably personal and accessible writing style. His tone is conversational, inviting the reader not only into the depths of his biblical and biological knowledge but also into his personal journey of faith. In fact, it may be this simple, personal, open voice that is the greatest strength of his book, which makes it more accessible than his earlier *Evolutionary Creation: A Christian Approach to Evolution*. Some of the arguments in the book are condensed and simplified versions of the arguments he laid out in *Evolutionary Creation*. However, the audience for this book is different from his earlier book.

This book is not for those who have comfortably settled in the Evolutionary Creation/Theistic Evolution

camp. It does not address human evolution in any depth or explore the newest genetic evidence for evolutionary theory. Rather, it is for those who are just embarking on a journey of reconciling evolutionary theory and their Christian faith. It is easy to read, understandable, clear, and accessible enough that beginners will not get lost in the details of the science or the theological arguments. Evangelical Christians will welcome his evangelical faith, expressed without hesitation, and will be drawn into his contagious enthusiasm for science. I will keep a few copies of this book on my office shelf to loan to students who come into my office with questions about how to navigate the integration of science and faith.

Reviewed by Sara Sybesma Tolsma, Professor of Biology, Northwestern College, Orange City, IA 51041.

Science and Religion

MAKING SENSE OF SCIENCE: Separating Substance from Spin by Cornelia Dean. Cambridge, MA: Harvard University Press, 2017. 281 pages. Hardcover; $19.95. ISBN: 9780674059696.

Science can tell us what foods and activities are healthy for us, what medicines we should take when we are ill, where and how we should build our homes, how our activities can affect the environment and human health, and the viability of local and global economic activities. However, despite its success at illuminating the workings of the cosmos, the information science provides is rarely wholly unambiguous, leaving the way open for unscrupulous or unwary hucksters to manipulate, denigrate, and exaggerate scientific claims as they craft whatever narrative best serves their particular interests. Thus the public, the politicians and policymakers charged to represent them, and journalists reporting on scientific issues often find themselves presented with assertions of dubious veracity, if not multiple mutually incompatible scientific claims. Cornelia Dean's *Making Sense of Science: Separating Substance from Spin* is designed to help nonscientists navigate this situation.

Dean has thirty years of experience as a science journalist, including seven heading the *New York Times* science department. *Making Sense of Science* grew out of her concerns about the decline of responsible science coverage in an age where misinformation promoting websites is easy to come by. Her 2009 book, *Am I Making Myself Clear?*, attempted to fill in the gap by equipping scientists to communicate with the public. *Making Sense of Science* is a follow up to that work, this time aimed at helping the public assess scientific claims.

Dean's stated aim in *Making Sense of Science* is to show "the kinds of thinking we do in the newsroom when we try to decide whether a given finding is newsworthy, trustworthy, and important." However, she also seeks to equip her readers with the ability to make such judgements themselves, even providing an appendix with guidelines for evaluating scientific claims.

Making Sense of Science is divided into five chapters, which gradually transition from preparing readers to interpret scientific findings to exploring a host of issues associated with how scientific information is used and presented in the scientific community, the courts, marketing campaigns, politics, and other venues. The first chapter addresses how popular aversion to science and uncritical thinking lead us to misinterpret both scientific information and its relevance for our lives, particularly when understanding and acting on risks. The second outlines how science works, and what distinguishes science from nonscience. Dean explores the nature of scientific knowledge and explains how population-based studies are designed, how statistical data analysis and model building affect the results of scientific studies, and how the peer review and publication process gives preference to certain types of findings. The third chapter, entitled "Things Go Wrong," explores problems that can occur both within science and as science engages the wider world. It covers a range of moderately disjointed topics including not only scientific misconduct but also problems with the use of science in the courtroom, how scientists interact with journalists, and how the media handles scientific controversies. The fourth chapter focuses on how financial interests can work against the scientific ideals of "universalism, communalism, disinterestedness, and [detached scrutiny]," by discussing numerous issues related to diet, medicine, and health. The final chapter addresses the impact of politics on science as well as the use and abuse of science in politics, a topic that also serves as a sort of common thread running throughout the book. Noteworthy for exploring how political considerations exert an influence on what scientists study and how science and technology shape public policy, it concludes with Dean's assessment of the evolution wars and the compatibility of science and religion.

So has Dean succeeded in achieving her aims? *Making Sense of Science* is easy to read at the sentence level and clearly illustrates how journalists evaluate scientific findings. However, it is less clear whether she has successfully equipped her readers with the

tools needed to evaluate scientific claims. Her work explores many concepts needed to understand how scientific knowledge is produced, disseminated, and deployed and offers useful rules of thumb that readers can use to evaluate scientific findings, including a very helpful discussion of the role of probability and statistics in scientific model building, forecasting, and evaluation. However, readers are likely to lose track of Dean's argument amidst the book's rambling discourse, a problem exacerbated by poor editing. In some places sentences unconnected to the topic at hand seemingly appear out of nowhere and in others a discussion is dropped in midthought, only to be picked up pages later with nary a reference to anything said in between. Readers are also likely to be confused by how often Dean's own judgements ignore her own guidelines for responsibly assessing scientific findings. For instance, her treatment of food and health largely eschews careful analysis in favor of extolling the virtues of organic agriculture and demonizing "Big Ag." At one point she even stoops to encouraging readers to avoid foods for which you would "need a degree in chemistry to know what you are eating."

Dean's portrayal of science is also at times misleading. She understandably focuses on science of interest to medical, environmental, and public policy concerns, much of which can be difficult to study or relies on speculative modelling. This, along with Dean's tendency to focus on problems in science rather than its ordinary operations, means that Dean effectively leaves readers with the impression that science is a more tepid, self-contradictory, and error-prone enterprise than it actually is. In short, the science she enjoins her readers to make sense of is far too easy to dismiss. This makes it hard to take her seriously when she alternately portrays science as unsure and encourages readers to accept the reality of global warming or scientific origin accounts on the authority of a supposed consensus.

Dean's reliance on the authority of luminaries rather than argumentation also limits the usefulness of the work as a resource for those who wish to understand the actual content of science and society issues or engage in the sort of thinking needed to develop their own position. This is well illustrated by her treatment of science and religion. Dean's account focuses narrowly on public debates over origins science and is at its best when exploring the debate's American educational context and the Discovery Institute's antievolutionary efforts. In contrast, the case for consensus origins science and its incompatibility with "literal" creation accounts that address "our place in the universe" are largely addressed via assertions based on the authority of mainline science and religion luminaries. Nowhere does she seriously explore the content of either evolutionary science or antievolutionist objections to it. Thus while readers of *PSCF* will likely find themselves in sympathy with her conclusion, that it is possible to believe in both science and a God "to whom one can pray," readers who do not agree with her at the outset will likely be left unpersuaded of either the reliability of evolutionary accounts or their compatibility with a coherent Christian theology.

It is also worth noting that while I enjoyed hearing Dean's insights into the role of special interests in the shaping of public perceptions and policy, her treatment of familiar topics often seemed sloppy, inaccurate, and misleading. The most notable example involved her confusion of ground level ozone with chlorofluorocarbons and smog, although it is also evident in her shallow account of scientific rationality based on an overly simplistic account of Popperian falsifiability and her sloppy use of ambiguous examples when summarizing Daniel Kahneman's *Thinking, Fast and Slow*. This left me wondering whether Dean accurately portrayed topics I knew less about.

Nevertheless *Making Sense of Science* can still be commended as one of the few popular-level books that seek to address the role of cognitive bias, modeling and statistics, and science's social and professional structure in the making of scientific claims. Dean is also at her best when discussing the public context of scientific issues; readers of *Making Sense of Science* will gain an appreciation for how science impacts American life. Dean also does well to introduce readers to the concepts and precedents that guide regulators, jurists, and others who use scientific findings in decision making, thus cautioning them about the role of politics and special interest-driven marketing campaigns in sidestepping the implications of unwelcome scientific findings. Yet in its treatment of scientific issues, *Making Sense of Science* does better at spurring further study than offering a clear and reliable guide.

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ASTROPHYSICS AND CREATION: Perceiving the Universe through Science and Participation by Arnold Benz. New York: Crossroad, 2017. 144 pages. Hardcover; $13.56. ISBN: 9780824522131.

In this short work, Benz takes the reader on a tour of the universe while also trying to make sense of religious experience. He does the first very well. But in the process of building his philosophy, he ends up

throwing out the Christian God, whom he replaces with an undefinable force that is known through "participatory perception."

The length of this book belies the breadth of its content. It is packed full of information and ideas spread over 12 chapters and divided into 3 parts. The first part is a description of the universe, focusing primarily on star and planet formation, entitled "Amazing Formation." Here Benz shows his ability to simplify complex science to a popular audience. Molecular clouds, accretion disks, planets, stars, black holes, and the big bang all are described without technical language. In fact, as part of the translation into English, he even removed SI units. For example, a density measurement is described as atoms per gallon instead of per cubic meter or centimeter. It is impressive and approachable for someone without background in astronomy.

The second part is entitled "Dissolution and Horror" and deals with topics such as stellar evolution, supernovae, and extinction causing meteors. Again, the science is accessible and engaging. Here Benz begins to build his thesis by pointing out that the formation of stars and planets required the destruction of previous generations of stars through supernovae, and biological evolution was shaped by meteors (among other destructive processes).

In this section, he also builds his philosophy of reality and science in chapters 7 and 8. He argues that reality perceived through science is on a different plane than religious "perceptions." This is not just observing reality through different lenses, but observing different levels of reality. For Benz, the overlap comes through "participatory perceptions." An example he provides is art. When observing a painting, colors can be defined scientifically with light wavelength or frequency. The chemical composition of the paint can be studied and is different depending on whether the artist used watercolors or oils. But an individual can also be moved by art at an emotional level and that emotional engagement is not quantifiable. Both the scientific observations and the emotional perceptions are real, but they reflect different kinds of reality.

However, science and other "perceptions" are interpreted; so in chapter eight Benz describes three types of interpretations. The first is "explaining and modeling." Scientists interpret this way when they use the scientific method and then publish their results. "Comprehending" is nonmathematical and might be best modeled by what Benz himself did in chapters 1–6. Finally, "construing" is what scientists do "with friends in the evening over a glass of wine at the fireplace," or, as reflected in the last four chapters, what scientists "write in popular science books." I see this chapter as the keystone that holds the rest of the book together. It is an interesting way of thinking about interpretation, though those in the social sciences and related areas of research would object to his claim that explaining and modeling require mathematical equations.

From here, Benz goes downhill rapidly in part three, "Interpreting the Universe as a Creation." Since he thinks that God cannot be seen in science, he is left with "construing" as the only remaining avenue to God. He is obviously fully engaged with existentialism. He rightly rejects the deistic "watchmaker" god and the nonoverlapping magisteria model of faith/science integration. But in the process he redefines God and Creation to be unrecognizable to traditional Christian theism.

First, he defines creation as the recycling of new out of old. As new stars form out of molecular clouds that are the remnants of previous stars' supernovae, so Jesus's resurrection was a new hope and new life out of death and despair. When Benz speaks of creation, he does not refer to God's making the universe out of nothing (*ex nihilo*). Rather, old material must be present and creation is better understood as recycling (*creatio continua*). It should be noted that Benz is agnostic about the origin of the big bang. He repeatedly says that we cannot know anything about its origin; he is happy to leave God out of it. This was surprising, as most Christian scientists argue that the big bang fits the biblical testimony of creation *ex nihilo*. Benz argues that his conception of creation as a regenerative process is how it would have been understood by ancient readers, but provides no support for this claim.

Secondly, Benz's concept of God appears to be something more akin to a transcendent force. On several occasions he opposes the idea that God is a person. He claims that conceiving or describing God as a person is simply metaphorical. Obviously, this is a significant departure from orthodox Christian belief. In what sense is Jesus God if God is not a person? Benz argues that characteristics of personality were ascribed to God by the writers of scripture as an attempt to make sense of their experiences. But traditional Christian theology argues that our personhood was given to us as part of being made in God's image, not the other way around. Again, Benz provides no support for this concept of God except to claim that the traditional view is "much criticized among physicists." Criticism by physicists is hardly proof or reason to abandon centuries of confessional Christianity. To support his claim that the traditional

view is "much criticized," Benz provides only one reference, that of Albert Einstein. Statements such as "God cannot be experienced objectively" raise questions about the incarnation. One of the unique aspects of Christianity that apologists often cite is that Christianity and the Bible make historical claims. Jesus, the God-man, coequal with the Father, told his disciples to make physical observations to confirm his resurrection (Luke 24:39; John 20:27).

In sum, there is one major assumption that Benz makes as outlined in the preface to the English edition. This is that "God cannot be evidenced by scientific methods." In defense of this claim, Benz uncritically cites Hume, including Hume's thesis that miracles are impossible, without ever acknowledging the many Christian responses. Since Benz cites the resurrection as an example of his idea of creation, I wonder if he considers it to be a literal, physical, and observable miracle. Those who disagree with Benz's assumption will remain unconvinced. But oddly enough, Benz says there is at least one condition in which he would recognize scientific evidence for God: if the laws of physics were one way on Earth, or in our region of the universe, while different elsewhere. I found this strange but keeping in line with his rejection of traditional Christian thought. Christianity has offered a framework in which science can flourish by understanding God as immutable and constant. The laws of nature are universal because they reflect God's attributes. This offers a response to the problem of induction. But Benz rightly acknowledges induction as a piece of the scientific process. The conclusion we are left with seems to be that only a God whose laws are not universal would be detectable by science, which depends on the universality of natural laws!

Perhaps Benz avoided the dialogue and debate that might make his philosophy more robust because the book is intended for a popular audience. The science content is engaging and accessible. But I wonder if the average person looking for an accessible review of astrophysics wants a popular work on existentialism. The Christian wanting a perspective on faith and science will find the faith dimension sorely lacking.

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ON FAITH AND SCIENCE by Edward J. Larson and Michael Ruse. New Haven, CT: Yale University Press, 2017. 298 pages. Hardcover; $30.00. ISBN: 9780300216172.

Two of the most distinguished, well-known historians and philosophers of science collaborate in another recounting of the historical encounter between science and faith. Much has been written on this topic and one might wonder what new insights there could possibly be. Yet, these skilled authors shed more light on the interface between these two paradigms.

Ed Larson is professor of history and Hugh and Hazel Darling Chair in Law at Pepperdine University. His most acclaimed work is the book *Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion*, for which he received the Pulitzer Prize for History in 1998. He has written nine other books, several of which deal with evolution and creation, and has made frequent appearances in public forums to discuss faith and science.

Michael Ruse is Lucyle T. Werkmeister Professor and director of the History and Philosophy of Science program at Florida State University. He taught at the University of Guelph in Ontario for 35 years and has been at Florida State since 2000. Though a self-described atheist not subscribing to Christian faith, Ruse argues that Christianity and evolution are compatible and he disagrees sharply with the harsh arguments of the so-called "new atheists." He has published numerous books and articles and participated in countless public events to make his case.

Larson and Ruse alternate as lead authors of the nine chapters, blending the views from their expertise in history and philosophy, respectively. They do not claim to be breaking new ground or proposing major new insights. Rather, they want to show how the science-faith interface cannot be described in a straightforward set of models, such as the conflict model or the compatibility model. They

> favor what might be called a "coexistence" approach, which views religion and science as two big messy and sometimes internally inconsistent categories of human perception and understanding that coexist in the same place and time, sometimes in a complementary or conflicting relationship but most often in a complex one, with both categories currently growing in influence and authority in many regions. (p. 12)

The conflict model exists and thrives as well as the complementary approach, with a wide range of complex interactions in between.

The first two chapters provide a high-level overview of the trajectory of science, particularly astronomy and physics, from ancient days until now. Ancient metaphors depicted the universe as an organism largely controlled by gods or vital forces. Then Galileo, Kepler, Newton, and others helped to transform the metaphor from that of an organism to that of a machine. The mechanistic universe took hold, incorporating even biology, thanks to Charles

Darwin, until the twentieth century revolutions of quantum mechanics and relativity shook the foundations. The story as told by these authors is clear and concise. They point out that the dominant players in the Scientific Revolution were Christians and their scientific work was done in the context of what they regarded to be a divinely created universe. The rise of mechanistic and reductionist views also gave room for agnostic and atheistic ideas to flourish, leading to a complex blend of theistic and nontheistic philosophies in science.

Chapter 3 considers the brain, the mind, and the soul. Ruse pens this chapter with a deft articulation of the challenge of understanding consciousness. He shows how advances in computer technology and in modern physics influenced our ideas of the mind and the brain. But in the end, he admits that we have made relatively little progress since Plato when it comes to understanding consciousness. It is no wonder that the "new mysterianism," which claims that consciousness is beyond our comprehension, is an attractive position.

Larson continues with a historical account of geology and how it was primarily Christian geologists who blazed the path in discoveries of the age of the earth. Again, the controversies seldom pitted science against faith in a simple conflict or compatibility model.

Ruse goes on to provide an insightful account of the grand philosophical motivations that set the stage for Darwin's theory of evolution. He points out that humans, particularly in the Christian and Judaic traditions, seek to answer three big questions:

1. Where did everything come from?
2. What kind of world do people live in?
3. Where do humans fit into the scheme of things?

Darwin's ideas provided provocative, though tentative, answers to these questions. While there were similarities to the Judeo-Christian views held at that time, the differences were significant enough to generate a complex set of reactions. The problem of evil, cast in a prominent role in Darwin's ideas, and the clash between Providence and progress seemed to dominate, as they do today.

When Larson traces the scientific ideas that Darwin presented, as well as their reception, he dismisses the broad scope of the biosphere to concentrate solely on the evolution of humanity. He points out that

> the big issue has never been the theory of evolution in general, but applying it to humans. After all, many people care more about humans than they do about other animals. And who cares if plants evolved? But many people find the idea of descending from monkeys or being related to apes as really quite degrading to their self-image. (p. 159)

Ultimately, the Christian understanding of human behavior in the context of a spiritual condition before God comes into conflict with the socio-philosophical extension of Darwinian ideas.

> Today, Darwin's sketchy social theories have matured by way of E. O. Wilson's sociobiology and modern evolutionary psychology to become foundational for understanding in the social sciences. Through these, human behavior is reduced to the physical, and people become merely matter in motion with evolved self-consciousness. (pp. 183–84)

The last three chapters of the book are devoted to highly pertinent issues in today's society. They explore sex and gender, from the mystery of why sexual reproduction exists in the first place to the role that our religious beliefs play in setting our cultural practices. They move on to examine the unsettling history of eugenics with the prospect for modified versions in our hopes for genetic engineering. Finally, they conclude with a chapter on living on the earth, devoted mainly to climate change and the close relationship between Christian stewardship and scientific ecological responsibility.

Few books manage to cover such a breadth of issues with the clarity that these authors do. They provide no easy answers but encourage readers to actively engage in discussion. They provide a very helpful bibliographic essay to guide further research.

The book concludes with the following sentences:

> The inhabitants of this earth face serious physical and social issues. Standing still and doing nothing is not an option. Hard thinking about the science and technology combined with deep moral seriousness and the religious conviction of believers are absolute requirements. Together with the realization that others, no less learned and no less serious, will come from other directions. No one should feel threatened by differences, nor should anyone quake and yield because there are differences. But if humans are in this together, sympathy and understanding are essential. Then perhaps we can move forward together. (p. 276)

Larson and Ruse have provided us with a valuable resource that deserves a place in the library of anyone seeking to understand the history and philosophy of the relationship between science and faith.

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Book Reviews

Technology

THE TETRIS EFFECT: The Game That Hypnotized the World by Dan Ackerman. New York: PublicAffairs, 2016. 265 pages. Hardcover; $15.00. ISBN: 9781610396110.

We may stare at computer-powered screens more and more, but in some ways, we think less and less about digital technology. It has become the water in which we swim: critical to our day-to-day life, and an assumed part of our background. Jacques Ellul warned that Christians, of all people, should be conscious of the ideological imperatives of technology; it is hard for us to bear witness to the world when we don't understand the ground we are standing on.

For me, then, the real value of books like Dan Ackerman's *The Tetris Effect: The Game That Hypnotized the World* is that they drill into the everyday work of technology creation, revealing what a messy and human process it is. As consumers, we frequently purchase shiny digital devices, software products, and entertainment titles without giving a second thought to who makes them and how. But the how matters a great deal, and that's true of something as serious as a hadron collider just as much as of a best-selling plaything.

The Tetris Effect is primarily an in-depth biographical history of the men (and it was pretty much all men) who created, marketed, and distributed one of the most profitable and significant video games of all time. Ackerman weaves a tale that traces the game from its creation by Alexy Pajitnov in the Soviet Union in the early 80s, through its diffusion around the world, to its tortuous legal commercial path into mainstream financial success.

The strength of this account is its highly readable prose and the colorful cast of characters that Ackerman assembles. His blow-by-blow account helps us understand that technology never just *appears* fully formed. We get to see how a programmer in a totalitarian dictatorship gets access to subpar computing equipment and finds space to do creative work. We get to see how cross-border business negotiations—a topic that would normally lull readers who are not in the import/export business to sleep—shape what we as consumers have access to and how the process changes the product. And more than anything else, we get to see how contracts, courts and legal maneuvers define our technology. This book is really a legal thriller in disguise.

That having been said, the book certainly has its limitations. Some of these are due to Ackerman's undoubted need to write for a general audience. Practically all video game history writing at this point is biographical, which means the writers follow individual characters, rather than talking about institutions or large-scale cultural factors. This makes for a pleasing read, but it often obscures the fact that humans are social in addition to being individual.

We like the Great Man theory of technology history (e.g., we got the light bulb from Edison, DNA from Watson and Crick, and the Teflon-coated electric grill from heavyweight inventor George Foreman), as it makes for engaging, accessible stories. But it badly oversimplifies the reality of decision making. No Great Man acts alone (the complex narrative here does illustrate this claim), and no Great Man exists without a social context (the book does not sufficiently address this assertion). All that to say that the scholar in me wishes for a few more detours into the nature of early 1980s Soviet bureaucracy or computer architecture, as we only get small tastes of those important topics and they are not quite as accurate as I would like. But on the flip-side, the reader in me often feels that story gets dragged out at points, and I'm pretty sure that's Ackerman's greater concern.

Ackerman also tries to make the book about more than history, and he includes a few interludes on the science of *Tetris*, primarily psychological but also mathematical. These bits are interesting, but they really feel a bit pasted in. He has clearly gathered mounds of data on the historical development of the game, but whether this is fair or not, the other bits feel more as if he looked at one or two sources and wrote the section. Still, if you're interested in the use of *Tetris* to treat PTSD or the number of possible game states for the program, you'll find some worthwhile nuggets here.

The other issue is that Ackerman seems to almost assume the importance of the game he's writing about. There's no question that *Tetris* is a landmark game, and it has had a unique staying power, unrivaled by any other video game from the late 1980s. But there are far more financially successful games, and I would argue that longevity does not automatically confer true cultural impact.

In the end, though, it is the granular and surprisingly interesting account of the various negotiations and investments and product development that is the real value of the book. I don't mean that this will teach readers how the industry works today. *Tetris* came about at a time when the games industry was

still establishing itself and regularizing systems of production. The people negotiating legal rights and systems of distribution and financing, as well as the people actually producing the games were, from the 1970s till the early 1990s, essentially breaking new ground, and today much of that work has become routine. No, the value of an account like this is that it shows the complicated web of interactions necessary to get *any* piece of technology created.

I don't think this is a perfect book for the reasons listed above, but it is worthwhile reading. If Christians want to be able to understand and speak to the digital world, it is important to get a sense of its fluidity and its very human character. Somewhat ironically, I think, Ellul himself, in his powerful call to interrogate the ideological baggage of technology, overlooked the actual conditions of design and production. I think Ellul is right to note the technological imperative of constant development throughout our culture, but when we look at the actual day-to-day activity of technology development, as *The Tetris Effect* does, we can see that ideology gets distinctly muddy, and a cocktail of ideas motivates the people who develop the digital artifacts we use. And it is in the trenches of technological development where grace and truth can make a difference. Understanding that has real impact—maybe even greater than the *Tetris* effect.

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Theology

FREEDOM ALL THE WAY UP: God and the Meaning of Life in a Scientific Age by Christian J. Barrigar. Victoria, BC: FriesenPress, 2017. 252 pages. Paperback; $14.49. ISBN: 9781460293836.

Freedom All the Way Up places the creation of love-capable beings at the core of its considerations: the universe exists to bring into being entities who freely love each other and everything else within it and beyond it. Christian J. Barrigar is an Anglican Pastor who holds two Masters degrees from the University of Toronto and a PhD in philosophy from McGill. He believes that God, in infinite freedom, brought into being at the big bang an initial mixture of physical magnitudes and forces destined over time to produce conscious, meaning-seeking, and significantly free beings capable of self-giving love. This view is not merely wishful thinking. Barrigar draws together a wealth of data that, when supplemented with some provocative yet disciplined theological and scientific speculations, can be forged into a fascinating narrative about how God used the past 13-plus billion years to evolve love-capable entities, what he calls *agape*-capable beings.

"So what is the meaning of life?" asks Barrigar in his first chapter, setting the stage for what his book aims to deliver. We all experience some meaningful events in our lives, but do our lives as a whole possess any ultimate meaning or purpose? Materialist, naturalist, and secular humanist worldviews surely give us motivation to construct meanings for ourselves, but, notes Barrigar, constructed meanings are all biodegradable: thus, living one's life within their terms tends to lead one toward nihilism, the view that nothing has meaning. So, are we condemned to meaninglessness?

Chapter two aims to recover rather than construct meaning, specifically to recover the religious basis for ultimate meaning in a scientifically respectable way. This chapter is the backbone of the whole book in that it lays the theoretical groundwork for the plausibility of a reenchanted universe, that is, a universe that has a grand *telos* rooted in God's intention to program its initial conditions toward the emergence of *agape* (love)-capable beings. It contains a fascinating discussion of a number of technical (largely scientific) topics that may be partially lost on readers innocent of recent scientific theories dealing with the entanglement of the deterministic elements of classical dynamics with the statistical probabilities of quantum mechanics. However, the gist of the chapter, in significantly simplified terms, might be put this way without too much distortion: through the big bang, God combined randomness with order by exploiting nonequilibrium thermodynamics and the law of massively large numbers to produce a long series of entropy-defying self-organizations that eventually and inevitably secure the emergence of beings with sufficient free will for genuinely engaging in *agape*-love relationships.

Chapter Three, "Responding to Materialism," is another large chapter filled with lots of interesting theological and scientific ideas and speculations that merit much more attention than I will be able to give them here. Barrigar first looks at a few of the materialistic accounts of the universe's origin, spending most of his time on "multiverse" proposals, at least one version of which he's willing to consider as subsumable within his theistic framework. The problems with most multiverse scenarios, however, are that they tend to rely upon "no-origin" models, models that posit an infinity of antecedent universes, and thus imply determinism (no possibilities beyond actuality) which alone cannot produce the freedom upon which *agape*-capable beings will need to rely.

Barrigar argues that his account of things shows how the problem of evil and human suffering is not so big a problem after all. Since God did not (perhaps could not?) create human freedom directly, God had to deploy indirect means to evolve human freedom and, of course, evolution depends upon random physical, biological, and evolutionary forces that always bring with them waste, suffering, and tragedy. Consequently, the good of human freedom as well as the *agape*-capable beings who depend upon it, could not be separated from nasty human suffering. Barrigar believes this blend of the free will defense and a greater-good account of natural evil in the world sits comfortably upon the foundation of his *agape*-probabilistic account of things.

Chapters four and five examine the nature of the *agape*-love that God engineered to emerge in creation. Questions such as "what do the scriptures have to say about God's *agape*-love for humanity?" and "how is God's *agape*-love manifested in his creation, in the lives of those who bear his agapic image, and in him who is the incarnated icon of God's *agape*-love?" are addressed and analyzed in detail and to rich effect. In the concluding portion of chapter five, Barrigar speculates about the relation of the *imago Dei* to the evolutionary emergence of humanity. His suspicion is that the emergent forces of genetic and cultural coevolution operative in the evolution of *Homo sapiens* established them (*Homo sapiens*) as responsible agents whom God elected to bear the divine image as agapic agents in charge of overseeing the well-being of their home bio-niches.

Chapters six and seven lay out Barrigar's version of the life that *agape*-capable beings are called to enact: lives of agapic freedom as *imago*-bearing individualities and as image-bearing makers of society and culture. These two chapters offer stimulating discussions of how "agapic freedom" differs from "autonomous freedom," how form and boundaries can actually enhance existential freedom, and how the implications of agapic freedom should shape the intellectual life of human cultures.

The final chapter (chap. eight) returns to the original issues of meaning and nihilism discussed in chapter one. Barrigar argues here that in reality, the materialists' battle with impending nihilism is more problematic than the theists' struggles with the inevitable sufferings in the world. He contends that the *agape*-probability account laid out in chapter two and the notions of freedom-all-the-way-up, *imago*-bearing individuality, and agapic freedom discussed in chapters four through seven reveal that God and science belong together as the basis for humanity's flourishing and deepest realization of meaning.

In the remaining space apportioned to this review, I will offer what I consider the most important failures of this significant and provocative book before I conclude with some praise.

I think that Barrigar's book would have benefitted enormously from an early, if only brief, discussion of (1) the degree of realism with which he takes scientific and mathematical theories; (2) how he conceives of the distinction between God's creating and God's sustaining of the universe[s] brought into being; and (3) how these distinctions articulate the relation of divine causation to causations arising within creation. Setting up his positions on these matters early on would enable the reader to discern the conceptual coherency (or its absence) of many of the scientific, philosophical, and theological speculations making up the core of this book, for example, his claims that God frontloaded creation with all the forces, fields, laws, and entities that populate contemporary scientific theories' ontologies; that human first-person agency emerged from third-person physical mechanisms; that robust human freedom is ultimately based on randomness; and that moral evil and natural evil are the same because they both arise from natural goods. Philosophically and theologically, all of these claims merit careful interrogation to underwrite their credibility, which is not really possible without knowing the broader theological and metaphysical commitments that Barrigar presumes.

The foregoing discussion does not do justice to the originality of Barrigar's integration of materials from all over the cognitive map, nor to his rich array of examples, speculations, and breath-taking inferences deployed to impress the plausibility of his narrative on the reader. His book is not limited to the abstract and airy concerns of science-religion integration, but also provides the reader with much practical and wise pastoral import to savor. For these reasons alone, the book merits attention from Christians who wish to dig deeper into their faith's relationship to the contemporary scientific consensus and its implications for a meaningful life well lived.

Reviewed by Robert P. Doede, Trinity Western University, Langley, BC V2Y 1Y1.

MADNESS: American Protestant Responses to Mental Illness by Heather H. Vacek. Waco, TX: Baylor University Press, 2015. xii + 271 pages. Hardcover; $39.95. ISBN: 9781481300575.

Heather Vacek is a professor of church history at Pittsburgh Theological Seminary. Her volume on Protestant reactions to mental illness in America is part of a new series: Studies in Religion, Theology,

and Disability, edited by Sarah J. Melcher and Amos Yong. Vacek aims to inform Christians about mental maladies through a historical examination of such; in particular she desires to dispel the myths that mental illness is a sin and that it is not the church's problem. Madness (the title representing only one of many historical appellations) focuses on five diverse individuals who exemplified a Christian response to mental illness, in contrast to the indifference or theological misunderstanding that has typically characterized American culture.

The book is well researched and the author's attention to detail and inclusion of personal accounts enhances its readability. Vacek examines the efforts of two clergy, one social activist, and two physicians; situates each individual in their complex and evolving social, religious, and medical contexts; and considers both historical and theological perspectives on mental illness. She incorporates views of illness causation, definitions of mental illness, and the changing relationship between church and state.

The first figure Vacek discusses is Puritan minister Cotton Mather (1663–1728). Influenced by American Colonialism and Calvinist theology, he believed sickness to be a result of sin and that all illness had a divine purpose, encouraging people to turn to God. Prayer and conversion to Christ could heal the mind. Nevertheless, Mather also encouraged care for one's own and others' health and even endorsed vaccination against smallpox. His book, *The Angel of Bethesda*, detailed remedies for multiple types of illness including madness.

The second individual is revolutionary-era physician Benjamin Rush (1746–1813), whose work in categorizing and proposing treatments for mental illness is legendary. He wrote one of the first scientific books on mental illness, *Medical Inquiries and Observations upon the Diseases of the Mind*, and founded the Philadelphia Humane Society to educate the public on preventive health. A Presbyterian, his faith guided his action, but Rush challenged the prevailing Christian view, arguing that biology, not sin, could better explain mental illness. He also argued that kindness and compassion were better treatments than being chained in a cold filthy cell, for example.

The third individual is social activist Dorothea Dix (1802–1887). This educated woman was appalled by the squalid conditions she found in mental asylums and, like Rush, advocated for change, travelling widely to educate others and to encourage Christians to be empathetic and work to ameliorate the suffering of the insane. Dix continued to see a role for sin and religious meaning in illness, but focused on cure, not cause. Her efforts in social reform, not always easy, are laudable. Vacek describes her as "part prophet, part moral authority, part civic expert" (p. 75).

The fourth figure is Presbyterian minister Anton Boisen (1876–1965), who personally experienced mental illness and was hospitalized (despite previous efforts, these institutions had deteriorated, were still stigmatized, and were more custodial than curative in nature). He reflected on his experience in *The Exploration of the Inner World: A Study of Mental Disorder and Religious Experience*. Boisen divided mental illness into two classes, organic and functional, and criticized psychiatrists for failing to recognize this difference. The church was equally culpable for failing to care for the suffering, ceding this role to medicine. He believed that some illness had religious meaning, but noted that when spiritual conflict was resolved well, it was labeled religious experience, but when it was not, it was labeled insanity. Boisen made inroads for clergy working in hospitals and began the Clinical Pastoral Education program.

The final person Vacek examines is psychiatrist Karl Menninger (1893–1990). A pioneer in his field and the author of several books, Menninger's medical work was fueled by his sense of Christian vocation and his belief in God's loving work in the world. With his brothers, he founded the Menninger sanatorium and clinics, and contributed to the new field of pastoral counseling. Menninger argued against the current medical use of diagnostic labels and viewed mental malady as a "state of functioning or way of behaving" (p. 141), not illness. And, against some Christian views, he rejected the supernatural and immorality as the cause of such suffering. Menninger, along with many others, championed both church and state to increase awareness of mental suffering, improve conditions in institutions, treat mental problems at an early stage, and exemplify compassionate care.

Of particular interest to those interested in the dialogue between science and faith are the threads evident in these individuals of the beginnings of a positive relationship between the two. Mather's desire to understand creation explained his interest in medicine. Dix viewed "science as a study of God's handiwork and providence" (p. 59). Boisen sought a new relationship between the church and psychiatrists. Menninger saw psychiatry and religion as part of a same whole, encouraged cooperation between church and state, and worked on integrating the two. He noted similarities in that both psychiatrists and clergy were aware of suffering and used similar tools, such as listening, reassuring, and correcting. In the centuries that witnessed the evolution of a separation between medicine and religion, these pioneers

argued for and exemplified a collaborative and mutually beneficial relationship between the two.

Vacek laments that despite the biblical calling to "love your neighbor," the church generally has not done better than society in understanding and caring for those who suffer mentally. There is often a gap between belief and practice; this is exacerbated by stigma, which not only limits care but is also contrary to biblical teachings on inclusion. In her concluding chapter, Vacek suggests using the concept of hospitality (e.g., Rom. 12:13), implied by the five individuals studied, as a way forward. A practical theology approach considers God's redemptive mission and informs a Christian response. We need to be conscious of suffering and work in solidarity with those who suffer. Hospitality includes welcoming and incorporating all people into fellowship, showing compassion, and exercising patience.

Vacek's work is thorough and thoughtful, but at times her conclusions extend beyond the evidence she presents. In particular, she neglects the many developments that have occurred in mental health care and the medicine-religious dialogue in the last few decades. Despite this weakness, *Madness* is a fascinating read and of particular interest to historians, mental healthcare practitioners, and those researching the intersection between medicine and religion. And, since the "poor in spirit" will always be with us, it also calls for action on the part of all Christians.

Reviewed by E. Janet Warren, MD, PhD, President of the Canadian Scientific and Christian Affiliation. ✦

Letters

Old Age at Lake Suigetsu, Japan, and Glacial Tillites, Geologic History, and Biblical Chronology

The fine article by Gregg Davidson and Ken Wolgemuth explains how we can have confidence in age dating, based on comparisons of independent data sets ("Testing and Verifying Old Age Evidence: Lake Suigetsu Varves, Tree Rings, and Carbon-14," *PSCF* 70, no. 2 [2018]: 75–89). It takes a unique approach of comparing raw carbon-14 data (no use of calibration curves) with tree-ring counts back to 14,000 years (most from Europe), and annual sediment layer (varve) counts covering 50,000 years of sediment deposition in Lake Suigetsu, Japan, to show how assumptions such as constant radioactive decay rates, annual growth of tree rings, and annual deposition of layered sediments can be tested and verified. Lake Suigetsu is well suited for radiocarbon studies, because storm water first enters an adjacent lake where the coarser sediment deposits, and then water flows into Lake Suigetsu with mostly very fine sediment. Bits of leaves and twigs washed in and deposited with these sediments contain carbon-14 derived directly from the atmosphere, preserving a historical record of atmospheric carbon-14 in each successive layer.

The article is simply fabulous for effectively communicating the reliability of radiocarbon dating to a reader interested in science. Instead of using a logarithmic scale for exponential decay of carbon-14, the authors used a graph with the scale of percent modern carbon: it shows visually the decrease of carbon-14 with the passage of time, due to radioactive decay (see fig. 1).

To my knowledge, no one else has ever plotted these data in this visually dramatic way to communicate with nonscientists. These tree-ring data and varve data from leaves are simply excellent to tie together the varve data to tree-ring data, because there are 4,000 years of overlap. The alignment of tree-ring and varve carbon-14 with conventional expectations, and the utter failure to align with young-earth expectations, is stunning. Furthermore, the research team found an ash from a known volcanic eruption at the depth where the carbon-14 content was equal to that of tree rings ~10,200 years. The Ar-Ar age of the ash was 10,000 ± 300 years, an excellent confirmation from a completely different radiometric dating method.

Then the authors went above and beyond merely writing a paper for a journal, by adding six call-out sections, referred to as "Casting Doubt," such as the topic of Circular Reasoning. Young-earth writers and advocates typically do not appreciate or understand radiocarbon dating correctly, so they can only raise doubt about the reliability of the results. These six sections address the various doubts and claims made

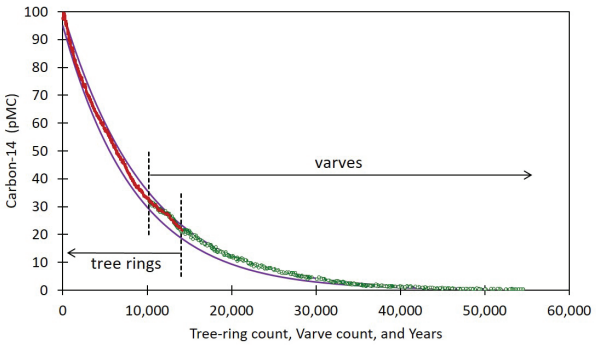

Figure 1. Tree ring and varve count vs. carbon-14 content. Solid lines represent the window for conventional expectations.

by young-earth advocates, and demonstrate why the conventional understanding is more in keeping with the nature of God. If I knew of a journal that offered an award for the paper with the most effective communication written for a most difficult target audience, I would submit this paper!

The above carbon-14 old-age dating is also consistent for very old ages as are obtained from U/Pb radiometric age dating that has been applied to glacial tillites that occur in the recent Ice Age, in the Paleozoic Era, and then farther and farther back in the Precambrian to very old ages. See http://www.csun.edu/~vcgeo005/Nr40tillites.pdf. Early life on Earth had anaerobic bacteria that produced methane as a waste product, but when cyanobacteria evolved that had photosynthesis as part of their metabolism, oxygen was released as a waste product, which was a poison for the anaerobic bacteria. Therefore, the earth experienced its first mass extinction as increased amounts of oxygen killed the anaerobic bacteria. Life then evolved to produce organisms that could tolerate oxygen, but these organisms combined oxygen with carbon in their metabolism and produced carbon dioxide as a waste product. But this waste product had subsequent consequences. Methane in the early atmosphere absorbed the sun's heat and kept the earth warm, but when carbon dioxide began to increase in the atmosphere, cooling occurred that may have produced a "snowball" Earth because tillites can be found at the earth's equator. All these changes certainly cannot have happened in 6,000 to 10,000 years as is promoted for the age of the earth by young-earth creationists, if the natural laws that the Creator also produced are obeyed.

Davidson and Wolgemuth should be congratulated on demonstrating the trustworthiness of scientific dating methods, and showing that the young-earth creationists have no logical basis for claiming a very young age for the earth.

Lorence G. Collins
ASA Member

About the "Literal" Interpretation of Genesis Chapters 1 and 2

I have a suggestion, or request, for our ASA community's discussion of the interpretation of the creation accounts in the Bible, primarily, of course, Genesis 1 and 2. We often use the term "literal interpretation," referring to the opinion that the days of creation were consecutive 24-hour days, and therefore that the creation of the earth and the entire universe occurred only about 120 hours before the creation of Adam, a few thousand years ago. This is commonly called young-earth creation, or YEC.

Whatever we call this interpretation, I propose that we cease calling it "the literal" interpretation. This is what the advocates of this view claim for it, thus implying that all other interpretations are not literal, but are something else, and claiming a sort of high ground in the competition for legitimacy. We do not need to concede this mantle to them.

What does the account literally tell us? It says God caused the earth to sprout. How long does that ordinarily take? Is there any indication in the text that this was done nearly instantaneously, in a few hours at most, with a mature botanical ecosystem and soil appearing from nowhere on top of previously bare inorganic rock? Can this be called literal interpretation? It says God planted a garden, again sounding somewhat slower than instantaneous completion.

If the sun, moon, and stars were not created until the fourth day, how was there light and dark, evening and morning on the first three days? And what does "the heavens and the earth" mean in verse 1? At what point on the globe was evening and morning observed? All these points have been debated for centuries, and I am not advocating any particular conclusion, only pointing out that whatever conclusions have been proposed, have all been heroic exercises of logical gymnastics. Such explanations may be right or wrong, but they cannot be called simple literal interpretation.

On this account, Adam had a prodigiously busy and productive first few hours of existence. From a blank slate of memory, he learned a language, learned to care for the garden, observed a large number of animals and formed meaningful names for them, and observed that they came in pairs and he did not. This is equivalent to a whole series of doctoral dissertations. Then he had to learn to fix his own lunch. No wonder he needed a nap in the afternoon and was happy to acquire a wife to help him. Is this seriously what we think Moses thought and meant when he wrote this account? Is this what the contemporary first-generation Israelite listeners thought when they heard it in the wilderness? Can we call this "literal" interpretation with a straight face?

So, whatever our various preferred interpretations are, and what we call them, let's stop conceding to the solar-day recent-creation viewpoint the claim of "literal" interpretation. There is no such thing as a simple, literal interpretation of the creation accounts, so let's retire this label. Of course, that raises the question of what label to replace it with.

Letters

Is there another term that is suitable, respectful, and avoids any pejorative feeling? That rules out "naïve," "wooden," and "unscholarly," and such terms are no more accurate than literal, so these cannot be considered as progress. We already commonly refer to YEC, and the advocates themselves use that label; will that do? However, YEC carries extensive baggage of the entire young-earth scenario, including Flood geology and claims of scientific verification of all this. We need a term that refers specifically to the interpretation of the biblical creation texts. Is there a better suggestion? Perhaps there really is nothing more compact and intelligible than "seven solar-day interpretation."

I hope this simple suggestion can clarify our discussion of this topic.

David Newquist
ASA Member

What Was Missing

I wish to suggest what was missing in Keith Miller's excellent article, "Doubt and Faith in Science and Religion," (*PSCF* 70, no. 2 [2018]: 90–100). Only in the last paragraph is the Holy Spirit briefly mentioned. Essentially every church service mentions the Holy Spirit, but it is too rare that much is said about what the Holy Spirit actually does. There is the belief that a discussion of this is subjective and mysterious. Yes, it is mysterious but definitely not subjective. I think that because of the Holy Spirit the rise of modern science was dominated by Christian scientists.

The primary function of our having the Holy Spirit is to better see what is God's will and purpose for us, and to strengthen our faith. In addition the Holy Spirit gives us better insight and understanding of both the Bible and God's work in creation. This is critical in the study of science and religion, and I am certain this helped me in my scientific research. We can see things around us much more clearly. I can see the Holy Spirit at work when I am on the same wavelength with my fellow Christian, as we understand and identify with every word spoken. When there is disagreement and conflict I wonder if I am out of tune with the Holy Spirit, or is it my fellow Christian, or both of us. We should never force our ideas upon our fellow Christian, but be humble and receptive, letting the Holy Spirit work in each of us.

William Wharton
ASA Fellow

Author Response

I want to thank William Wharton for his comments. My article was intended to address the comparison of science and religion with regard to faith and doubt more broadly than a consideration of Christianity alone. I agree fully that the Holy Spirit is essential in guiding us into spiritual truth and providing correction from error. l also believe that one of the primary ways in which the Holy Spirit does that is through the Body of Christ—that is, through the spiritual gifts and witness of the Christian community.

Keith B. Miller
ASA Fellow

An Appreciation

I am just sending you a short note to thank you for this journal. I look forward to receiving it each quarter. It is so well done and full of compelling articles that really provide comprehensive insight into the faith-science conversation. Information from each issue enriches my research and lectures. And thank you as well for the valuable book reviews.

Scott Flaig
ASA Member ✧

A Call for Book Reviewers

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