Environment

A SUGAR CREEK CHRONICLE: Observing Climate Change from a Midwestern Woodland by Cornelia F. Mutel. Iowa City, IA: University of Iowa Press, 2016. 251 pages. Paperback; $14.40. ISBN: 9781609383961.

Have you had the unfortunate experience of having friends or family members learn of a medical condition that had existed long before the symptoms became apparent? How often have we commented on how well a person looked who really was very ill? Have you ever ignored medical symptoms, wishfully hoping it was not anything serious and would resolve itself without intervention?

What if you discovered that the environment in which you lived and loved was changing in gradual and subtle ways and realized that wishful thinking would not make it better? Would you be moved to speak out?

Cornelia Mutel studied the reports on climate change so she could ably edit a report on climate change effects in Iowa. She was profoundly moved by her research, coupled with changes she was seeing in her woodland, and she felt compelled to use her voice to address the issue. As an ecologist and senior science writer, she has the ability to write a book about what she learned and make that book accessible to people with little science background. Through the use of a monthly journal, we accompany Cornelia on walks through her woodland and experience with her the changes she saw taking place as a result of the extreme weather conditions that existed in Iowa during 2013. As an ecologist, she is able to point out the changes that occurred and speculate whether these were the vague symptoms of climate change.

The science of climate change is not easy reading nor readily understood by people outside the field. Mutel took an interesting approach: sharing with us a yearlong journal that she wrote for her granddaughter about a woodland in which she lives, describing its ecology and natural history. Throughout this journal, she gently introduces the process of climate change by describing the changes in her woodland alongside weather events of the year. Using this approach, she shows what we might expect in a future when greenhouse gases reach a level that causes irreversible changes to our environment. To be clear, she notes that weather events described in her journal are best called weather and not climate change, but these weather events may already be influenced by climate change. If the extreme weather in 2013, in Iowa, gives us a sense of the change that could take place because of the rising heat energy in the atmosphere, it may be a way to understand the future impact of climate change. Mutel also shared personal life-changing problems that, by analogy, provide a unique way of understanding the insidious changes that are taking place.

As a reader, I was drawn into the gentleness of the book. Thinking of the effects of climate change are overwhelming for me. The future is a scary dwelling place for my mind. I am too old to see what will happen, but my grandchildren and their children will live in this changing world and it frightens me. I have read and studied scientific articles about the topic and am convinced that we are heading in a bad direction. The general warming trend is caused by human-induced increases in greenhouse gases. We have had other warm periods in the life of the earth and high CO_2 levels, but never when the earth was the home to almost 8 billion people. We all have heard about the future ramifications of this increased heat energy in the environment. Yet we do not seem to be moved by the probability of an increased frequency of extreme weather events, challenges to world food security, weather patterns that will amplify droughts that are already persistent in many areas of the world, rising sea levels that will cause mass migrations of the majority of the world's population that lives near ocean coasts, all creating world competition for space, water, and food leading to severe political unrest. Why don't we seem to care? Is it because we are told over and over that climate change is a hoax?

In 2016, the year of a national election, I saw the issue of climate change denied, ignored, and obfuscated. The general public does not know what to think. The science is hard to understand. So it takes a gentle but firm hand to introduce a nonscientific audience to the ramifications of heating the earth's atmosphere by what most would consider an insignificant change in temperature of a few degrees and to help them understand that this heating is caused primarily by greenhouse gases emitted through human activity.

My visits to national parks have always been invigorated by the lectures and tours provided by the park rangers. So, going on walks with Mutel through her journal descriptions of her woodland was a pleasure. I wanted to be there with her through the four seasons she beautifully described so that I could learn about her unique natural world. But since I could not be physically present, I read her journal chapters and compared them to my own experience, living in the urban sprawl of a metropolitan city. No woodland, just a small city lot, small house, and small perennial garden. Could I find parallels to her experiences? Or

could readers, living in different locations, identity with the changes she described to her woodland?

She made me think about the increased frequency of "100-year storms" and record-setting weather events (22 inches of rain in August) in my area. I see the changes in our urban mammal populations (e.g., skunks, rabbits, chipmunks), butterfly and mosquito populations, seasonal temperatures not following predictable patterns, and longer periods of droughts followed by too-heavy precipitation. I remembered (and liked) the warmth of an early spring only to watch the buds of emerging flowers and trees be nipped by a frost occurring on a normal seasonal date. So, yes, I found parallels, and the more I walked with her through her journal, the more connections I was able to make.

The book provides a very good explanation of climate change. Too often, the language of science gets in the way. We need a science conversant-society, but we are far from being there. We need a society that has a healthy trust of science. We are not there either. We need to have a society that believes that science and religion can be on the same side. Still, not there. What this book provides is good, understandable science and gentle reading. And, if you allow it, you will realize that the changes she describes in a woodland in Iowa are the same ones you find in your own backyard.

Mutel points out that, initially, climate change will not affect all of us the same way. Poor nations will find it more difficult to recover from severe weather events. The poorest people will be the least likely to prepare for the changes to come. I think of how difficult the recovery process was for hurricanes Katrina and Sandy or the number of deaths of elderly people during the extended heat waves in Chicago. Climate change is a social justice issue. Christians know of God's love for his creation and for all his children. As Christians, we need to mirror God in our actions.

Mutel has faith in this planet's people and in her nation, that they will act to slow climate change. She suggests meaningful ways in which people can act. She is optimistic, and she made me a little more so. However, it is difficult to be optimistic. I watch politicians continue to block basic measures to address the issue, and I see how corporate wealth influences decision making. I would like to believe that my reducing my energy footprint, and Mutel saving her woodland, is all that it will take. But I am wrong. We cannot have national elections without this issue being discussed and debated. We cannot have the world's religions ignore the symptoms. The world communities differ in their contributions to climate change, in their ability to respond to climate change, and in their ability to bear the costs involved. Whatever the imbalance, we will all suffer the consequences.

It is important to have books like *A Sugar Creek Chronicle* written for nonscience citizens. We need gentle, firm persuasion. We need a better understanding of the issues. We need hope. All of these are provided in this book. Get a copy, read it, and pass it along.

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Earth Sciences

EARTH SCIENCE: God's World, Our Home by Kevin Nelstead. Austin, TX: Novare Science & Math, 2016. xxii + 501 pages. Hardcover; $75.00. ISBN: 9780096352911.

I spent many years teaching science to young adolescents in Christian schools. Throughout those years, I generally preferred using a secular text, because I found that the science content was often stronger, even if a distinctively biblical perspective was lacking. I believed that I, as a middle school teacher, was better equipped to infuse a biblical perspective into my lessons than to develop the science content for myself, and so I made my curriculum choices along these either/or lines. Thankfully, with the ongoing development of new texts, this sort of either/or decision making may no longer be necessary. Nelstead's *Earth Science: God's World, Our Home* is a strong offering in terms of both the science content and the faith perspective. The text invites students and teachers to do "good science" while also presenting a faithful biblical worldview.

Before becoming a teacher at a Christian school, Nelstead served as Senior Cartographer, Geospatial Analyst, and Natural Resources Specialist for the United States federal government for seventeen years. His educational background is strong in Earth science, particularly in geology. He developed this text for middle school teachers in Christian schools based on three core principles: (1) Mastery: aiming for deep understanding and retention rather than the coverage approach prevalent in many science curricula; (2) Integration: deliberately uncovering the connections between the sciences and other disciplines; and (3) Kingdom Perspective: teaching students to "effectively engage issues" and "perceive God's fingerprints in creation" (pp. xiv–xvi).

The text begins with two helpful prefaces: one for teachers and one for students. In these prefaces, Nelstead explains the approach taken in the text in a way that is appropriate for each of these audiences. He includes an exposition of the faith perspective,

beliefs about science, and pedagogical assumptions that underlie the text, as well as suggestions for how to use this text, both as a teacher and as a learner.

The science content included is comprehensive and rigorous. Topics one would expect to find in a middle school science text, such as volcanoes, earthquakes, the water cycle, and climatic zones, are all present here. However, many other topics are also included to support and extend understanding of the major concepts. For example, the chapter on minerals opens with a detailed investigation of atomic structure, the periodic table, and chemical bonds, as these concepts are helpful for developing an understanding of crystal structure. Similarly, the chapter on climatology begins with topics that would be expected, such as the factors that determine climate and an exploration of climate classifications, but then moves on to more challenging topics such as climate change and the impact of air pollution on climates. These are just two illustrations, but I hope that they serve to shed light on the careful structuring of the content both to explain the underlying concepts and to provide application of the ideas in each chapter.

The content encompasses all of the major aspects of Earth science, including techniques for visualizing the earth: geological concepts, including rocks and minerals, the rock cycle, the structure of the earth, and plate tectonics; environmental science topics, such as weathering and erosion, the hydrologic cycle, and landforms; an exploration of Earth's history and geologic timescale; an introduction to oceanography; and meteorology concepts, including the composition of the atmosphere, weather, and climate. This book provides a faithful elaboration of current scientific theories, explaining the natural features of the earth and the processes at work in creation. On a quick read through the book, some of the content seems demanding for young adolescents. Exploring the overall structure of the text, however, helps one to see the thoughtful design to support students' mastery of this challenging content.

The text is very readable, and it includes appropriate graphics to illustrate concepts and provide examples. Nelstead's warm voice present in the text suggests a caring teacher behind the writing rather than the cold prose typical in many science textbooks. Each chapter begins with a historical vignette to introduce the topics to be investigated in an engaging way. A list of objectives to guide students' learning and to offer a means of self-assessment leads the text of the chapter, which is followed by a list of new vocabulary to be mastered. Each chapter is laid out in outline format, providing a deliberate structure for the content. The section headings are informative about what is included, and each section is well written with a clear introduction and conclusion. Each major section of a chapter concludes with a "learning check" composed of several questions that provide an opportunity for formative assessment, and each chapter closes with a series of exercises in various formats, including writing prompts, potential test questions, projects for application of the chapter concepts, and suggestions for further research. Eight of the fifteen chapters conclude with a suggested experimental investigation that students might conduct.

I very much appreciated the approach to potentially controversial topics for Christians teaching science. It can be a challenge for science teachers to navigate the perceived disparity between what scripture teaches and what is observed in creation. Nelstead addresses this challenge head-on by describing a proper understanding of the nature of science:

> We need to engage thoughtfully with the scientific claims of our day. It is not a scientific claim to say that the universe got here by itself; that is a metaphysical claim based on an atheistic worldview. But it is a scientific claim to say that the universe began with the Big Bang and is now 13.77 billion years old … We do not believe it is appropriate to teach students to be dismissive of claims like this one simply because they do not line up with certain ways of interpreting Genesis. (p. xv)

Nelstead is clear throughout the text that he loves scripture and holds the perspective that the Bible reveals God as the caring, sovereign Creator. He emphasizes the perspective in this text as one that accepts "the strong evidence for an old universe" (p. xvi). However, Nelstead also encourages Christian educators to put the issues of the age-of-the-Earth debate behind them, stating, "Since Scripture and creation both come from the same God, they cannot be in conflict. And when both are rightly understood, they won't be" (p. xvi). I recognize that not all Christian educators will agree with this perspective. However, many Christian educators teach with secular texts that embody a very different worldview than that of the teacher. The fact that Nelstead is upfront about his beliefs and how they influence the writing of the book is encouraging, and a model that Christian educators might follow.

The reader should be aware that this text seems to embody a strongly essentialist philosophy of education, emphasizing the development of vocabulary, understanding of basic concepts, and memorization. This is not necessarily problematic, but it is something to be considered in the process of selecting a text. The emphasis on mastery of the material—as opposed to the "cram-pass-forget" cycle introduced in the preface (see p. xiv)—is admirable. However, the current consensus in science education is that

a constructivist approach, emphasizing exploration, first-hand investigation, and authentic inquiry along with reading and writing in science, may lead to a deeper understanding of the concepts. While eight suggested investigations are included in this text, Nelstead seems to acknowledge that this might not be enough to truly provide opportunities for students to explore concepts firsthand. Included in the preface is a short section on "enrichment activities," which includes the statement, "understanding will be enhanced and memory will be strengthened when students engage with the content in activities outside the text" (p. xviii). Teachers intending to follow best practices for inquiry-infused science teaching will still find this a very valuable text for background reading and development of conceptual understanding related to Earth science topics.

I thoroughly enjoyed reading this text, and I believe Christians teaching science will find it a valuable resource. It may prove to be an excellent textbook choice for an earth science course for students in grades 7–9, and I would recommend that science teachers in Christian schools examine it for themselves for possible adoption. Christians involved in teaching science at other grade levels or in different types of schools would also benefit from this text as a resource to keep on the shelf. I believe that anyone interested in a thoughtful elaboration of Earth science that holds a biblical perspective as integral to that study would benefit from reading this book.

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PALEOBIOLOGY

CETACEAN PALEOBIOLOGY by Felix G. Marx, Olivier Lambert, and Mark D. Uhen. Chichester, UK: Wiley-Blackwell, 2016. 345 pages, including contents, preface, color plates, and index. Hardcover; $149.95. ISBN: 9781118561270.

Cetaceans, including modern whales, dolphins, and porpoises, have long been enigmatic animals. In the first edition of *On the Origin of Species* (1859), Charles Darwin speculated how natural selection could have given rise to aquatic mammals like cetaceans, but his example, which was based on observations of black bears swimming in the water and eating insects, was so ridiculed that he removed much of it from subsequent editions. Some key cetacean fossils, hinting at their terrestrial ancestry, were recovered in the mid-to-late nineteenth and early twentieth centuries, but the origin of cetaceans was largely considered a mystery well into the mid-twentieth century. Discoveries of fossils in Pakistan and Egypt in the 1970s and 1980s spurred renewed interest in the early history of these animals, and in the past several decades, the evolution of cetaceans has become one of the most widely cited examples of large-scale evolutionary change evident in the fossil record.

Cetacean Paleobiology is a detailed look at what is currently known about this remarkable evolutionary transition based on the fossil record. The book aims to provide a complete and thorough overview of cetacean evolution, including basic principles of anatomy and taxonomy, summaries of extinct and modern families, explanations of techniques and concepts used to study fossils, detailed analyses of the fossil record, and various case studies. It was cowritten by three authors who have focused on different aspects of cetacean evolution. Felix Marx has worked primarily on the fossil record of the earliest baleen whales (mysticetes), while Olivier Lambert has studied principally the fossils of extinct toothed whales (odontocetes). Mark Uhen has focused his work on the earliest known cetaceans (archaeocetes), which bridge the gap between the terrestrial ancestors of cetaceans and the first fully aquatic forms. Between the three of them, they provide expertise on virtually all aspects of the cetacean fossil record.

Chapter 1 provides a brief overview of cetaceans and how different forms are classified. It includes a short introduction to functional anatomy and a thorough discourse on the methodology that is used to infer evolutionary relationships. This chapter also introduces some of the methods that are used to infer habitat and feeding preferences in fossil animals, including a detailed explanation of stable isotope ratios, and discusses the interplay between evolutionary trends and the biotic and abiotic factors that drive them.

The cetacean fossil record is detailed in chapter 2, and it includes a brief history of exploration and some of the key early figures involved in studying whale fossils. The basics of fossilization are discussed along with its major effects on the fossil record of cetaceans. Much of the chapter is devoted to descriptions of major cetacean fossil localities in the world, including sites such as Wadi Al-Hitan in Egypt, deposits all along the southeastern coast of the United States, and the Pisco and Sacaco basins in Peru.

I suspect that, for many readers, it is in chapter 3, which involves a detailed look at morphology, that the rubber meets the road. The chapter begins with an overview of the skeleton before moving into a detailed look at the skull. The ear region, which is vital for understanding cetacean taxonomy and ecology, is described in extensive detail. Comparatively little of the chapter is devoted to the postcranial skeleton, but the discussion of osteological correlates of soft tissue structures (e.g., muscles, baleen, brain) is

welcome. The anatomical overviews get complicated pretty quickly, but this may be unavoidable in most cases. Here, and throughout the text, the authors seek to mitigate these challenges by highlighting, in bold, key terms that may be unfamiliar to the reader, although occasionally some jargon slips into the text without being highlighted or defined. Throughout this chapter, photos and illustrations are used to demonstrate the structures being described. The labeled photos are of the highest quality, and although the line drawings of various skulls and skeletons are more simplified than I would like, they are sufficient for illustrating what they are intended to show.

The longest chapter of the book is chapter 4, which covers cetacean phylogeny and taxonomy. The authors systematically work through the various groups of extinct and modern cetaceans, beginning with the oldest forms (archaeocetes) and continuing through different groups of baleen and toothed whales up to the present. The summaries for some groups are brief, but most of them are fairly extensive. Throughout the chapter, the skulls of representatives from the different groups are illustrated with accompanying phylogenies to help keep track of the proposed relationships among the different groups. (Life constructions of many of these fossils are also included among the 16 full-color plates at the center of the book.) This chapter concludes with a short discussion of the current consensus and conflicts in cetacean phylogenetics. After completing this chapter, it is difficult not to come away with a sense of awe for the immense amount of biological and ecological diversity in the history of cetaceans.

The next several chapters discuss particular topics related to various aspects of cetacean ecology and evolution. Chapter 5 includes a more detailed discussion of several key cetacean fossils along with some nice photographs, but it focuses mostly on certain key innovations and developments in cetacean history. These discussions include the various lines of evidence for changes in locomotion, terrestrial competency, habitat preference, and sensory systems. This chapter also details the development of baleen for feeding in mysticetes, the evolution of echolocation in odontocetes, and the radiations of freshwater cetaceans. Chapter 6 focuses primarily on the evolution of different feeding strategies, but also includes briefer discussions of reproduction, migration, sexual dimorphism, and diving. The authors take a step back in chapter 7 to look more broadly at larger-scale patterns of biodiversity between the Eocene and the present. Hypotheses for the drivers of these radiations and extinctions are discussed, and the stratigraphic ranges of all known cetacean families are documented. Trends in the evolution of body size and brain size are covered, as are biogeographic patterns and instances of convergent evolution. In chapter 8, the authors explore some of the insights that the fossil record can give into the evolution of development in cetaceans. This chapter includes discussion of limb development, vertebral column regionalization, tooth morphology, and changes in the relative timing of developmental events.

The book ends with a very brief summary and synthesis in chapter 9. The key breakthroughs and discoveries "that finally cracked the cetacean conundrum" (p. 302) are highlighted, and the authors compiled the many cases discussed in prior chapters in order to describe the overall arc of cetacean evolution from their first forays into the water until now. This conclusion discusses the connection between humans and cetaceans, including the role that studying cetacean history can have in guiding future decisions about cetacean conservation.

In sum, this book is impressive in both its scope and depth. Given its well-written summaries and its copious citations and references, it will quickly become a go-to resource for researchers, graduate students, and undergraduate students interested in the evolution of these marvelous marine mammals. Professors and teachers who are not specialists will find much here that they could discuss with their students when looking at the evidence for evolution. However, this may be a difficult book to work through for individuals who do not have much background in the biological or physical sciences. Given its steep price tag, this book is unlikely to find a home on the shelf of a nonspecialist, but it is still well worth a read. It takes just a quick perusal of this book to make sufficiently clear why the evolution of cetaceans has become one of the most compelling examples of large-scale evolutionary change.

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Philosophy & Theology

HOW CAN PHYSICS UNDERLIE THE MIND? Top-Down Causation in the Human Context by George Ellis. Heidelberg, Germany: Springer-Verlag, 2016. 501 pages. Hardcover; $79.99. ISBN: 9783662498071.

In this *magnum opus*, as Philip Clayton described it in his endorsement, George Ellis lays out the case for top-down causation from an emergentist perspective. For decades he has been one of the leading proponents of emergence, a philosophical perspective that lies between strong reductionism on the one hand and vitalism on the other. Reductionist critics of emergence had claimed that the properties and substances that emerged from more fundamental

elements had no causal power of their own but were solely determined. Ellis powerfully argues that these emerging entities do indeed have top-down causal powers to constrain or structure more fundamental components and that any understanding of the mind, consciousness, and free will must take that into account. He credits many colleagues for work over several decades in compiling the evidence, including Nancey Murphy, Warren Brown, Tim O'Connor, Robert Russell, and others.

George F. R. Ellis was born in Johannesburg, South Africa, in 1939. He earned a BS degree in physics from the University of Cape Town and a PhD in applied math and theoretical physics at Cambridge University. He collaborated with Stephen Hawking to co-author the book *The Large Scale Structure of Space-Time*. He returned to the University of Cape Town in 1973 where he taught until retirement in 2005, becoming one of the world's leading theorists in cosmology. He is a Quaker, and a Platonist, and has served as president of the International Society for Science and Religion. He was awarded the Templeton Prize in 2004. He is a co-author with Nancey Murphy of the book *On the Moral Nature of the Universe: Theology, Cosmology, and Ethics*. Ellis has long worked on the emergence of complexity and top-down causality, the focus of this book.

Emergence is as much about the existence of entities, and their characteristics, that arise from the interaction of their components as it is about the process by which these components came together. Ellis suggests that there are three primary ways in which components come to interact.

First of all, in the inanimate, or abiotic, world, the primary way in which elements come together is self-assembly. That is, the basic forces of nature bring them together. For example, a very large number of hydrogen atoms in space are drawn together by gravitational force. Eventually, they self-assemble into a massive ball of fire when the hydrogen atoms come close enough to each other to ignite fusion. A star emerges from this interaction. The entire collection of atoms carries out top-down causation to force hydrogen atoms to come close enough to fuse, and the bottom-up causation ignites the star. Many similar examples are familiar to us, for instance, gems emerging from mineralization and compression, and sand dunes emerging from particles of sand. These tend to be very simple but are the easiest to understand.

A second type, dominant in the biological world, is the process of adaptation through, for example, natural selection. Biological cells and organisms emerge from a vast complex of interacting biochemicals and have the ability to reproduce. During development from embryo to organism, the cells reproduce and interact so that limbs, organs, and specialized tissue emerge from the interaction of those biochemicals. The top-down causation of reproduction modifies the collection of component biomolecules which, through bottom-up causation, form the organism. Since each reproduction involves a small amount of variation, new organic systems emerge from these reproductions.

A third type is design and construction by external agents. This occurs when birds build nests, bees construct hives, spiders weave webs, ants create hills, and humans make houses or tools such as computers. The agents use top-down causation to shape and constrain the atoms and molecules in solids, gases, and liquids which, in turn, use bottom-up causation so that the function desired by the agent emerges from the components. Emergence deals with the hierarchy of entities in the products that emerge at each level. The possibility space far exceeds that of the simple capacity of self-assembly and even the impressive power of natural selection.

Ellis also suggests that there are three main timeframes in which emergence occurs. The longest time frames involve the evolution of species or of objects such as stars and galaxies. Medium time frames are required for the development processes in which an individual object or being grows from conception to maturity. The shortest time frames relate to the development of the function of an object or being.

At the publisher's request, Ellis structured the book in such a way that each chapter could be sold as a separate stand-alone booklet, in addition to the entire set of eight chapters as a single book. This style led to a significant amount of repetition, especially of references, but in a sense, that repetition helped provide one with an illusion of actually understanding the material. A brief description of each chapter will help readers decide which option is best for them.

Chapter 1: "Complexity and Emergence"
Ellis introduces all the key terms and ideas in the first chapter, though with few examples and a minimum of detail. He sets forth the basic ideas of the hierarchical structure of the universe and of emergence of causal entities at the higher levels. He ends the chapter with some practical implications for health care, mental health, and education. The chapter therefore serves as an effectively complete summary of the book but will leave the reader seeking a more detailed exposition.

Complexity lies in the hierarchical structure, in which the bottom layers are the fundamental forces and particles of physics and chemistry. The higher levels

are composed of combinations and interactions of the entities in the lower levels. Ensembles of large numbers of interacting entities at one level enable new entities at the next higher level. Those higher-level entities can, in turn, have a causal effect on the lower-level entities by controlling the scope and bounds of their interaction. These higher-level entities are said to emerge from that interaction. Bottom-up causation refers to the lower levels of physical particles and their interactions generating higher level, more complex entities. Top-down causation refers to the higher levels imposing constraints or boundary conditions on the lower-level entities.

Reductionists claim that top-down causation is an illusion and everything is determined in a bottom-up fashion. Vitalists, and, in a sense, spiritualists, posit a vital or spiritual force that provides the top-down causation to the lower-level entities. Emergentists claim that the top-down causation of higher-level entities is real, necessary, and sufficient for the joint top-down/bottom-up causal effects to explain the structure of the universe. Ellis ignores the vitalists and addresses this book as a response to reductionists.

Ellis is careful to caution that there is no way of knowing with certainty what is the lowest or the highest level in the hierarchy. Though we now think we know what are the fundamental particles and basic forces of nature, we may in the future learn of additional underlying levels. Likewise, higher levels of interaction may also exist or come into existence in the future.

Chapter 2: "Digital Computer Systems"
Anyone who, like me, has participated in the design of a computer hardware system or who has written any software program will greatly enjoy this chapter. Ellis describes the hardware and software as hierarchical systems that display all the key features of emergence. A reader unfamiliar with or uninterested in computing systems can safely skip this chapter, but it does provide an illuminating description of the major features of emergence.

Most, though not necessarily all, higher-level entities in computing systems are created by intelligent designers and do not emerge through self-organization of the lower levels or through natural selection. In other words, the higher levels of the hierarchy that impose constraints on the lower levels are constructed by intelligent agents external to the computing system itself. A circuit designer, for example, can direct a computer processor chip manufacturer to constrain the size and shape of a transistor. The atoms and molecules in that transistor then interact within the confines of that top-down constraint and effect the behavior desired by the designer. Emergence refers to the properties and entities that arise when the designer has implemented the desired constraints and context, and not to the way in which those interactions and higher-level entities came into being. Emergence deals primarily with the consequence of an interacting ensemble of components rather than with the method by which that interaction arose.

Ellis closes this chapter with this gem: "At a higher level, the existence of computers is an outcome of the human drive for meaning and purpose: it is an expression of the possibility space of meanings, the higher levels whereby we guide what actions take place" (p. 80).

Chapter 3: "The Basis of Complexity"
Chapters 3 and 4 lay out the technical details of emergence. In chapter 3, the focus is on the hierarchical structure that forms the basis for complexity. Moving from a lower level to a higher level in the hierarchy, the components of one level are composed of ensembles of interacting elements of the next lower level. For example, solid materials are composed of a very large number of atoms which occupy a lower level in the hierarchy. These atoms, in turn, are composed of protons, neutrons, and electrons which comprise an even lower level. Looking upwards, the solid material forms the basis, when shaped or combined with other solids, of an object that can be used as a tool. The tool may result from an even higher level of intent or purpose to carry out a particular function. The shape of that tool forms a basis for the range of motion of the component atoms. In this way, both top-down and bottom-up causation can be seen.

Chapter 4: "Kinds of Top-Down Causation"
The second part of the technical explanation of emergence emphasizes the many different ways in which top-down causation can occur. The simplest types are deterministic as in the lower levels where, say, quarks interact to form protons and neutrons with little variation. More complex types occur in higher-level systems in which feedback can occur. Feedback systems in mechanical systems are common to all of us, such as in thermostats and audio amplifiers. In biological systems, we observe homeostasis, in which our bodies maintain a nearly constant temperature, blood pressure, and oxygen levels in blood. Ellis does not focus on how such biological feedback systems might have evolved but delineates all the ways in which emergent feedback systems operate.

At even higher levels there are many more interesting types involving adaptive systems. When a higher-level entity can change in such a way that the lowest levels are channeled into enabling a modified higher-level system, then adaptation has occurred. It is here that the tremendous power of emergence can be seen.

Chapter 5: "Room at the Bottom?"

Ellis asks whether the notion of bottom-up and top-down working simultaneously would overdetermine the system. If the physics of the lowest levels is causally closed, can top-down causation really occur? Here Ellis provides several ways in which top-down causation can work. There can be contextual constraints or constraining structures or a change in the nature of the lower-level elements. An example of the latter is that a free neutron has a lifetime of less than 15 minutes, but when the neutron forms a higher-level nucleus by interacting with one or more protons or other neutrons, it is stable. The interaction of the neutron with other particles changes the nature of the neutron. Causality from above influences the outcomes of the lower-level causal forces.

Quantum dynamics comes into the picture at the lowest levels. Inherent uncertainty and probabilistic descriptions are important when quantum effects dominate. This is one reason why determinism fails. No explanation at the lowest levels can deterministically predict the effects at higher levels. Randomness and uncertainty prevail.

Another more pervasive reason for indeterminacy is the ubiquitous nature of what Ellis calls "equivalence classes." These classes refer to, on the one hand, a set of differing states at one level that can all arise from the same lower-level state, and, on the other hand, a set of differing states at a lower level that lead to the same higher-level state. For example, there can be many different combinations of kinetic energy of molecules in a gas that lead to the same pressure and volume of the whole.

Chapter 6: "The Foundations: Physics and Top-Down Causation"

Physicists and chemists as well as astronomers and cosmologists will revel in reading this chapter. Ellis dives into the details of the lower levels of the hierarchies in this universe to examine the fundamental forces. He explores quantum dynamics, the arrow of time, and numerous other examples from condensed-matter physics and chemistry. The principles of emergence as laid out in the previous chapters are beautifully illustrated by many examples. Those who are not enamored with physics or chemistry can safely skip or skim the chapter.

Chapter 7: "The Mind and the Brain"

At last Ellis arrives at the issue everyone is waiting for. How can the brain give rise to the mind? No one should miss this chapter. Not only are biologists and neuroscientists in prominence but also those broadly involved in the social context of our world.

A typical complex organism includes the capability of sensory perception, such as sight or smell. The organism responds to its environment by reacting to these perceptions. The network of neurons integrates these perceptions with the cells, such as muscle cells, that initiate responsive action. The interaction of these complex networks leads to the emergence of ever more sophisticated capabilities. Ultimately, the ability to sense one's self as distinct from the environment underlies self-awareness and consciousness in a way that is still far from understood.

In the hierarchical perspective, a brain is enabled from the bottom by a series of levels from the fundamental particles up through the biochemistry of life and the neurons and neural networks. In turn, these networks in the brain enable a higher level of individual consciousness which, in turn, enables a society of interacting individuals forming a culture. All of this occurs in the context of an environment and leads to a fine-tuned system.

The high-level social interactions of individuals, together with the environment, affect personal perceptions, ideas, and purpose, leading to decisions and actions that causally work downward to direct biochemical activity. Such activity then enables the desired actions. In this way, bottom-up and top-down causality work together to implement what we perceive as our intention. Free will exists because of the equivalence classes, in which a variety of high-level states can be equally realized from the bottom-up effects which are constrained and selected by purposeful top-down action from the brain. There is no single deterministic solution from the bottom up.

Ellis is careful to clarify that he has not solved the mystery of free will and consciousness. Rather, he claims that the emergent properties of top-down/bottom-up causation are vital parts of what will someday be the story of consciousness.

The importance of adaptive systems is emphasized in this chapter. Biological systems are far more adaptive than nonbiological systems. When higher-level entities are able to modify selection criteria and adapt to the environment by influencing the outcomes of the lower-level processes, then a vast spectrum of possibilities opens up. This is another description of the process of evolution.

Chapter 8: "The Broader View"

Ellis refers to this portion of the book as a polemic that sets emergence apart from reductionism. He reprises the full concept of emergence and then looks at the broad implications.

Inserted into this chapter is a section on "Learning to Read and Write," which Ellis co-authored with his wife, Carole Bloch. They argue that modern methods of teaching people to read overemphasize a bottom-up approach. This means that there is a focus on the elemental phonemes before putting it all together into a meaningful sentence. Rather, they recommend a greater emphasis on top-down learning in which the meaning is emphasized first. Then the combination of top-down and bottom-up learning leads to a more efficient process. This exemplifies Ellis's view that everything in our universe can be treated as an integrated bottom-up/top-down system.

Ellis does not allude to the implications for science and faith. He is a man of faith and has written elsewhere of his disagreement with atheism and with those who advocate a scientific religion. His views seem to be essentially that of Non-Interventionist Objective Divine Action (NIODA) as advocated by Robert Russell, Nancey Murphy, and others. The emergence that he describes in this book is easily compatible with such a view. Multilevel explanations lend themselves well to including the spiritual domain, as Donald MacKay, for example, explained in the middle of the twentieth century. However, materialists can also find support for their own presupposition in this book. The higher levels of explanation, including those leading to meaning and purpose, are fully enabled by the underlying physics and need no external source. If spiritual levels are not required, though not negated, by a complete hierarchical explanation of a system, then on what basis do we believe they exist?

Most of all, this book strikes at the heart of dualism, at least in the sense of the body and mind. The mind is described as enabled by the brain through the emergence of entities capable of supporting consciousness and rational thought through the interaction of a vast number of complex neurological components. It cannot exist independently from the brain and needs no external vitality other than the environmental interaction for food and energy. The implications of top-down causation for neuroscience are significant and were ably discussed by William Newsome in his plenary lecture at the 2016 ASA annual meeting.[1] The concepts in this book will fuel discussions on faith and science for a long time to come.

Is there more to biology than physics and chemistry? Is there telos, meaning, and purpose in our universe? Walter Thorson posed these questions in the 2012 Robert Herrmann Lecture Series.[2] Ellis addresses the same questions and answers with a resounding yes. But that affirmative is not in the sense of an external deity imposing its intentions or vitalism to the material world. Rather, for Ellis, the telos emerges from the physical system. It is more than physics or chemistry because it cannot be explained by the laws of physics at the fundamental level, not because something external must be added to the causal mix. Purpose arises from the ability to causally adapt the lower-level elements to achieve higher-level functions.

Ellis closes the book with this final paragraph:

> The daily world in which we live came about by imaginative investigation of possibilities, discarding those that don't work: the adaptive process that is a central theme of this book, enabled by a modicum of randomness at the macro- and micro-levels, interacting with necessary physical processes. And it is these processes that also allow the emergence of the ordinariness of everyday life …: which actually is quite extraordinary. Bottom-up effects are crucial to emergence. Physics underlies all. Nevertheless, the vitality of life, which arises from physics, transcends it. (p. 454)

Many parts of the book, and particularly parts of this chapter, have the character of a dictionary or encyclopedia that lists and describes all the possibilities of top-down causation. As a result, the book is more like a reference book than a persuasive, flowing prose that presents an elegant defense of a philosophical view.

The book suffers from the weight of making each chapter a stand-alone booklet. The flow is uneven and repetitive. The benefit is that each chapter can indeed be read by itself and a reader interested in only one aspect of emergence can profitably select the relevant chapter. The reader will then be left hungry for more and will want to return for the remaining chapters. I found the book to be persuasive but, admittedly, I was inclined toward an emergentist perspective before I started reading the book. Nevertheless, I sense it would be difficult for a strong reductionist to counter what appears to me to be an overwhelming collection of evidence for emergence.

The casual reader seeking a relaxing fireside read is advised to look elsewhere. This book is an indispensable resource for anyone who seriously ponders the structure of the universe, the miracle of life, and the mystery of consciousness.

Notes

[1]William Newsome, "Of Two Minds: A Neuroscientist Balances Science and Faith," plenary address, ASA Annual Meeting, Azusa Pacific University, Azusa, CA, July 22, 2016, http://www2.asa3.org/movies/ASA2016Newsome.mp4.

[2]Walter R. Thorson, *The Woodpecker's Purpose*, ed. Emily Ruppel (Wenham, MA: Center for Faith and Inquiry at Gordon College, 2014).

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Science & Biblical Studies

ADAM AND THE GENOME: Reading Scripture after Genetic Science by Dennis R. Venema and Scot McKnight. Grand Rapids, MI: Brazos Press, 2017. xii + 225 pages. Paperback; $19.99. ISBN 9781587433948.

The emergence of a number of books on the so-called historical Adam in evangelical Christian circles during the last decade demonstrates how conservative Protestants in particular are grappling with important issues across the theological spectrum in the light of contemporary science. The advantage of this volume is that we are treated to a way beyond "the Bible or science" impasse by the joint efforts of a biologist (Venema) and a biblical scholar (McKnight), both of whom have impeccable scientific/scholarly and evangelical credentials: Venema with a PhD in biology from the University of British Columbia and a longtime professor of biology at Trinity Western University in Vancouver, British Columbia; McKnight with a PhD in New Testament from the University of Nottingham and with three decades of service at evangelical or evangelical-friendly institutions in the Chicago area: Trinity Evangelical Divinity School, North Park University, and Northern Seminary. Northern Seminary is affiliated with the American Baptist Convention (ABC), but it is more evangelically aligned than other ABC seminaries.

The first four chapters are biological; the latter four are biblical. Venema's contributions are to introduce evangelicals to the scientific ideas related to human origins. He first explains what it means to say that evolution is a scientific theory, helping evangelicals to understand that theory in a scientific context does not signify the merely hypothetical. He then explicates genomic science, in particular, the science of population genetics and its role in helping us understand the evolution and speciation of *Homo sapiens*. Next, he elucidates the early history of hominids from a genomic perspective, showing how the interbreeding of humans leaving Africa approximately 50,000 years ago with Neanderthals (in what is now the European region) and with members of the Denisovan species (in the Asian sphere, from DNA found in the Denisova Cave in the mountains of Siberia) have produced the basic racial variations we now associate with Africa, Europe, and Asia/Oceania. Venema also shows how all members of the human family today can be descendants of the so-called Mitochondrial Eve with respect to their mitochondrial genome and DNA, yet have 10,000 or more other ancestors vis-à-vis their chromosomal DNA. Thus, he exposes the challenges that population genetics and research on the genome present to both young earth creationist and intelligent design advocates, addressing specifically the arguments of Michael Behe (whose ideas Venema embraced at one point in his studies as a young and aspiring biologist) and Stephen Meyer, both of whom represent God-of-the-gaps approaches that have waylaid prior apologetic endeavors. Some of the terrain is dense, but evangelical Christians interested in understanding better the science of evolutionary genomics will be richly rewarded for their patience.

McKnight's part of the book proceeds with the assumption that science is coherent and plausible, and that scripture is dependable and authoritative. How then can believers subordinated to the Bible square its message with our evolving understanding of human origins, including our relationship with other species that share 95% of our DNA? The four-stranded response begins. First, McKnight lays out basic hermeneutical principles of respect for the distinctiveness of ancient voices, honesty with current knowledge, sensitivity to students of science, and the primacy of scripture. Second, he moves to clarify how the ancient biblical authors, especially of Genesis, presented not a *historical Adam* (that has emerged in our modern scientific milieu) but a literary and genealogical perspective. Third, he traces the reception history of the Genesis narrative in Jewish tradition that produced interpretations of Adam as moral archetype (Sirach), as immortal/transhistorical figure (Wisdom of Solomon), as philosophical Logos (Philo), as exemplar of Torah observance (*Jubilees*), as Roman figurehead (Josephus), as fallen creature (Ezra 4), and as representative of all humankind (Baruch 2), all of which combined to produce Adam as "the paradigm or prototype or archetype of the choice between the path of obedience and that of disobedience" (p. 169). Finally, he concludes with a discussion of how this legacy of Adamic understandings illuminates St. Paul's retrieval of the literary and genealogical Adam of the inherited biblical traditions in a moral, exemplary, and archetypal direction in order to accentuate Jesus's universal relevance. By the end of the book, the argument is clear: current debates about any historical Adam are fraught with modern scientific (biological and increasingly genetic) presuppositions that are not only foreign to the biblical world but are intrusive upon a faithful approach to the sacred text considered in its original context.

As a systematician, I come away from this book more convinced than ever before that the idea that God might have picked out *Homo sapiens* from among other creaturely species (with other hominids eventually dying out) is consistent with how divine election has been shown to work (e.g., choosing Israel

from among the nations). True, the authors recognize that there is the slenderest thread of support for such a view within Genesis itself—perhaps the lone clue being that Cain's wife came from somewhere else—but the fact that this question was not one the biblical author(s) would have asked is precisely the point of the arc of *Adam and the Genome*. If the broad lines of the way forward presented in this book are deemed cogent, then the implications will be most impactful for those traditions for which notions of original sin/guilt remain prevalent, especially Reformation-oriented traditions. (I am thinking, for instance, of those associated with the churches represented by many contributors to Hans Madueme and Michael Reeves, eds., *Adam, the Fall, and Original Sin: Theological, Biblical, and Scientific Perspectives*; Baker Academic, 2014.) The big question will then be hermeneutical: to what degree is scriptural interpretation dependent on ecclesially developed frames of reference and what might it mean for ecclesial traditions that take *sola scriptura* seriously to wrestle with the Bible in a late modern world quite removed from the (sixteenth century and later) polemics that precipitated formation and nurtured development of their traditions initially?

On the science side, this book will no doubt motivate young earth creationists to master especially the sciences of population genetics, which will be an interesting development to follow. Further, Christian and evangelical intelligent design theorists (not all ID proponents are either Christian or evangelical) should surely reconsider how Venema's personal confession of "evolution as God's grand design for creating life" (p. 90) and McKnight's position of "planned evolution" (p. 96)—both of which also go by other names (theistic evolution and evolutionary creationism, for example)—might be allies as opposed to opponents in the overall theological task of reconciling science and scripture. For the foreseeable future, this book is a significant intervention in the convoluted space where modern science and biblical faithfulness meet, and I recommend it as a text for evangelical colleges and universities to be used not only in programs in the natural sciences but also in worldview, Bible, and theology courses.

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Along with all their other contributions, many members of ASA and CSCA publish important works. As space permits, *PSCF* plans to list recently published books and peer-reviewed articles related to the intersection of science and Christian faith that are written by our members and brought to our attention. For us to consider such works, please write to patrick.franklin@prov.ca.

Science and Religion

TOUCHING THE FACE OF THE COSMOS: On the Intersection of Space Travel and Religion by Paul Levinson and Michael Waltemathe, eds. New York: Fordham University Press, 2016. 280 pages. Paperback; $19.95. ISBN: 9780823272112.

Space exploration—human spaceflight in particular—has received much attention recently. New generations of telescopes promise ever more discoveries that elucidate the origin, structure, and fate of the universe. The rise of the commercial spaceflight industry leads to the hope that all sorts of people, not just professional astronauts, will eventually be able to travel to space. Elon Musk, founder of SpaceX, has ambitious plans to colonize Mars, and NASA's own plans call for a human expedition to Mars in the 2030s. Recent movies and television programs have contributed to this surge of interest: *The Martian, Interstellar, Gravity,* and the *National Geographic* series *Mars*. This interest is not misplaced, for we have never been closer to making space flight a reality for thousands, to making observations that elucidate the state of the universe soon after the Big Bang, and to leaving Earth for extended stays.

In this milieu, it is perhaps natural to wonder if there is a "cosmic" meaning to space exploration. Space is, after all, historically the realm of the heavens, the home of God, the place to where we lift our hearts in prayer, the source of manna from heaven. One cannot contemplate the immensity of the times and distances inherent to space exploration without a sense of awe and wonder, and these almost inevitably bring one to thoughts of ultimate meaning, God, and religion. Thus there would appear to be a strong natural connection between space exploration and religion. Or is there?

In the June 2015 issue of this journal, I reviewed the book *To Touch the Face of God: The Sacred, the Profane, and the American Space Program, 1957–1975*, by Kendrick Oliver; this is another book that feels almost obligated to find a connection between space and religion. Nevertheless, it reached the overall conclusion that, despite expectations, in fact there is not a strong and compelling connection between space and religion. Certainly there are people who see intimations of God in the enormity of creation, and many religious scientists see science and exploration as forms of worship that attempt to fathom God's thoughts, as Einstein put it. But there is little or no evidence of an overall religious motivation for space exploration, of a sense that those involved experience religious conversions or insights, or that space might bring us closer to God. Within this broad envelope, however,

there are specific areas in which space and religion do come into contact. Some of these are explored in *Touching the Face of the Cosmos*. It has ambitions similar to those of the Oliver book, and although it strongly endorses a final position it does reinforce (at least for me) the overall conclusion of Oliver's book. Unlike that earlier book, which presented a logical and cohesive analysis by a single author, this one is a compilation of essays and stories by various authors.

The book is a mixed bag. The essays in Part 1, in general, are not light reading. Some have a strong academic tone, some are direct and straightforward with a single simple point, and some ramble (or are wide ranging, depending on one's view). All are thought provoking, but might prove challenging for the casual reader as there is a lack of coherence, given the variety of authors and topics. The stories in Part 2 are also a mixture, and may be more approachable for the general reader or fan of science fiction. Some of the stories are reprints from science-fiction magazines, going as far back as the 1980s. One wonders if the editors are grasping at straws in putting this collection together. The stories in many cases explore common religious issues in settings other than Earth. In some cases, this is just an excuse to talk about religion in space. In others, it is a natural way to explore what might make the Earth's religions unique. Rarely is there a true commingling of the space-travel and religion aspects.

When starting the book, one wonders if the topic under discussion is actual human space travel, as the subtitle implies, or travel more broadly construed as in the virtual travel of astronomical observation. The Introduction seems to make clear that it is indeed human space flight that is the issue and contends that one reason for our slow progression beyond our current presence in low-Earth orbit is that we have not accounted for a major benefit of human space flight, namely the spiritual and religious dimension. This is an unusual hypothesis, given that such justification was never a compelling reason for space travel, even among the astronauts themselves. This line of reasoning could well lead to an interesting discussion. But that is not what this book presents. Instead, if offers a number of loosely connected chapters that seem to have as their overall goal the exploration of the intersection of space travel and religion in a myriad of different forms. Presumably this broad-based approach will strike a nerve for a broad range of people, more so than an academic discourse based on a single theme.

The book starts with an account of an interview of Senator John Glenn conducted by one of the authors. The interview is compelling in two ways. First, Senator Glenn points out that his faith was firm before his flights. Second, interviewer/author tends to ask leading questions, probably hoping to draw out the religious effects of space flight. The outcome of the interview coincides with what has been noted by others: the experience of human space flight does not typically alter astronauts in any fundamental way, while those on Earth were often driven by a desire to see flights into space in a larger and in some cases spiritual sense. Even though Glenn is a devout Christian, his practical side as a military and political figure takes priority in his assessment of the value of human space flight. Nevertheless, his own personal faith was strengthened by his space flight, a point mentioned several times in recognition of his passing in December 2016.

The rest of the book includes 28 short chapters: fifteen essays and thirteen stories. I will briefly describe a few of the more notable contributions in order to demonstrate the range of material and ideas covered.

The author of "A Catholic in Space: Coming Home" (Consolmagno) is a Jesuit priest and Vatican astronomer. His chapter summarizes observations which his unique position, straddling these communities, has made possible. In trying to resolve his faith with the enormity of the universe, he points out that humans are special because we reflect the character of the universe. If we have faith in our science and faith in our faith, then each will be universal. Although each will be challenged with new discoveries, these challenges can be met because of our belief that what we know here on Earth is true throughout the universe.

"Our Cosmic Future? How Religion Might Shape It" (Ambrosius) presents a summary of surveys showing that there is relatively little support for space exploration among evangelical Christians, due partly to a belief of Christ's imminent return and partly to a belief that humans were uniquely created (so looking for life elsewhere is wasteful and possibly even an affront to God). Given that space exploration depends on public support, these religious aspects should not be ignored by those who aim to promote space exploration and travel.

"Faith in Space: A Christian Perspective" (O'Neal) provides a simple, concrete review of how some astronauts have carried on their religious faith traditions while in space. There is a smattering of examples of the ways astronauts from the early Mercury program to more recent flights to the International Space Station have expressed their Christian faith while in space. It is interesting and brief, without much in the way of synthesis or overall interpretation except to point out that these expressions are as natural for astronauts in space as they are while on Earth.

"The Heavens Declare the Glory of God" (Waltemathe) draws on examples of religious motivations for previous voyages, such as fleeing from persecution or from impending disaster (Noah), that could well be motivators for space flights in the future. In addition, the nature of the destination plays a major role in religious motivations for these voyages, and the sense of exploring God's creation via space travel is relevant. Such a journey gives the traveler a broader perspective from which to see anew our place in the universe, which is one of the more profound outcomes of any pilgrimage.

"Space Exploration as a Religious Pilgrimage" (del Toro) also deals with space travel as a form of pilgrimage, from the perspective that the universe is a holy place where we can get in contact with the divine. The author draws parallels to Earthly pilgrimages, framed around questions such as "where do we come from?" and "what is our purpose?" Space exploration allows us to see ourselves in a different way; this is one goal of pilgrimage.

"Anticipating the Contours of Extraterrestrial Religion" (Hess) places religion in the context of human evolution, as a cultural phenomenon subject to natural selection and societal pressures (as do several other essays in this volume). This leads to a series of questions about what non-Earth religions might be like. Issues of incarnation and eschatology are examined closely. All of this is admittedly hypothetical but leads nevertheless to theological self-examination.

Overall, this book might appeal to those who enjoy reading science-fiction stories that touch on space and religion, even if tangentially. It could also pique the reader's interest in a range of space-religion interactions. Those wanting a deep exploration of any specific aspect of this topic will be left wanting more.

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A LITTLE BOOK FOR NEW SCIENTISTS: Why and How to Study Science by Josh A. Reeves and Steve Donaldson. Downers Grove, IL: InterVarsity Press, 2016. 134 pages. Paperback; $12.00. ISBN: 9780830851447.

As its title indicates, this is genuinely a little book, but there is an abundance of helpful information packed into its few, small pages. Reeves and Donaldson state clearly in *A Little Book for New Scientists* that their purpose in writing this book is to "help Christians studying and practicing in the sciences to connect their vocation with their Christian faith" (p. 13). I suspect that the primary audience for their book will be new scientists or new Christians who are scientists, and I think that these audiences will find this book helpful.

Using the popular two-books metaphor, this book begins by arguing that, because the natural world can teach us about God, we can point to a specifically Christian reason to study science. It cautions that there are limits to what the natural world can teach us about God and, although the book touches on the converse, it does not offer a similar overt caution about what scripture can and cannot teach us about the natural world.

Chapter 2 is dedicated to the history of science, making the important point that science and faith have not always been in conflict. It also briefly outlines the reasons why it was a Christian worldview that laid the foundations for the development of modern science. This chapter ends by helpfully distinguishing between methodological naturalism and scientific naturalism (scientism).

Chapter 3 discusses science as an ethical activity in and of itself. Given the limitations of a little book, I was surprised at the attention the authors gave to explaining that scientists are morally ordinary rather than ethically superior. The authors argue that the scientific method was the source of this sense of ethical superiority, which resulted in widespread trust of scientists. In contrast, scientists are not actually ethically superior because their explanations of the way the natural world works are not value free.

I found chapter 4 to be the least engaging chapter of this book. It outlines special tools for Christians who are scientists to help them avoid pitfalls and temptations. I was less engaged, not because avoiding these pitfalls is unimportant, but because I do not find these pitfalls and temptations unique to science or scientists. I appreciated the section pointing out the problem of specialization and suggest that this could have been a strong argument for learning and doing science in the context of the liberal arts.

Chapter 5 includes a welcome shout-out to the ASA and implores scientists, especially scientists who are Christians, to work toward community building. It points out the value of integrative scholarship as a means to building community. The thorough reminder in chapter 8 that many scientists are people of faith supports this call to community. Chapter 6 asks whether intellectual humility is more difficult for scientists than for others, echoing the theme of chapter 4, and I was similarly unconvinced that this is more difficult for scientists than for nonscientists.

My favorite chapter was chapter 7, and I plan to find a way to work this chapter—if not the whole book—

into some of the courses I teach. The authors do a beautiful job of arguing for as much openness and humility in our hermeneutics as in our science, for listening graciously to each other, for a deep understanding of the cultural context of scripture, and for a commitment to resolving apparent conflicts between science and faith. The appeal to seek dialogue and understanding with a commitment to graceful listening is one we certainly need today in science, faith, and beyond.

The book concludes with a call for scientists to bring science into their churches and how doing so can "positively affect the mission and ministry of the church" (p. 120). I found the arguments in this chapter to be the most compelling of the book. I loved the authors' appeal for scientists to step forward to educate their pastors and congregations, to open up and lead conversations about the integration of science and faith, and to serve as a bridge between people of faith who may fear science and those whose worldview puts science in place of God. In a world that seems more divided by the day, this message of education and reconciliation may be the most important of the book.

I enjoyed this book. It is extremely accessible. It would be very useful in first-year college or university courses for science majors, for advanced high school students in Christian schools, in adult discipleship classes in churches, or for individuals. I encourage anyone interested in science and faith to pick it up. It is well worth the short time that it takes to read its few, but valuable, pages.

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TECHNOLOGY

IN OUR OWN IMAGE: Savior or Destroyer? The History and Future of Artificial Intelligence by George Zarkadakis. New York: Pegasus, 2016. xxi + 362 pages, endnotes, index. Hardcover; $27.95. ISBN: 9781605989648.

The origins and possibilities of near-ubiquitous and transformative AI (artificial intelligence) constitute the important subject of this clearly written, often insightful, and provocative work. The book consists of sixteen chapters, framed by an introduction and an epilogue and timeline. This is ambitious popular science writing that weaves together often-contested or speculative ideas and disciplines from history and cognitive archaeology, mathematics, sciences (from quantum theory to psychology), philosophy (expositions here are one of Zarkadakis's strengths), religion (not so much), engineering, and science fiction (he cites many morally serious science fiction stories, novels, and movies). A problem with multidisciplinary attempts, of course, is that one cannot have expertise in everything or be familiar with all the relevant scholarship; the science fiction references, for example, are interesting but far from comprehensive. To his credit, the author, a computer scientist, argues that "essential aspects of being human" remain beyond technological reproduction; our intelligence "cannot be captured in formal rules" and is distinctively *embodied*; and biological consciousness cannot be reduced to computational machines (pp. 278–79). He is doubtful about an imminent, apocalyptic "singularity" of artificial *super*-intelligences.

The book begins with two chapters on deep history. Between 150,000 and 50,000 years ago—before religion or science—language birthed intelligence; we created a symbolic "world of animals and things" endowed with spirit, mind, and meaning. This was "the [cognitive] big bang" that, with naturalistic Paleolithic painting, let us come to terms with inevitable death and ultimately imagine making "robots … as intelligent as ourselves" (pp. 15–16). Zarkadakis zips through millennia of thinking (Aristotle: good; Plato and Descartes: bad), rejecting any hint of nonmaterial life forces or uploadable minds, with helpful discussions of the roles and implications of metaphors, analogies, and narratives in scientific thought about AI. (See chapters three and six on limits to our knowledge.)

Science fiction readers will enjoy the discussion in chapter four, including the old trope of superior robots/androids rising up to exterminate their human creators (see also pp. 270–75). Chapter five, "Prometheus Unbound," further examines fictional anxieties and fears, especially Mary Shelley's incomparable *Frankenstein* (1818); the familiar analysis does not engage the scholarly literature, however. We are becoming cyborgs (chap. six) and could create "digital gods" of "infinite wisdom" but we would lose our humanity in merging with them, Zarkadakis cautions.

Chapter seven discusses questions of mathematics, mind, and more philosophy. Chapter eight argues against mind/body dualism, which contradicts physics and disallows humanlike AI (pp. 118–30). The author criticizes Ray Kurzweil's singularity thesis (after about 2045, AI will be utterly beyond our comprehension) as a "quasi-religious" belief inspired by Teilhard de Chardin's evolutionary theology (as is the cosmic anthropic principle, pp. 126–28). Scientific claims are verifiable or falsifiable; religious ones are neither (p. 130). Chapter nine again contests philosophical dualism; Daniel Dennett's 1991 reductive/

materialist explanation of consciousness is highly regarded (pp. 143–46). Chapter ten unpacks the meanings of "consciousness" following Francis Crick's claim—in his 1994 *Astonishing Hypothesis*, "a book that changed everything"—that it is "entirely due to the behavior of cells … and the atoms … that make them up" (p. 155). Chapter eleven regards cybernetics as omnicompetent, if not omniscient and omnipotent: "ultimately" it could "show us how to govern the evolution of life and the universe," including fully conscious AI (pp. 172–91).

Chapter twelve is a careful discussion of logic from Aristotle, through Boole, Gödel, Turing, and others. Next comes a chapter on the Victorian background to AI, dependent on unnamed historical studies. Chapters fourteen and fifteen move through Colossus and ENIAC to Watson and true machine learning. Zarkadakis suggests that there are reasons to mistrust governments and corporations using AI against citizens, yet AI may turn out to be our savior. Chapter sixteen wonders whether mimicking the structures, connectivity, and feedback loops of human cortical neurons could result in artificial consciousness. Perhaps swarms of self-organizing and reproducing nanorobots could evolve into intelligent organisms. In his Epilogue, Zarkadakis asks if AI will create a utopia. Will we become more human, post-human, more machine-like, or superceded?

Zarkadakis's views of Christianity are often ham-fisted. For example, in Genesis, God creates the first humans, endowing them with free will, resulting in their disobedience. This "stands as a cautionary tale for the … future of Artificial Intelligence. We would not want to repeat the mistake God made with us." As a solution, he references science fiction writer Isaac Asimov who "like a biblical prophet" used his three (hardwired) laws of robotics to restrict the freedom of intelligent robots, preventing them from harming humans (p. 58). Actually, there were four laws, and the most famous three were suggested by Asimov's editor, John W. Campbell. In any event, "we know that the biblical version of humanity's origins is wrong" (p. 217; as if Genesis were a scientific monograph).

According to Zarkadakis, body/mind dualism is the self-contradictory dead end and bane of rational discourse on AI and consciousness: a matter of unverifiable faith, not falsifiable knowledge (e.g., pp. 129–31). Nevertheless, Descartes's separation of the mental and spiritual from the material "liberated" science "from the shackles of the Church." Scientists could now explore what the world was "*really* made of." *Cogito ergo sum* shifted "the debate from 'what is true?' to 'how can we be certain about anything?'" Thus certainty, rooted in biblical revelation, was "shattered beyond repair" (pp. 113–14) and "the scientific method" provided explanations superior to "divine providence" (p. 102). "Most" Christians, says Zarkadakis, believe that at death "the soul goes directly to heaven and that the body perishes forever." And "many scientists with Christian beliefs" still uncritically accept mind/brain, soul/body dualism (p. 126). Scientific explanation is necessarily materialistic, so it is surpassingly strange that "even many practicing scientists" believe in God (p. 134). Lastly, he claims that in order to create AI we "must reject" any version of dualism and "must accept" that "there is no soul"; "there is only matter"; intelligence in any form is "purely material"; and if brains can be conscious, then other material objects can as well (p. 152).

Apart from some typos (e.g., the misspellings of "Planck" on p. 127), there are errors to be noted. Zarkadakis vastly underestimates the number of cells in our body at "several billion" (p. 152). We have far more just in our brains; and if we count the many microbial species we host, the estimated numbers move from hundreds of billions to tens of trillions. William Paley's 1802 work that put forward a watchmaker analogy for design was actually titled *Natural Theology*, and was not the first such argument; and it was not so much negated by Darwin as it was a significant influence on him in the *Origin of Species* (p. 289). Zarkadakis writes that "ten years after [Charles] Babbage's death [in 1871], George Boole demonstrated" the automation of thinking via symbolic logic (p. 229); but by 1881, Boole—whose application of logic to theology is ignored—had been dead for seventeen years.

Zarkadakis often provides helpful social and intellectual context, but his concept of invention does not reflect its complex social nature and contexts. For example, he refers to Bell and the telephone (1876) and Edison and the incandescent light bulb (1879) as simple fact (pp. 230, 319). To be fair, at p. 340, note 14, he refers to historians Robert Friedel and Paul Israel, who identified twenty-two inventors of electric lights before Edison, including Joseph Swan who received a British patent in 1878. (Their study is not identified; see *Edison's Electric Light: Biography of an Invention*, Rutgers University Press, 1986. Even Wikipedia has reliable, up-to-date, nuanced articles on the origins of both the telephone and electric light.) Karel Čapek (not "Capek," p. 319) did not coin the term "robot" in his play *R.U.R.* in 1917; his brother Josef did—and Karel's play appeared in 1921.

A final comment about the book's misleading title, which may be due to the publisher or editor, not the author: *In Our Own Image* alludes to Genesis 1:26, so one might expect a bit more than the book's minimal

biblical/theological content. *Savior or Destroyer?* is a fallacious dichotomy; the two may be mutually exclusive, but together they do not exhaust the possible roles of AI in society. And the book offers *a* history and *a brief possible* future of AI, not *The History and Future* of AI. This is not a definitive history and philosophy of mind, nor of AI science and technology, much less of related science fiction and theology.

Readers interested in a more skeptical treatment of the subject than can be found in Kurzweil's *The Age of Spiritual Machines: When Computers Exceed Human Intelligence* (1999); *The Singularity Is Near* (2005); and *How to Create a Mind* (2013) will appreciate Zarkadakis. I would also recommend Noreen Herzfeld's *In Our Image: Artificial Intelligence and the Human Spirit* (2002) and *Technology and Religion* (2009), chap. 3; James Barrat, *Our Final Invention: Artificial Intelligence and the End of the Human Era* (2013); Murray Shanahan, *The Technological Singularity* (2015); Nick Bostrom, *Superintelligence: Paths, Dangers, Strategies* (2016); Yuval Noah Harari, *Homo Deus: A Brief History of Tomorrow* (2016); and Hector J. Levesque, *Common Sense, the Turing Test, and the Quest for Real AI* (2017).

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TECHNOLOGY VS. HUMANITY: The Coming Clash between Man and Machine by Gerd Leonhard. Kent, UK: Fast Future Publishing, 2016. 172 pages, index. Paperback; $15.95. ISBN: 9780993295829.

Technology vs. Humanity is a call to arms against the adversary of *dehumanizing* technology. An influence of tech futurists such as Ray Kurzweil, Alan Turing, Alvin Toeffler, and sci-fi writers such as Ray Bradbury, is evident. Leonhard extrapolates present trends far into the future, but his call to arms is not readily dismissible. If he is correct, we surely must respond. By the time you read this review, it may already be too late, because in Leonhard's view, 2016—the year of the book's publication—is the critical year to take action.

There is a lot to ponder in this book—including but not limited to Leonhard's claim that we reached the pivot point in 2016 (*this* is the very moment when exponential increases are starting to really matter); his ability to envision future technology-generated scenarios and to support them with believable rationales ("What makes us think (these things) won't happen? We simply must consider these unpalatable what-ifs because this is the road we are on—fueled by exponential technologies," p. 83); his account of androrithms (a neologism, or word that Leonhard made up to describe those unique qualities that make us human); his assertion that we will be held responsible for the decisions we make at this very moment (responsible to whom, he doesn't say); and his boldness in attempting to get the conversation started.

Leonhard explains that the pivot point is an inflection point of an exponential curve in many fields of science and technology; now we are moving at "warp speed" toward a blend of hell and heaven that he labels "HellVen." Even if Moore's law eventually ceases to apply as far as microchips are concerned, many fields of technology, from communications to artificial intelligence (AI) and deep learning, are still likely to grow at least exponentially and with combinatorial effects—the changes reinforcing one another. Engineers would call this "positive feedback."

Mathematically speaking, exponential curves do not have an inflection point. Perhaps Leonhard is thinking of the so-called "hockey stick" curve of global temperatures vs. time. Is energy use really rising exponentially? Are food production and consumption, and transportation? Perhaps he is using "exponential" metaphorically, not mathematically. But the concept is central to the argument, so I wish he were more rigorous on this point.

By 2020, Leonhard writes, almost everything will be perceived or defined as a service because everything will be digitized, automated, and "intelligized." This will have huge economic impact as it

> progressively creates abundance in almost every sector of society—first music, movies, and books, followed by transportation, money, and financial services, and eventually, medical treatments, food, and energy. (p. 79)

By 2030

> technology and pharma will have converged almost completely. Mankind's biggest diseases, including cancer, diabetes, heart disease, and AIDS are being tackled by advanced bioengineering. We will very rarely take pills to fight sickness or diseases; instead, we will increasingly use technology and genetic editing to observe, predict, and prevent the onset of diseases. (p. 157)

Leonhard cautions that we should not anthropomorphize our technologies too much or confuse our priorities when it comes to making important societal choices and decisions, and we should not forget our responsibility as we venture out to create technology that may end up surpassing us. Unfortunately, slow but systematic reduction or even discarding of androrithms is already underway. Distinctly human traits include the ability to ask questions, to imagine that something could be different, to be critical, to look at things from different angles, to read between the lines, and to see what may not yet be there. If

we don't spend as much time and resources on androrithms as we do on algorithms, not only will technology end up running our lives, but we will also be forced, tricked, or otherwise cajoled into becoming technology ourselves. We shall become "the tools of our tools."

Technologies with potentially catastrophic consequences such as geo-engineering or artificial intelligence, Leonhard writes, should be guided and supervised by those who have been proven to possess practical wisdom, what the ancient Greeks called *phronesis*, and not by technology developers, corporations, or military bureaucrats. In particular, we should not attempt to mend, fix, upgrade, or eradicate what makes us human; we should design technology to know, respect, and protect andorithms (p. 113).

Profit-and-growth-driven open markets will only escalate the challenges. The prevailing Silicon Valley ideology of "Why don't we just invent our way out of this, have loads of fun, make lots of money while also improving the lives of billions of people with these amazing new technologies?" could prove to be just as lazy—and dangerous—as Luddism. If something can be done, does it mean it should be done? Should we consider *not* doing things because they might also have negative side effects on human flourishing?

Leonhard suggests that precaution and proaction—the two principles often deployed to date as possible mitigation tools—are both insufficient to deal with this combinatory, exponential scenario where waiting will be as dangerous as firing ahead. Too much precaution will stifle progress and innovation, and too much proactivity will free some powerful and likely uncontrollable forces. He does not mention technology assessment, intelligent trial-and-error, Hippocratic engineering, responsible and appropriate technology, professional codes of ethics, or Lanny Vincent's *innovation in the company of God*.

Environmental issues receive scant mention—except (in passing) for geo-engineering, and the prediction that food, transportation, and energy supply will be abundant by 2020. But global climate change, scarcity of clean water, strategic minerals, species extinction, farmland conversion, sanitation, power distribution, flood control and irrigation are not mentioned as threats. Certainly these issues also demand attention.

Civic and political leaders must develop a deep understanding and personal foresight about technology in the context of humanity, and become stewards of our collective future. Across all sectors of all industries, we will need a new kind of hyper-collaboration, not hyper-competition. (To this reviewer it seems that political conservatives and many evangelicals miss this point.)

In sum, Leonhard believes we must: (1) put our collective human flourishing first and above all other concerns; (2) allow those uniquely human things such as imagination, chance, mistakes, and inefficiencies to continue to matter even if they are undesired by or incompatible with technology; (3) fight the spread of machine thinking, i.e., not change what we stand for and need as humans simply because it might make it easier for the technologies that surround us; (4) not be tempted into preferring technological magic (i.e., great simulations of reality over reality itself) and getting addicted to technology; and (5) not prefer relationships with screens and machines over those that we can have with fellow humans.

For Leonhard the meaning and the purpose of life, the aim of human existence—is *happiness*. The only way to create lasting benefits in business as well as in society is by putting human happiness and well-being at the heart of decision making and governance. Technology should be guided toward human well-being or *flourishing*—the state of being comfortable, healthy, or happy. The Greek word *Eudaimonia*—central to Aristotelian philosophy and commonly translated as happiness or welfare—captures the point.

Religious approaches are deliberately ruled out because "they are not universal and are often regressive." Biblical higher calling—such as *imago Dei*, creation care, or the kingdom of God—is ruled out a priori. Thus Leonhard misses a very large body of work by biblical scholars and theologians who have developed equally profound insights and urgent calls to action. At least twenty-five books on the topic, in addition to my own, reside on my bookshelf.

If we want to master those imminent clashes between humans and machines, Leonhard says,

> We will need a new kind of global stewardship backed up by ever more prescient foresights. We will need the ground rules to be decisive yet flexible enough not to inhibit progress. Daunting? Yes. Impossible? No. Alternatives? None. (p. 160)

Drawing from Greek philosophy, the Buddhism of the Dali Lama, and humanism, Leonhard develops his "digital age philosophy" of *exponential* humanism. In my view, however, the questions he raises are beyond the reach of secular and humanistic reasoning.

Leonhard's grasp of the meaning and purpose of life is bigger than mere "happiness," but his approach is basically humanistic and anthropocentric. As a Presbyterian elder, I am compelled to suggest a

higher calling as set forth in the *Westminster Shorter Catechism*: "Man's chief end is to glorify God, and enjoy Him forever."

If the issue is as urgent as Leonhard believes, I think that publishing this book (or any book) is totally insufficient to draw attention to the threat. A massive marketing campaign is required. The church might undertake such a task, if so inclined. But the church is sleepwalking in this arena. Some are struggling with trusting science, let alone steering it.

Even with these limitations, however, I strongly recommend *Technology Vs. Humanity*. Why? First, because Leonhard alerts us to the dimensions and urgency of the problem. Second, he proposes semi-tangible approaches, which he says are only conversation starters. Third, he sets forth fifteen *shall-nots*, five *core human rights* that should be incorporated into digital ethics, five *elements* of what it means to be human, and eight *must-do* actions in order for us to become stewards of our collective future. Finally, he appeals for action, not just another forum!

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ALGORITHMS TO LIVE BY: The Computer Science of Human Decisions by Brian Christian and Tom Griffiths. New York: Henry Holt and Company, 2016. 368 pages, bibliography, index. Hardcover; $30.00. ISBN: 9781627790369.

In *Algorithms to Live By: The Computer Science of Human Decisions*, authors Brian Christian and Tom Griffiths offer an answer to "the oldest question of all: how to live" (p. 4). Their bold recommendation is to live "by the wisdom of computer science" (p. 6).

In the introduction, Christian and Griffiths announce that they will demonstrate that "applying the lens of computer science to everyday life" reveals "the algorithmic underpinnings of our daily lives" (p. 4). They define an algorithm as "a finite sequence of steps used to solve a problem" (p. 3), and they contend that computer science algorithms offer us "practical, concrete suggestions for how to solve specific problems" (p. 4) in life. The authors contend that many of life's dilemmas actually correspond to "solved problems" in the field of computer science, which, "unlike most advice," is "backed up by proofs" (p. 6). Indeed, the authors go so far as to suggest that many people "don't need a therapist; they need an algorithm" (p. 3). Moreover, they claim that "as computers become better tuned to real-world problems," they also provide "a better standard against which to compare human cognition itself" and, therefore, can reveal the "meaning of rationality" and the very "nature of the human mind" (p. 4).

Algorithms to Live By is subtitled "The Computer Science of Human Decisions." Indeed, a number of the algorithms considered in the book for application to human decision making are associated with the discipline of computer science. For example, chapter 3 considers how sorting algorithms might lead to recommendations for organizing a library of books or designing an athletic tournament. Chapter 4 looks at caching algorithms and how they might assist us not only in organizing the clothes in our closets but also in understanding our own human capacity for memory. Chapter 10 explores what the design principles underlying the technologies driving the Internet might imply for how we think about and conduct our communications with other humans. However, in the remainder of *Algorithms to Live By*, the authors employ algorithms from other disciplines so often that a reader might question how well the subtitle describes the contents of this book. In these other eight chapters, most of the algorithms under consideration are not so much computer science algorithms as they are formulae from other fields, particularly mathematics, that a computer scientist might draw upon in attempting to construct a computer model, simulation, or analysis of a given real-world human phenomenon or data set.

The authors acknowledge in the introduction that the design of algorithms for computers requires theories not only from computer science but also from mathematics, engineering, statistics, and operations research. Moreover, they suggest that the application of computer algorithms to human minds requires looking "to cognitive science, psychology, economics and beyond." Christian and Griffiths also share how their own multidisciplinary academic backgrounds have assisted them in the fundamentally interdisciplinary task of writing this book.

Regardless of the disciplinary origins of the algorithms, the authors do cover an impressive range of topics in their text as they work to develop their central argument in favor of a computer-science-like, algorithm-oriented approach to human life. In the process, their recommendations for the employment of a particular algorithm are variously descriptive, predictive, and prescriptive.

The authors' argument is perhaps most compelling when they recommend the *descriptive* use of algorithms. They demonstrate how algorithmic models can provide insight into complex real-world phenomena that might be difficult to describe otherwise. For example, in chapter 3, they provide a superb explanation of "Big-O notation" and its usefulness

in describing why certain human tasks are more algorithmically complex than others. The descriptive limitations of certain algorithms are also acknowledged. For example, chapter 7 describes how what they term an "idolatry of data" can lead to "overfitting" data, resulting in overly detailed models that actually become less useful for describing real-world phenomena.

More often, the authors recommend not only the descriptive use of algorithms but also the *predictive* use of them. Indeed, the subtitle of chapter 6 is "Predicting the Future," and it is an indication of the degree to which the authors evaluate algorithms in terms of their ability to predict future events. In chapter 7, the authors' concern in regard to the overfitting of data is not merely that it may lead to a less descriptive model but, more importantly, that it "may make our predictions dramatically worse" (p. 155). The authors do acknowledge a degree of uncertainty that persists in the predictive use of algorithms. For example, in chapter 10, the authors underscore the futility of algorithmically predicting the actions of other humans by trying to guess their thoughts. However, at other times, the goal of using algorithms predictively is sometimes stated in terms that might make many Christians uneasy. During the consideration of caching algorithms in chapter 4, one computer scientist quoted by the authors suggests that the key question is: "if you don't know the future, how *close* can you come" to clairvoyance, to "God's algorithm, if you will," to the "algorithm in the sky?" (p. 98). The authors go so far as to assert that "every decision is a kind of prediction," and that, while "computer science can't offer you a life with no regret," it can offer "a life with minimal regret" (p. 43). In contrast, many Christians would profess a belief that certain decisions should not be based upon human or computerized algorithmic predictions of the future but, rather, should be made prayerfully, entrusting the unknown future to God, not so much in the hope of minimizing regret as a way of acting based upon faith.

The authors of *Algorithms to Live By* also recommend the *prescriptive* use of certain algorithms. Computer algorithms, they suggest, can tell us "how to think and decide, what to believe and how to behave" (p. 4). For example, chapter 5 examines scheduling algorithms that usefully prescribe the order in which to complete a set of tasks in accordance with a particular overall goal, such as minimizing the lateness of the most overdue task. However, in the Introduction and chapter 1, the authors insist that "the 37% rule" prescribes precisely how long to look for a parking space, an apartment, a new employee, or a spouse before making a choice, that is, after considering 37% of the available options or after 37% of the available time has passed. "Mathematically," the authors claim, "these are solved problems." The 37% rule "is not merely an intuitively satisfying compromise between looking and leaping" but, rather, "the *provably optimal* solution" (p. 2). The authors' prescription to put one's trust in a mathematical algorithm when making such important life decisions as where to reside, whom to employ, and whom to marry is difficult to reconcile with faith in a God who knows the future, has a plan for our lives, and hears our prayers for guidance and patience.

In a similarly prescriptive manner, the authors advocate redesigning library systems in accordance with sorting algorithms. However, such insensitivity to the local knowledge is one of the factors that can make computer software so frustrating, when users are expected to reshape their mental models of their tasks in accordance with computer science algorithms that have been used to design the software modeling these tasks. In contrast, Egbert Schuurman suggests in his *Faith and Hope in Technology* that "human beings ought not to have to adapt themselves to computer systems but vice versa," and that "respect and love for one's neighbors means not allowing computer systems to rule their lives."

Interestingly, toward the end of the text, the authors use the famous quote from Sartre that "hell is other people" to describe the complex recursive algorithms in games that require players to guess their opponent's thoughts. However, this utterance by Sartre is often interpreted instead as a comment upon the tendency of humans to objectify each other. Indeed, the hazard inherent in the authors' recommendation of looking at the world algorithmically, through the "lens of computing science," is a tendency to regard the world—including other people—as problems to be solved. However, humans tend to resist such an objectifying gaze, and rightly so. A contemporary and French compatriot of Sartre, the Catholic existentialist Gabriel Marcel, contended in his *Being and Having* that we are called to regard one another not as problems to be solved, but as mysteries which exceed technical understanding and require a more conversational engagement by our whole self. Accordingly, if we do undertake to look at the world through the lens of computer science, we need to remember the reductive nature of algorithms and avoid the inappropriate application of them, particularly in situations involving other persons.

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