History of Science

FLAT EARTHS AND FAKE FOOTNOTES: The Strange Tale of How the Conflict of Science and Christianity Was Written into History by Derrick Peterson. Eugene, OR: Cascade Books, 2021. xii + 359 pages, including bibliography. Paperback; $44.00. ISBN: 978153265339.

My interest in Christianity and science first developed more than forty years ago, while I was teaching science and mathematics at a Christian secondary school. After the late Frank Roberts introduced me to the ASA, books by Bernard Ramm, Richard Bube, and others helped refine my thoughts and led me to pursue doctoral work in the history and philosophy of science at Indiana University. There I was mentored by two eminent scholars who shared and encouraged my interest, Richard S. Westfall and Edward Grant. Ironically, they were initially skeptical that a dissertation about the influence of theology on early modern natural philosophy even qualified as history of science—it would be more appropriate for a thesis in religion.

Both later came around to the idea, but their hesitation signaled the prevailing attitude among academics: religious beliefs often conflict with scientific facts, and for millennia religion has held back scientific progress. Although logical positivism was then waning, the philosophers in my department never got that memo. As for Grant and Westfall, like many other scholars of the postwar generation they mainly aligned with the classic view of the Scientific Revolution: modern science arose in the time of Copernicus, Galileo, and Newton, and then only when traditional Christian beliefs were set aside or entirely discarded, as enlightened reason triumphed over blind and obscurantist faith. Years later Grant changed his mind, writing major books and articles about the importance of medieval Christian natural philosophy for the rise of modern science—often cited in this book—but Westfall never budged from his position that science dethroned religion during the Scientific Revolution, and that Newton's religious beliefs (which Westfall studied more intensely than almost anyone else) were irrelevant to his science.

If only a book like this had been available to me then. Of course, it couldn't have been—it depends heavily on the best scholarship about the history of science and religion, so much of which was published after I finished graduate school. A freelance writer with graduate training in history, Derrick Peterson explains how history is done, and how historians created the "conflict" view of religion and science that I encountered on all sides in graduate school, in an accessible manner that I would have found enormously helpful. At that time, only a few historians were taking that bull by the horns, and it had not yet been slain. Coming from a science background, I had not yet developed the ability to read historical literature with a critical eye. It took me several years to learn how historians think. History is not just a pile of facts: it is about how to assemble those facts into a coherent narrative that is faithful to the ideas, activities, and beliefs of the historical actors themselves, while taking care not to impose on them modern viewpoints and attitudes. As novelist L. P. Hartley famously wrote, "The past is a foreign country: they do things differently there." Until I understood this, I could not begin to dismantle the conflict view and begin to delve more deeply into the real history of Christianity and science, which had long been obscured by false rumors of warfare.

Many ASA members today are probably where I was then. As Christians trained in science, not history, they recognize the cultural significance of the conflict view and instinctively reject it, but lack the historical tools to critique it effectively. *Flat Earths and Fake Footnotes* functions well as a primer for nonspecialists on the ideological origins of the conflict view and how badly it misled scholars in earlier generations, leading them to write many things that would not pass muster today; the book explains how the conflict view was eventually deconstructed. That is its main value—despite the annoying absence of an index—but the book is much more than a primer. The latter half of the book examines numerous bogus stories of conflict that are still often repeated, starting with the notion (referenced in the title of the book) that most Christians before the rise of modern science believed on biblical grounds that the earth is flat. I found his debunking of the modern mythmakers Catherine Nixey and Stephen Greenblatt, authors of award-winning books advancing the conflict view, particularly on point. All lovers of truth should applaud this material. More importantly, Peterson has read widely in the history of ideas, enabling him to contextualize the history of science itself—which became an academic discipline in the twentieth century, substantially by embracing nineteenth-century versions of the conflict view. Nor are nonspecialists the only readers who will learn from this book. To cite just two (of many) examples, I did not realize the extent to which Leonardo da Vinci was wrongly presented as a secular saint by scholars opposed to traditional religion; nor did I know that John Tyndall was a pantheistic naturalist rather than a pure secularist.

Unfortunately, *Flat Earths and Fake Footnotes* contains at least a few fake footnotes of its own. Certain quotations are either misattributed, or wrongly cited. The most glaring instance involves a lengthy passage supposedly from Westfall, crucial to the argument at that point, which is not actually in the work identified in the footnote (pp. 52–53). Although it sounds authentic (and might be), I cannot identify the source. Some statements are also erroneous, such as the description of Goethe, Humboldt, and Haeckel as "contemporaries" (p. 262). All scholars make errors from time to time (myself included), but we should keep in mind that this is not an original work of scholarship; it is rather a popularization of conclusions reached by other scholars—and more reliable than many other popular-level works about the history of science, especially considering the complex historical ideas it relates. Readers who appreciate economy of expression may also be somewhat frustrated. Certainly, the author could have greatly reduced the number of quotations and cut some other information, without losing any real substance or nuance. A stern editorial hand would have helped. Partly for this reason, I rank this book lower than *Galileo Goes to Jail and Other Myths about Science and Religion* (2009), edited by Ronald L. Numbers, and *Unbelievable: 7 Myths about the History and Future of Science and Religion* (2019), by Michael Newton Keas. However, all three belong in the libraries of ASA members who want a better understanding of the conflict thesis and its fatal shortcomings.

Reviewed by Edward B. Davis, Professor Emeritus of the History of Science, Messiah University, Mechanicsburg, PA 17055.

Origins

COSMIC QUERIES: StarTalk's Guide to Who We Are, How We Got Here, and Where We're Going by Neil deGrasse Tyson and James Trefil. Washington, DC: National Geographic Society, 2021. 309 pages. Hardcover; $30.00. ISBN: 9781426221774.

Neil deGrasse Tyson is a well-known popularizer of science; the StarTalk podcast he hosted for years is both a fun and educational resource for countless science subjects. He has teamed up with James Trefil, a prolific science writer and popularizer in his own right, to produce a book trying to summarize a vast array of human discoveries about our place in the cosmos for a primarily nonscientific audience. The book attempts to mimic the style of StarTalk in using humor and even a bit of goofiness at times to keep it light.

Two observations are worth starting off with. First, the authors have attempted to summarize and simplify a huge amount of science, and no reviewer could possibly do justice by attempting to summarize their summary. There is no central thesis or question which is under debate. An overview of topics and some high points discussed below will suffice.

But secondly, and more importantly, given the full title including the subtitle, these are questions which humans have wrestled with for millennia, and especially as they engage with personal considerations of meaning, purpose, and destiny. The ancient Greek philosophers asked similar questions, and surely humankind had pondered them for millennia before that. Yet the book settles for a response with a rather casual and unfortunate scientism. The science is wonderful, but apparently the publisher thought the book would sell better by choosing a philosophical title for a purely scientific discussion.

It may be a sign of the times that the 1982 cult movie *Blade Runner* engages more directly and significantly with those title questions than this 2021 book does. Recall the scene near the end of the movie in which Deckard asks, "All he'd wanted were the same answers the rest of us want. Where did I come from? Where am I going? How long have I got?" That is an extremely important tone and context in which those subtitle questions belong! But the essential philosophical side of those questions is utterly ignored in the book, except perhaps for a few times they poke fun at common straw man views of the church (they could at least acknowledge that the Christian worldview provided a foundation for the beginning of science as we know it). For example, the authors casually dismiss important questions when they say, "The emergence of galaxies, stars, and human intelligence all followed from this event" (p. 216). Excuse us? Human intelligence did what? Followed from galaxies and stars? Like water downhill? Is there no hard problem of human consciousness? Unfortunately, obvious categories of ideas are avoided as if they do not exist. This is clearly not accidental.

The chapter "Are We Alone in the Universe?" provides a great opportunity to characterize the book. Tyson and Trefil neatly and enjoyably summarize the history of the search for extraterrestrial intelligence starting with Lowell's "canals" on Mars and proceeding through modern day SETI. The writing is light, fast-paced, and even includes a "Dad joke." They present the Drake equation, of course, and even try their hand at a calculation of the odds, ending up as most do with a range of from one to possibly millions of intelligent races in the Milky Way. But then there is the meat—or lack thereof. They mention the Fermi Paradox that asks, "If aliens exist, where are they?" But the authors do not consider the question

of why the cumulative SETI effort, after surveying over 60 million stars, has found no evidence of other intelligent races out there. The authors mention the Rare Earth hypothesis, that the odds strongly favor very few if any other intelligent races, but dismiss it with, "This scenario is popular with religions that favor Earth as God's unique and special place in the universe" (p. 208). This slap against *Rare Earth*'s authors Brownlee and Ward is made although the word "God" does not appear in their book. Indeed, many scientists who, like Brownlee and Ward, have no apparent religious motivation, have entertained the question of whether intelligent life is common or rare. For example, consider the 2021 paper published in the peer-reviewed *Astrobiology Journal* with the title "The Timing of Evolutionary Transitions Suggests Intelligent Life Is Rare" by astronomer Andrew Snyder-Beattie et al. at the University of Oxford. In a YouTube video, physicist Sabine Hossenfelder, who is herself an atheist, states that in her experience scientists who are believers are better at keeping religion out of their work than scientists who are atheists.

One more example: the last chapter discusses the subject "before the beginning," and the fine-tuning problem is brought up briefly, but according to the authors, "The multiverse saves the day" (p. 282). First, no, it doesn't. And second, that is hardly a scientific claim! Later in the chapter they comment that when the science becomes too difficult, "philosophers step in and give it a go" (p. 286). Apparently, according to Tyson and Trefil, it is nice to have those philosophers around to engage with the insignificant questions, like who we are, how we got here, and where we're going. Oh wait, that's the book's subtitle! Yet it disingenuously ignores or disparages the deeper human questions it claims to consider and settles "merely" for amazing facts and discoveries.

This is, either accidentally or on purpose, an anti-philosophy book. Despite all of the fascination with the science, this black-and-white view of the world painfully downplays the color of our genuine deepest questions. Indeed, it has been stated that scientists often make lousy philosophers. Very bright minds can make indefensible statements, as when Stephen Hawking wrote "philosophy is dead," oblivious to the fact that this was a philosophical statement.

Ah well, enough on that theme for now. The science in the book is quite fascinating. A more appropriate subtitle for the overall work would be, "What can science alone tell us about ourselves and our universe?" But that probably would not sell the same.

The book begins with Newton and Aristotle watching an object fall, and discusses how the two would see it differently, tracing some of the history of scientific views of Earth and the cosmos. It is good to see the authors point out that the Greeks, as far back as the third century BC, knew that the world was round. Eratosthenes measured the length of the shadow of an obelisk in Alexandria at the same time the sun touched the bottom of a well in Syene, and he calculated from the angle of the shadow and the distance between the cities the size of the Earth. The authors here introduce the "distance ladder," how observations on a smaller scale can then be used to estimate much larger things. They use this several times to explain how we know some of what we think we know, especially about the size of our universe. This is well done.

After a history of views of our physical placement in the cosmos follows the history of tools of discovery—from telescopes, through radio waves, and reaching above our atmosphere to access the full electromagnetic spectrum.

Next, they look at our universe in the macro, along with its age and materials, leading to stars, planets, and solar systems, including, of course, our own. Further detail about the beginning follows, including the Cosmic Microwave Background (CMB), Inflation, and so-called Dark Energy and Matter.

After a look at chemistry for elements, particles, and quarks, and also a look at life and biochemistry, they turn to the very beginning and end of the universe, and conclude with a brief but unsatisfying chapter that explores before the beginning.

On the positive side, the book is a good basic primer to the science behind our universe. It will leave any serious student of science, professional or not, unsatisfied. Very few new ideas are presented, breadth over depth is preferred, and controversial views are omitted or minimized.

In the end, *Cosmic Queries* is an easy read and might be fine for a person just becoming interested in science and the universe, such as perhaps a high school student or a person with little or no science background. Some disclaimers are warranted regarding the utter lack of engagement in the philosophical side of the questions in the subtitle. At least the science is solid. However, a person even somewhat well read in science will find little new or exciting in it. If you need a gift for that well-read person, or if that describes you, the reviewers suggest you pick up the richer and more nuanced *Welcome to the Universe*

(2016) which Tyson cowrote with Richard Gott and Michael Strauss.

Reviewed by Marty Pomeroy, ASA Member and Software Engineer, and C. David Seuss, Founder and CEO of Northern Light, Boston, MA 02129.

EVERY LIFE IS ON FIRE: How Thermodynamics Explains the Origins of Living Things by Jeremy England. New York: Basic Books, 2020. 272 pages. Hardcover; $28.00. ISBN: 9781541699014.

Physicist Jeremy England's unique book on the latest developments in origin-of-life research is scientifically fascinating and refreshingly devoid of the typical faith/science antipathy that plagues much work in this field. What England offers is essentially a down-to-earth primer on statistical thermodynamics which enables the nonphysicist reader to understand current developments in non-equilibrium thermodynamics, such as "dissipative adaptation," that have much to say about what life is and what needs to occur for life to start naturally (i.e., spontaneously from natural precursors).

England discusses at length the precariousness of life and the improbability of a living organism being thrown together at random, but contra the Intelligent Design (ID) movement, he takes this as evidence not of its impossibility but, rather, that non-equilibrium thermodynamics must be involved in any scientific explanation. England directly addresses ID only once in a footnote:

> … of course, whenever we do not yet understand something, we always have the option of throwing up our hands and declaring that intelligent contrivance is the only way things could be this way, but we also have the option of trying harder to understand, often with a successful result … (p. 245)

Far from offering a mechanism for how life began, however, England instead examines the necessary prerequisites for what we instinctively call "life," including energy consumption, replication, and anticipating changes in the environment, and stresses that these distinctive aspects of life cannot all come from one mechanism. Through variegated collections of matter responding to flows of energy impinging on them, non-equilibrium states can be created and sustained in a manner that looks for all the world like intelligent design but can be explained by new ideas in non-equilibrium thermodynamics. The ability for an organism to live in a high-energy, non-equilibrium state without being consumed by the "fire" of energy surrounding it is not necessarily related to an organism's ability to reproduce, and neither stability nor self-replication necessarily guarantees an ability to predict environmental variables and respond to them in a self-preserving fashion. England argues that having multiple mechanisms operating and evolving in parallel for the somewhat independent qualities that constitute life makes the natural emergence of living things less improbable than hitherto imagined.

While non-equilibrium thermodynamics can help us better understand how living things may have arisen naturally from inanimate matter, the book also argues that we still need to look beyond science for why a living pile of molecules has more meaning that a pile of ashes. England, who states his personal commitment to the Jewish faith, looks to the Hebrew Bible for grounding and inspiration when wrestling with the questions of "What is life?" and "How did life begin?" He finds in the signs God gives to Moses on Mt. Horeb (Exodus 3), including his staff turning into a snake, a rich treasure-trove of wisdom regarding life, its meaning, and its intimate connection with the natural world. Thus, while the book is mostly an explication of recent insights from physics regarding what it means to be alive, it is woven together in a fascinating way with biblical wisdom gleaned from the Torah. The rich allusions and connotations England impressively draws from the Mt. Horeb signs provide another example of the deep wisdom that scripture offers in its timeless narratives.

What especially sets this book apart from other faith-based origin-of-life discussions is the fact that England himself is a leading researcher in the current science of non-equilibrium thermodynamics. He was a physics prodigy who has now established a career bridging academia and industry, and much of the book is based on his own groundbreaking work. In this regard, he carries a distinctly authoritative voice that is perhaps best compared to Francis Collins or John Polkinghorne—leading scientists whose scientific work directly overlaps the theological waters they wade into. There is some risk that the nonphysicist may feel bogged down by the detailed scientific lessons and explanations, but England does an impressive job of explaining things in everyday terms, including balls rolling down hills, springs, and snowflakes. He is also careful to include helpful summaries along the way. The accessibility of the scientific ideas and the originality of the theological reflections make Jeremy England's *Every Life Is on Fire* a must-read for anyone interested in origin-of-life issues.

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Science and Faith

WHY SCIENCE AND FAITH BELONG TOGETHER: Stories of Mutual Enrichment by Malcolm A. Jeeves. Eugene, OR: Cascade Books, 2021. 294 pages. Paperback; $35.00. ISBN: 9781725286191.

Many sense tension between modern science and Christian faith. Malcolm Jeeves, however, intends to show how the two are quite complementary. As Emeritus Professor (University of St. Andrews), past-President of the Royal Society of Edinburgh, Fellow of both the Academy of Medical Sciences and the British Psychological Society, and a prolific author in the arena of science and faith, he is supremely qualified to write this book.

The Preface reveals his motives: emails from distraught students despairing over a faith that seems incompatible with modern science, and polls showing the mass exodus of young people from faith for the same reason. The emails come from those appealing desperately to believing experts for help to hang on to faith, while the polls represent those making the opposite choice by voting with their feet. Scripture has much longer roots than modern science: the written texts go back two or three millennia, and the oral traditions underlying them another several millennia, whereas modern science is very new. So, when these two divinely inspired searches for truth seem to come into conflict, the tendency for some is to favor the tried-and-true, whereas others feel it necessary to favor what is seen as the "new-and-improved." Jeeves's goal is to show how these two books actually complement one another even when they appear to conflict.

The book is divided into three sections. The first looks at how science and cultural changes seem to keep shrinking and changing God, while introducing new alternative gods. God had long been the explanation for many previously unanswerable questions (the origin of the universe and of life, for example), but as modern science made more and more discoveries and filled in knowledge gaps, God grew smaller and smaller. At the same time, changes in societal values prompted some to re-define God to conform to more modern thinking. Essentially, we started making God in our own image using insights gleaned through science (psychology, psychoanalysis [pp. 35–38]) and theology (Augustine, Aquinas, Jonathan Edwards, Karl Rahner [pp. 38–41]). A plethora of substitute gods came into view, chief of which is technology. Social media and the internet seemed to facilitate the erosion of belief. However, Jeeves closes out this section looking at how science and technology can also expand our view of God. From studies of the very small (including DNA and the genetic code) to the very large (the known universe expanding from an estimated radius of 100,000 light years in 1917 to the present day estimate of 46 billion light years), there is now greater reason to be in awe of the Creator God.

The second section explores five major questions: (1) human origins; (2) human nature; (3) miracles of nature; (4) healing miracles; and (5) the nature of faith. For each, there is a pair of chapters: one subtitled "evidence from scripture," and a complementary chapter subtitled "evidence from science." Those subtitles might be misconstrued to imply that evidence would be proffered to explain or answer the question. Sometimes, that is the case. More often, distinct lines of evidence are cited to raise thought-provoking questions, provide divergent perspectives, add a bit of color or fill gaps, and call for more careful nuancing of the data. They serve more to stimulate questions and reflection than to provide an overview or explanation. I eventually came to see that the two sources of human evidence, when brought together within the mind of the reader, become a three-dimensional stereoscopic hologram.

In chapters 4 and 5, on human origins, Jeeves opens with the challenge, voiced by other secular scientists, that genetics does not explain everything about humanity, such as the emergence of personhood and consciousness, our moral values and ethical sense, and language. Therefore, standard evolutionary theory is too limited in scope and needs a "re-think." Equally true, however, theological explanations of these also need a "re-think." The scientific data clearly shows that humans are not starkly different from other animals, and in fact that it is almost certain that we evolved from them. We humans are, though, much more than genes, tissues, and organs.

In chapters 6 and 7, on human nature, nonscholars (both believing and not) are in nearly unanimous agreement that Christianity is critically tied to substance dualism—the idea that humans comprise a material body and an immaterial soul/spirit. In contrast, many scholars, across the spectra of belief (belief/nonbelief) and knowledge (science/theology/philosophy), see major problems with such dualism. Can science explain the soul? Is the case of a child with nearly normal cognitive abilities but lacking a major proportion of brain mass, evidence for a nonmaterial soul (p. 101)? Does Libet's experiment say anything about free will (p. 102)? If humans do not exhibit categorical differences from animals, how are we created in the image of God?

In chapters 8 and 9 (on miracles of nature), Jeeves asks a number of questions. Do miracle claims constitute proof of God? Is God a divine upholder, or occasional gap filler? Do attempts to explain miracles "[explain] them away" (pp. 140–41)? What exactly do we mean by words such as "miracle" and "supernatural"? What does the Bible mean by "signs" and "wonders"? Is there merit in trying to normalize biblical phenomena that appear to be miraculous, using modern scientific explanations? Or do such attempts only raise other problems?

Chapter 10 addresses healing miracles. If someone claims an experience/event which can be shown to have a probability of one-in-a-million, is that a miracle … given that those odds predict that roughly 7,500 such events will occur within the present global human population? Do religious people tend to live healthier or longer lives than their secular counterparts? Studies that look at cognitive variables (depression; optimism) might suggest "yes," while those that look at biological variables (cancers; cardiovascular events) say "no" (p. 171). Do prayers become cosmic-vending machines? Do miracle claims stand up to medical/scientific scrutiny? Do they need to?

Chapters 11 and 12 concern the multifaceted nature of faith. Jeeves describes faith as involving "credulity," "intellectual assent," and "the psychological processes involved in the act of believing" (p. 178), and then compares faith with belief, doubt, trust, certainty, action, and discipleship (pp. 178–82). Jeeves recounts fascinating evidence from patients suffering various forms of brain disease (Alzheimer's, Parkinson's), discussing how such biological injuries degrade their enjoyment of faith because they rob them of the ability to focus attention, feel emotion, or keep track of a sermon or a passage of scripture (which, Jeeves points out, is another argument against substance dualism). He also looks at how brain dysfunction affected many well-known people of faith, including Martin Luther, John Bunyan, John Wesley, William Cowper, Gerard Manley Hopkins, Lord Shaftesbury, and Christina Rossetti.

The third section focusses on a central theme in this book: that of God interacting with creation in general, and humans in particular. God does this by creating all things, including humans, in his image (as the divine creator), by constantly upholding that creation through natural laws which he has set in place to maintain it (as the divine sustainer), and by putting off his divinity and embodying himself within creation (divine self-emptying or kenosis). Here, Jeeves unpacks divine kenosis, as well as the evolutionary origins and emergence of kenotic behavior in his creatures (otherwise commonly known as altruism, love, compassion, and empathy).

The book concludes with a valuable resource for self-reflection and group study. For each of the thirteen chapters, he provides a few relevant scripture passages, a variety of short paragraphs to review and reflect upon, a number of specific questions for discussion, and suggestions for further readings (books, articles, web-links).

The book is written at the level of a well-read and informed lay-person. No formal training in science or religion is needed, although a keen interest in both is essential. Overall, I found the book very useful, and I highly recommend it. But actions speak louder than words. My first thought upon reading it was to suggest it to my own church pastor for a small group book study; he read the book, then promptly and convincingly made the sales pitch to our church leaders.

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STANLEY JAKI: Science and Faith in a Realist Perspective by Alessandro Giostra. Rome, Italy: IF Press, 2019. 144 pages. Paperback; $24.24. ISBN: 9788867881857.

The subject of this short introduction—Father Stanley L. Jaki (1924–2009), a giant in the world of science and religion—is more important than this book's contents, a collection of conference papers and articles published between 2015 and 2019.

Readers of this journal should recognize Jaki, a Benedictine priest with doctorates in theology and physics, 1975–1976 Gifford lecturer, 1987 Templeton Prize winner, and professor at Seton Hall University, for his prolific, valuable work in the history of the relations between theology and science. He sharply contrasted Christian and non-Christian/scientific cosmologies and unfortunately, often slipped into polemics and apologetics. The title of Stacy Trasanco's 2014 examination of his work, *Science Was Born of Christianity,* captures Jaki's key thesis. Science in non-Christian cultures was, in Jaki's (in)famous and frequent characterizations, "stillborn" and a "failure" (e.g., see Giostra, pp. 99, 113). Incidentally, Giostra seems unaware that various Protestant scholars shared Jaki's key thesis and arguments.

The Introduction begins with a quotation from Jaki that so-called conflicts between science and religion "must be seen against objective reality, which alone has the power to unmask illusions." Jaki continued, "There may be clashes between science and religion, or rather between some religionists and some

scientists, but no irresolvable fundamental conflict" (p. 15).

This raises two other crucial aspects of Jaki's approach: his realist epistemology and his claim that, properly understood, science and Christian theology cannot be in conflict. Why? Because what Jaki opposed was not science itself—which he saw as specific knowledge of the physical world that was quantifiable and mathematically expressible—but ideologies that were attached to science in the eighteenth and nineteenth centuries, that is, materialism, naturalism, reductionism, positivism, pantheism, and atheism.

For Jaki, the real problem for Christian approaches to the natural world was the scientism which dismissed theology, especially Catholicism, as superstition, dogmatism, and delusion. Jaki followed the groundbreaking work of Pierre Duhem in arguing that the impetus theory of the fourteenth-century philosopher John Buridan was the first sign of the principle of inertia, the first law of Newtonian physics. One of the foundational shifts in the birth of a new "revolutionary" science in the Christian West was a post-Aristotelian understanding of bodies in motion (both uniform and uniformly accelerating: see chapter three for more details).

The first chapter is a bio- and bibliographical essay by an admiring Antonio Colombo that traces and situates Jaki the historian as a man of both science and faith. Chapter two lays out Jaki's critical realism and theses about the history of science and theology, in contrast to scientisms past and present that claim scientific reason as the sole trustworthy route to legitimate knowledge. The roles played by the doctrine of creation *ex nihilo* and the Christology of the pre-existent Logos in Jaki's cosmological thinking are also outlined.

Many readers will be most interested in the third chapter which surveys Jaki's writing about the notorious case of Galileo, condemned by the church in 1633 for defending Copernicus. Jaki detected scientific and theological errors in the positions of both Galileo and the church. For instance, Galileo did not provide proof of the motion of the earth around the sun. Nor did the church understand errors in Aristotelian science. Galileo was right, however, in arguing that the Bible's purpose was not to convey scientific knowledge; while the church's rejection of heliocentric cosmology was correct, given the dearth of convincing evidence for it.

Chapter four is of wider interest than its title, "The Errors of Hegelian Idealism," might suggest. Jaki's belief that only Christian theology could give birth to the exact sciences is reviewed, along with his rejection of conflict and concord models of faith and science. His critiques of Hegelian and Marxist views of the world are thoughtfully discussed.

Jaki was unrelentingly hostile to all types of pantheism, and Plato was the most influential purveyor of that erroneous philosophy. Chapter five outlines Jaki's objections to Platonism, as well as to Plotinus's view of the universe as an emanation from an utterly transcendent One, and to Giordano Bruno's neo-Platonic animism and Hermeticism.

Jaki's interpretation of medieval Islamic cosmologists is the subject of the fifth chapter, in which the Qur'an, Averroes, and Avicenna are examined and found wanting. Monotheism by itself could not lead to science. Incorrect theology blinded those without an understanding of the world as God's creation or of Christ as Word and Savior from seeing scientific truth. This chapter is curious in several respects. On page 98, Giostra equates Christ as the only begotten Son with Jesus as the only "emanation from the Father." Emanationism is a Gnostic, Manichaean, and neo-Platonic concept; it is not, to my knowledge, part of orthodox Catholic Trinitarian discourse. On pages 101–2, the presence of astrology in the Qur'an disqualifies it as an ancestor of modern science. But astrology then was not yet divorced from astronomy. Astrological/astronomical imagery and terminology were integral to ancient cosmologies and apocalypses, including Jewish, Christian, and Muslim ones. Lastly, pages 104–5 feature quotations in untranslated Latin.

Chapter seven is a review of the 2016 edition of Jaki's *Science and Creation*; this is one more example of content repeated elsewhere in the book. "Benedict XVI and the limits of scientific learning" is the eighth and final chapter. The former pope is presented as a Jaki-like thinker in his views of science and faith. Strangely, Benedict does not cite Jaki; this absense weakens Giostra's case somewhat.

Jaki—whose faith was shaped by the eminent French theologian and historian of medieval thought, Etienne Gilson—was a diehard Roman Catholic, wary of Protestant thought, defender of priestly celibacy and of the ineligibility of women for ordination. On the other hand, his study of both Duhem and Gilson probably sensitized Jaki to ideological claims made by scientists.

As a historian of science, Jaki was meticulous and comprehensive in his research with primary documents. His interpretations of historical texts were as

confident and swaggering as his critiques of scientists and scientism were withering. Among Jaki's more interesting and helpful contributions to scholarship are his translations and annotations of such important primary texts as Johann Heinrich Lambert's *Cosmological Letters* (1976), Immanuel Kant's *Universal Natural History and Theory of the Heavens* (1981), and Bruno's *The Ash Wednesday Supper* (1984).

Personally, I have found much of value in Jaki's *The Relevance of Physics* (1966); *Brain, Mind and Computers* (1969); *The Paradox of Olbers' Paradox* (1969); *The Milky Way* (1972); *Planets and Planetarians* (1978); *The Road of Science and the Ways to God* (1978); *Cosmos and Creator* (1980); *Genesis 1 through the Ages* (1998); *The Savior of Science* (2000); *Giordano Bruno: A Martyr of Science?* (2000); *Galileo Lessons* (2001); *Questions on Science and Religion* (2004); *The Mirage of Conflict between Science and Religion* (2009); and the second enlarged edition of his 1974 book, *Science and Creation: From Eternal Cycles to an Oscillating Universe* (2016).

Jaki also published studies of figures whose life and work most impressed him personally. These include three books (1984, 1988, 1991) on the Catholic physicist and historian of cosmology, Pierre Duhem, author of the ten-volume *Système du Monde*, and studies of English converts to Catholicism, John Henry, Cardinal Newman (2001, 2004, 2007) and G. K. Chesterton (1986, new ed., 2001).

Among Jaki's books not mentioned by Giostra but of interest to readers of this journal are *The Origin of Science and the Science of its Origin* (1979), *Angels, Apes, and Men* (1988), and *Miracles and Physics* (2004). For a complete Jaki bibliography, see http://www.sljaki.com/.

No translator is identified in the book under review; my guess is that Giostra, an Italian, was writing in English. Although generally clear and correct, the book contains enough small errors and infelicities to suggest that the services of a professional translator were not used. Not counting blank, title, and contents pages, this book has but 128 pages, including lots of block quotations.

For those unfamiliar with Jaki's work and not too interested in detailed studies in the history and philosophy of science and religion, this introduction is a decent start—and perhaps an end point as well. I strongly encourage curious readers to consult Jaki's own books, including his intellectual autobiography *A Mind's Matter* (2002). For other scholarly English-language perspectives on his work, see Paul Haffner, *Creation and Scientific Creativity: A Study in the Thought of S. L. Jaki* (2nd ed., 2009); *Science and Orthodoxy* [special issue of the *Saint Austin Review* on Jaki], vol. 14, no. 3 (2014); and Paul Carr and Paul Arveson, eds., *Stanley Jaki Foundation International Congress 2015* (2020).

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Technology

ATLAS OF AI: Power, Politics, and the Planetary Costs of Artificial Intelligence by Kate Crawford. New Haven, CT: Yale University Press, 2021. 336 pages. Hardcover; $28.00. ISBN: 9780300209570.

Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence is Kate Crawford's analysis of the state of the AI industry. A central idea of her book is the importance of redefining Artificial Intelligence (AI). She states, "I've argued that there is much at stake in how we define AI, what its boundaries are, and who determines them: it shapes what can be seen and contested" (p. 217).

My own definition of AI goes something like this: I imagine a future where I'm sitting in a cafe drinking coffee with my friends, but in this future, one of my friends is a robot, who like me is trying to make a living in this world. A future where humans and robots live in harmony. Crawford views this definition as mythological: "These mythologies are particularly strong in the field of artificial intelligence, where the belief that human intelligence can be formalized and reproduced by machines has been axiomatic since the mid-twentieth century" (p. 5). I do not know if my definition of artificial intelligence can come true, but I am enjoying the process of building, experimenting, and dreaming.

In her book, she asks me to consider that I may be unknowingly participating, as she states, in "a material product of colonialism, with its patterns of extraction, conflict, and environmental destruction" (p. 38). The book's subtitle illuminates the purpose of the book: specifically, the power, politics, and planetary costs of usurping artificial intelligence. Of course, this is not exactly Crawford's subtitle, and this is where I both agree and disagree with her. The book's subtitle is actually *Power, Politics, and the Planetary Costs of Artificial Intelligence*. In my opinion, AI is more the canary in the coal mine. We can use the canary to detect the poisonous gases, but we cannot blame the canary for the poisonous gas. It risks missing the point. Is AI itself to be feared? Should we no longer teach or learn AI? Or is this more about

how we discern responsible use and direction for AI technology?

There is another author who speaks to similar issues. In *Weapons of Math Destruction,* Cathy O'Neil states it this way,

> If we had been clear-headed, we all would have taken a step back at this point to figure out how math had been misused … But instead … new mathematical techniques were hotter than ever … A computer program could speed through thousands of resumes or loan applications in a second or two and sort them into neat lists, with the most promising candidates on top. (p. 13)

Both Crawford and O'Neil point to human flaws that often lead to well-intentioned software developers creating code that results in unfair and discriminatory decisions. AI models encode unintended human biases that may not evaluate candidates as fairly as we would expect, yet there is a widespread notion that we can trust the algorithm. For example, the last time you registered an account on a website, did you click the checkbox confirming that "yes, I read the disclaimer" even though you did not? When we click "yes" we are accepting this disclaimer and placing trust in the software. Business owners place trust in software when they use it to make predictions. Engineers place trust in their algorithms when they write software without rigorous testing protocols. I am just as guilty.

Crawford suggests that AI is often used in ways that are harmful. In the *Atlas of AI* we are given a tour of how technology is damaging our world: strip mining, labor injustice, the misuse of personal data, issues of state and power, to name a few of the concerns Crawford raises. The reality is that AI is built upon existing infrastructure. For example, Facebook, Instagram, YouTube, Amazon, TikTok have been collecting our information for profit even before AI became important to them. The data centers, CPU houses, and worldwide network infrastructure were already in place to meet consumer demand and geopolitics. But it is true that AI brings new technologies to the table, such as automated face recognition and decision tools to compare prospective employment applicants with diverse databases and employee monitoring tools that can make automatic recommendations. Governments, militaries, and intelligence agencies have taken notice. As invasion of privacy and social justice concerns emerge, Crawford calls us to consider these issues carefully.

Reading Crawford's words pricked my conscience, convicting me to reconsider my erroneous ways. For big tech to exist, to supply what we demand, it needs resources. She walks us through the many resources the technology industry needs to provide what we want, and AI is the "new kid on the block." This book is not about AI, per se; it is instead about the side effects of poor business/research practices, opportunist behavior, power politics, and how these behaviors not only exploit our planet but also unjustly affect marginalized people. The AI industry is simply a new example of this reality: data mining, low wages to lower costs, foreign workers with fewer rights, strip mining, relying on coal and oil for electricity (although some tech companies have made strides to improve sustainability). This sounds more like a parable about the sins of the tech industry than a critique about the dangers of AI.

Could the machine learning community, like the inventors of dynamite who wanted to simply help railroads excavate tunnels, be unintentionally causing harm? Should we, as a community, be on the lookout for these potential harms? Do we have a moral responsibility? Maybe the technology sector needs to look more inwardly to ensure that process efficiency and cost savings are not elevated as most important.

I did not agree with everything that Crawford classified as AI, but I do agree that as a community we are responsible for our actions. If there are injustices, then this should be important to us. In particular, as people of faith, we should heed the call of Micah 6:8 to act justly in this world, and this includes how we use AI.

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SYSTEM ERROR: Where Big Tech Went Wrong and How We Can Reboot by Rob Reich, Mehran Sahami, and Jeremy M. Weinstein. New York: HarperCollins Publishers, 2021. 352 pages. Hardcover; $27.99. ISBN: 9780063064881.

Remember when digital technology and the internet were our favorite things? When free Facebook accounts connected us with our friends, and the internet facilitated democracy movements overseas, including the Arab Spring? So do the authors of this comprehensive book. "We shifted from a wide-eyed optimism about technology's liberating potential to a dystopian obsession with biased algorithms, surveillance capitalism, and job-displacing robots" (p. 237).

This transition has not escaped the notice of the students and faculty of Stanford University, the elite institution most associated with the rise (and sustainment) of Silicon Valley. The three authors of this

book teach a popular course at Stanford on the ethics and politics of technological change, and this book effectively brings their work to the public. Rob Reich is a philosopher who is associated with Stanford's Institute for Human-Centered Artificial Intelligence as well as their Center for Ethics in Society. Mehran Sahami is a computer science professor who was with Google during the startup years. Jeremy Weinstein is a political science professor with experience in government during the Obama administration.

The book is breathtakingly broad, explaining the main technical and business issues concisely but not oversimplifying, and providing the history and philosophy for context. It accomplishes all this in 264 pages, but also provides thirty-six pages of notes and references for those who want to dive deeper into some topics. The most important section is doubtless the last chapter dealing with solutions, which may be politically controversial but are well supported by the remainder of the book.

Modern computer processors have enormous computational power, and a good way to take advantage of that is to do optimization, the subject of the first chapter. Engineers love optimization, but not everything should be done as quickly and cheaply as possible! Optimization requires the choice of some quantifiable metric, but often available metrics do not exactly represent the true goal of an organization. In this case, optimizers will choose a proxy metric which they feel logically or intuitively should be correlated with their goal. The authors describe the problems which result when the wrong proxy is selected, and then excessive optimization drives that measure to the exclusion of other possibly more important factors. For example, social media companies that try to increase user numbers to the exclusion of other factors may experience serious side effects, such as the promotion of toxic content.

After that discussion on the pros and cons of optimization, the book dives into the effects of optimizing money. Venture capitalists (VCs) have been around for years, but recent tech booms have swelled their numbers. The methodology of Objectives and Key Results (OKR), originally developed by Andy Grove of Intel, became popular among the VCs of Silicon Valley, whose client firms, including Google, Twitter, and Uber, adopted it. OKR enabled most of the employees to be evaluated against some metric which management believed captured the essence of their job, so naturally the employees worked hard to optimize this quantity. Again, such a narrow view of the job has led to significant unexpected and sometimes unwanted side effects.

The big tech companies are threatened by legislation designed to mitigate some of the harm they have created. They have hired a great many lobbyists, and even overtly entered the political process where possible. In California, when Assembly Bill 5 reclassified many independent contractors as employees, the affected tech companies struck back with Proposition 22 to overturn the law. An avalanche of very expensive promotion of Proposition 22 resulted in its passage by a large margin.

It is well known that very few politicians have a technical background, and the authors speculate that this probably contributes to the libertarian leaning prominent in the tech industry. The authors go back in history to show how regulation has lagged behind technology and industrial practice. An interesting chapter addresses the philosophical question of whether democracy is up to the task of governing, or whether government by experts, or Plato's "philosopher kings" would be better.

Part II of the book is the longest, addressing the fairness of algorithms, privacy, automation and human job replacement, and free speech. The authors point out some epic algorithm failures, such as Amazon being unable to automate resumé screening to find the best candidates, and Google identifying Black users as gorillas. The big advances in deep learning neural nets result from clever algorithms plus the availability of very large databases, but if you've got a database showing that you've historically hired 95% white men for a position, training an algorithm with that database is hardly going to move you into a future with greater diversity. Even more concerning are proprietary black-box algorithms used in the legal system, such as for probation recommendations. Why not just let humans have the last word, and be advised by the algorithms? The authors remind us that one of the selling points of algorithmic decision making is to remove human bias; returning the humans to power returns that bias as well.

Defining fairness is yet another ethical and philosophical question. The authors give a good overview of privacy, which is protected by law in the European Union by the General Data Protection Regulation. Although there is no such federal law in America, California has passed a similar regulation called the California Consumer Privacy Act. At this point, it's too soon to evaluate the effect of such regulations.

The automation chapter is entitled "Can humans flourish in a world of smart machines?" and it covers many philosophical and ethical issues after providing a valuable summary of the current state of AI.

Although machines are able to defeat humans in games like chess, go, and even Jeopardy, more useful abilities such as self-driving cars are not yet to that level. The utopian predictions of AGI (artificial general intelligence, or strong AI), in which the machine can set its own goals in a reasonable facsimile of a human, seem quite far off. But the current state of AI (weak AI) is able to perform many tasks usefully, and automation is already displacing some human labor. The authors discuss the economics, ethics, and psychology of automation, as human flourishing involves more than financial stability. The self-esteem associated with gainful employment is not a trivial thing. The chapter raises many more important issues than can be mentioned here.

The chapter on free speech also casts a wide net. Free speech as we experience it on the internet is vastly different from the free speech of yore, standing on a soap box in the public square. The sheer volume of speech today is incredible, and the power of the social media giants to edit it or ban individuals is also great. Disinformation, misinformation, and harassment are rampant, and polarization is increasing.

Direct incitement of violence, child pornography, and video of terrorist attacks are taken down as soon as the internet publishers are able, but hate speech is more difficult to define and detect. Can AI help? As with most things, AI can detect the easier cases, but it is not effective with the more difficult ones. From a regulatory standpoint, section 230 of the Communications Decency Act of 1996 (CDA 230) immunizes the platforms from legal liability due to the actions of users. Repealing or repairing CDA 230 may be difficult, but the authors make a good case that "it is realistic to think that we can pursue some commonsense reforms" (p. 225).

The final part of the book is relatively short, but addresses the very important question: "Can Democracies Rise to the Challenge?" The authors draw on the history of medicine in the US as an example of government regulation that might be used to reign in the tech giants. Digital technology does not have as long a history as medicine, so few efforts have been made to regulate it. The authors mention the Association for Computing Machinery (ACM) Software Engineering Code of Ethics, but point out that there are no real penalties for violation besides presumably being expelled from the ACM. Efforts to license software engineers have not borne fruit to date.

The authors argue that the path forward requires progress on several fronts. First, discussion of values must take place at the early stages of development of any new technology. Second, professional societies should renew their efforts to increase the professionalism of software engineering, including strengthened codes of ethics. Finally, computer science education should be overhauled to incorporate this material into the training of technologists and aspiring entrepreneurs.

The authors conclude with the recent history of attempts to regulate technology, and the associated political failures, such as the defunding of the congressional Office of Technology Assessment. It will never be easy to regulate powerful political contributors who hold out the prospect of jobs to politicians, but the authors make a persuasive case that it is necessary. China employs a very different authoritarian model of technical governance, which challenges us to show that democracy works better.

This volume is an excellent reference on the very active debate on the activities of the tech giants and their appropriate regulation. It describes many of the most relevant events of the recent past and provides good arguments for some proposed solutions. We need to be thinking and talking about these issues, and this book is a great conversation starter.

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