ENVIRONMENT

DUSTY EARTHLINGS: Living as Eco-Physical Beings in God's Eco-Physical World by John Mustol. Eugene, OR: Cascade, 2012. 280 pages. Paperback; $33.00. ISBN: 9781620321171.

Author John Mustol deserves credit on many fronts with this interestingly titled book, his first. *Dusty Earthlings* explores environmental ethics from a Christian standpoint, doing justice along the way to the conceptual and theoretical challenges of thinking about nature as well as grounding his work in the nitty-gritty dust and dirt of this world.

There is a certain expansive approach to the topic that in a different author might be interpreted as facileness. Of necessity, given the breadth of its subject, the book moves quickly across an array of theological, philosophical and scientific arguments and conclusions, almost any of which would be suitable for book-length treatment on its own. One has the feeling of quickly hopping from stone to stone across a fast running stream, hoping that each stone is properly anchored. If not, one's feet will get wet or worse.

Fortunately, the stones are solidly placed, in large part due to the situatedness of the author. Mustol is a come-late-to-writing author who packs a lifetime of significant reading, thinking, and reflecting into a single volume. A physician by training and career, Mustol retired from the medical profession to pursue a theological PhD late in life and now teaches at Bethel Seminary in San Diego. Mustol's medical experience and scientific background illumine his approach to the subject. He has obviously been engaging these questions for some time, and this book constitutes his considered conclusions.

The second half of Mustol's title is transparent: Humans are physical entities enmeshed in ecological webs within God's world. This is the way God created both us and the world. Much of the book is devoted to drawing out the implications of this eco-physical enmeshment.

The first part of the title is more complex. We are, of course, created from the dust of Earth—hence, "dusty earthlings." But Mustol is indebted to Fuller Seminary theologian Nancey Murphy's notion of nonreductive physicalism. We are inescapably physical entities, although not in a reductionistic sense. Knowing that Murphy's position on philosophical anthropology is controversial, Mustol wisely refuses to hang his entire argument on it. Instead he argues that nonreductive physicalism is sufficient, but not necessary, to ground his argument that Christians must heed the ecological realities of life in this world. So long as readers accept that humans are inescapably physical, and therefore need to be reconciled to rather than alienated from the physical world, Mustol's argument should resonate.

What audience would benefit most from Mustol's writing? *Dusty Earthlings* would well serve as a basic text in a survey course on Christian environmental stewardship. Mustol's copious quotations from a wide variety of Christian writers, as well as his referencing of select environmental issues as examples, create rabbit trails of potentiality for further investigation.

Dusty Earthlings's most pointed arguments function primarily as an *apologia* toward Christians who dismiss environmental concerns as beneath the dignity of theological attention. They also serve a secondary purpose, that of countering arguments from non-Christians who claim that Christianity is inescapably other worldly in its concerns.

For readers already familiar with the basic outline of Christian environmental thought and who need little convincing of our connectedness to creation, two sections of the book will generate the most interest. One will satisfy; the other will most likely disappoint.

Mustol is particularly helpful when summarizing the available data and arguments on human uniqueness as they relate to and inform the concept of the *imago Dei*. His medical and scientific expertise is particularly evident when he reviews the evidence on human capacities in relationship to the rest of the animal world. This is comfortable ground for him, and he does his work thoroughly. This comfort level carries over into his theological conclusions as he eschews a singular meaning to the *imago Dei* and opts for a multi-faceted interpretation that emphasizes our representation of God on this earth through our various functions and abilities.

Less satisfying is Mustol's invocation of Murphy's nonreductive physicalism. For many readers, this will be the most novel idea in the book. Mustol's inclination to hedge his bets, however, prevents him from fully exploring the concept. Mustol spends insufficient time on the concept of nonreductive physicalism to give the reader—especially one for whom the concept is new—an opportunity to explore the implications of a monist understanding of human beings. Nor does he fully engage some of the primary New Testament texts that slant toward

a dualism of body and soul. Mustol repeats the canard that Hebrew notions of creation and anthropology must be kept free of the taint of Hellenism (despite the presence of Hellenistic vocabulary and concepts in the New Testament, however, they may be shaped Hebraically). Those intrigued by nonreductive physicalism will wish for a fuller treatment, while those skeptical will wish that judicious use of Occam's razor would leave a cleaner look and smoother complexion to Mustol's overall intent.

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General Sciences

IF TRUTH BE KNOWN by Clarence Menninga. Published by Clarence Menninga, 2012. 286 pages. Paperback. ISBN: 9780985882310.

Though few under the age of fifty may realize it, Clarence Menninga was one of the early voices among Christian geologists to raise concerns over the treatment of science by young-earth creationists. Menninga was hired by Calvin College in 1967 to start a geology program, where he eventually joined with fellow Calvin faculty members Howard Van Till and Davis Young to author the classic work *Science Held Hostage: What's Wrong with Creation Science AND Evolutionism* in 1988. A quarter century later, Menninga has produced a solo-authored work, *If Truth Be Known*, on a similar topic.

The book is written, as related in the foreword, for "those who attend Christian churches … who have legitimate questions about conflicting stories from science and Christian faith, but have had little or no training in science …" His concern for this target audience stems from his own experience and frustration of being told as a child that dinosaurs were "just the wild imaginings of godless scientists who are trying to lead Christians astray," only to discover later that dinosaurs were, in fact, quite real. The stated intention of the work is to address arguments related to the age of the earth, not evolution, but the book does touch on the subject of increasing complexity of life in discussions on the second law of thermodynamics in chapters 13 and 14.

The title of the book derives from a popular expression that often follows the telling of a story in which details are either left out or misrepresented, resulting in a mischaracterization of the actual events. But—"if truth be known"—when missing details of the story are related, or when correctly represented, the story takes on an entirely different meaning. Each chapter of this book relates a common partial or inaccurate story used to defend a young earth, followed by a detailed and well-documented account of the parts of the story that were either left out or communicated incorrectly, to show how the full story does not support a young earth. Though unabashedly critical of young-earth arguments that misrepresent scientific evidence, Menninga repeatedly states that there is no dishonor in believing that the earth is young, but one should not base such belief on misrepresented or inaccurate scientific data.

Chapter 1 opens with a review of what science is, and what its limitations are. Science is possible because the physical universe is ordered, allowing us to investigate and understand how it works. The presence of order neither presupposes nor denies the existence of a Creator, and is thus practiced by Christians and non-Christians alike. While science is subject to human interpretation and thus is fallible, Menninga reminds readers that theology (our understanding of the Bible) is also subject to human interpretation and is likewise fallible. To minimize human error in the reporting of scientific studies, Menninga provides four guidelines: (1) report the data and observations accurately (honestly); (2) report all the data without omissions (completeness); (3) make the methods, data, and observations freely available (openness); and (4) mention of others' work should be accurate and representative (faithfulness). All of the young-earth arguments discussed in the subsequent chapters violate one or more of these guidelines, resulting in a mistaken appearance of supporting a young earth.

No attempt was made by the author to group chapters by the type of violation, and readers are not always explicitly told that chapter *X* is an example of violating a particular guideline *Y*. Nonetheless, Menninga does an excellent job of documenting what was left out, misquoted, misrepresented, or misunderstood for a diverse collection of arguments, addressing fossils (dinosaurs, whales, frozen mammoths, petrified trees, fish, and birds), hoaxes (Piltdown Man and Java Man), rock layers (Green River varves, Mount St. Helens ash, Columbia Basin lava), principles and terminology (uniformitarianism, thermodynamics), and radioactive decay (decay rates, dating methods, isochrones, uncertainties, sample selection, neutrinos, inconsistent results, radiocarbon).

Menninga will likely take some criticism from young-earth advocates for "not keeping up with

current young-earth literature," because of his frequent references to Henry Morris's *Scientific Creationism*. However, Menninga accurately notes that *Scientific Creationism* continues in recent printings to be touted as "authoritative and thoroughly documented," and the young-earth arguments described either are still being circulated or are excellent examples of how stories have been historically misrepresented. A particular strength of this book is Menninga's attention to original source material, particularly in his chapters on frozen mammoths and "brontosaurus" fossils. The juxtaposition of the young-earth renderings of history with the actual words of the original explorers and researchers is quite enlightening.

The final three chapters of the book are devoted to general observations on science and the conflict with young-earth claims, including why it is appropriate to bar creation science from public education (because the claims have been tested and found false), why changes in scientific paradigms do not mean that science cannot be trusted, and why Menninga believes we have reached a point at which we can say, "Enough! There is no scientific support for that [young earth] viewpoint."

Perhaps the most significant shortcoming of the book is a general lack of illustrations (ignoring the cartoons in chapter 1, there are only four). Many places in the book would have benefitted, both aesthetically and educationally, from sketches or images of the described subject material. Menninga's closing thoughts also include his opinion that scientific explanations should never be described as fact. Though this is a popular sentiment among many scientists, it is an oversimplification that often clouds the appreciation of scientific advances. There are many scientific discoveries that should, indeed, be considered fact. No one, for example, will continue to question whether the air we breathe is made up of physical atoms or not. The exact nature of the subatomic particles making up those atoms may still be tentative, but as science advances, so does our certainty in various respects.

Minor criticisms aside, *If Truth Be Known* is a worthwhile read. It is well written, respectful in its tone, and describes the problems with each young-earth argument in a manner that is clear, easy to follow, and thoroughly documented. It is a great resource for understanding exactly why many common young-earth arguments fall short of truth.

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Health and Medicine

DEMENTIA: Living in the Memories of God by John Swinton. Grand Rapids, MI: Eerdmans, 2012. 308 pages, index. Paperback; $25.00. ISBN: 978-0802867162.

John Swinton is professor of Practical Theology and Pastoral Care at the University of Aberdeen, Scotland. He writes from the conviction that the church should approach "dementia" (his preferred general term over Alzheimer's) from a theological point of view rather than a neurological or biological one. Thus, the central religious questions should be "WHO is the person?" and "Where is GOD?"

Swinton states his position very early: "At a very basic level, well-being within Christianity is not gauged by the presence or absence of illness or distress" (p. 7), and Christians should seek to understand "what it means to be a person with dementia living in God's creation" (p. 9).

Unfortunately, from Swinton's vantage point, there has been an almost universal tendency to approach dementia from a *negative sociobiological* starting position that focuses on behavior deficiencies rooted in internal biological changes. Thus, we talk of confusion and loss of memory, identity, orientation, and interactive skills as symptoms of neurological changes. We think of demented persons as having a disease, e.g., Alzheimer's. We label them with a biological diagnosis that explains their condition and depicts "who" they no longer are or "who" they have become. Very often the demented individual is treated as no longer a person but as an embodied diagnostic disease category. Christians, like much of the rest of society, have gone along with this tendency.

This analysis stirred memories of two incidents that occurred in my predoctoral internship in clinical psychology at Topeka State Hospital, where diagnostic conferences for new patients were led by psychiatric residents who were being trained by Topeka's Menninger Foundation. The residents had to fit their patients into one of the categories listed in the DSM (*Diagnostic and Statistical Manual of Mental Disorders*) in order for their treatment to be paid by insurance companies. The head of the Foundation, Karl Menninger, had disaffection for such diagnoses similar to Swinton's dislike of neurobiological diagnoses for demented persons. The psychiatric residents were caught in a bind between the insurance companies and Menninger who preferred that the

residents learn how to describe their patients uniquely. He did not want them reduced to DSM categories. Menninger would make surprise visits to the diagnostic conferences, and the residents often felt his wrath.

The second memory involves chaplain interns at the hospital who tended to present reports full of psychiatric jargon. Paul Pruyser, the Menninger Foundation chief psychologist who was also a serious Presbyterian layman, became disturbed over this tendency. He asked why chaplains should use such modern jargon in their evaluations of patients when they had at hand a two-thousand-year-old religious tradition that provided them a model to use in describing human beings. He encouraged them to use their Christian faith in their reports. This is similar to the theological point made by Swinton in this volume.

Swinton voices a strong apologetic appeal to Christians to understand persons as having selfhood and identity as a gift from God, not based on their success in interpersonal communication (the quality that is so often disrupted in dementia). He grounds this contention in Gen. 2:7, where God creates humans and breathes into them so that they become living souls. He cautions against any presumption that humans have a body *and* a spirit (or soul). They do not have a soul; they are souls. Their integrity and value are established and do not only come into being as they acquire abilities, relationships, or language. Such persons were present at the outset of creation and exist within the memories of God, as the title of the book attests. Swinton does not claim to know the form God's memory takes but strongly asserts that human life is God's business and that its value does not rise and fall with either the adequacy or the loss of certain interpersonal skills of the body or the mind.

Swinton considers a number of ways in which the physical, behavioral, or social sciences have defined personhood. He notes how dependent human life is on social functioning at both the intimate and interpersonal levels. Memory and role functioning are essential to the everyday value humans automatically place on one another. While he acknowledges the importance of these interpersonal skills, he has an especially negative view of what he calls "negative sociology," in which persons become devalued and isolated when they lose some ability in these areas. He suggests that this routinely leads to depersonalization and pulling back of human contact and interaction. Demented individuals become more confused when relationships are withdrawn. Granted, caring for such individuals can become very difficult. People speak of the demented as "not themselves any longer." He strongly contends that, from a theological point of view, they can never lose their selfhood or identity as long as there is a God (Ps. 139:7 ff; Rom. 8:35 ff).

Readers of *PSCF* will find reading this volume very enlightening, if somewhat disturbing. They will experience a sense of courage in trying to apply their Christian faith to personal situations involving dementia. It will take courage to think within a theological framework when loved ones cease to respond adequately and normally. They will feel refreshed in their efforts to affirm the essential personhood that is God given and treasured for all time within God's memory.

However, *PSCF* readers may be disturbed by the possibility that nothing of essential worth can be learned from science, in the face of Swinton's insistence that their research might not be the starting place for Christians to begin their thinking. Certainly biological and neurological scientists among us may wonder whether Swinton would affirm their efforts to find alleviation, if not a cure of dementia's symptoms.

I think any negative reaction to Swinton's perspective might be eliminated if two things were kept in mind. First, it should be remembered that he is writing primarily to Christian pastoral caregivers who have been neglectful of the treasure of their theological training. Second, he is essentially calling for a both/and rather than an either/or approach to dementia. This encourages mutual respect and genuine appreciation.

Further, it should not be overlooked that we are fortunate to be able to read such a highly literate, readable, informed, and erudite set of reflections on one of the major health conditions of our time. Personally, as a clinical psychologist and ordained minister, I found his book to be a most perceptive and informed analysis.

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EXPOSED SCIENCE: Genes, the Environment, and the Politics of Population Health by Sara Shostak. Berkeley, CA: University of California Press, 2013. 312 pages. Paperback; $26.95. ISBN: 9780520275188.

It is difficult to determine whether I found *Exposed Science: Genes, the Environment, and the Politics of Population Health* a helpful book or not. It is obvious that Sara Shostak has done much research

and preparation for this book, including extensive scientist interviews and a fairly clear explanation of genetic techniques. The book is based on "fields theory," in which the development of a field of study is explored over time (in this case, the field of environmental health). The book starts by discussing the history of United States government agencies that deal with environmental health issues, such as the National Institute of Environmental Health Sciences (NIEHS), the National Toxicology Program (NTP), and the Environmental Protection Agency (EPA). Subsequently, Shostak brings to the fore one of the main issues that she is trying to get across in the book: that, namely, there are a large number of environmental chemicals for which we have little data on human exposure and for which rodent models may not be the best way to determine toxicity or oncologic potential. As a result, Shostak indicates that human genetic studies dealing with environmental health may be a helpful and forward-thinking strategy.

Several advantages are given for human genetic testing, such as the superiority of molecular genetic studies over classic toxicology testing techniques, the high throughput and lower cost of such techniques, and the expansion of these techniques into the ever-expanding field of environmental health. Shostak does a good job of describing how scientists have been interested in using genetic testing to determine disease susceptibility as well as to determine chemical differences between individuals. The idea of "inborn errors of metabolism" is used as an example of chemical differences, although it is not clear how this term is truly defined in the book, as inborn errors of metabolism are typically associated with specific enzyme deficiencies (such as tyrosinemia or galactosemia) that often can be improved by dietary elimination, medications, or removal of the organ with the missing enzyme component (as in liver transplantation). Nor is it entirely clear how this term could be related to environmental studies at all times, and I am hopeful that further editions of this book will expand on this issue.

One weakness of this book is that it includes only one expanded case study of environmental health and its genetic and political consequences. In particular, the author explores the case of Midway Village in the San Francisco, California, area in which soil contaminated with oil refuse was potentially associated with "chromosomal aberrations and irregularities," which are only briefly listed. For a lay person, this chapter will be difficult to understand. It would have been helpful if a listing of potential cancers associated with the exposure had been included. Also, it is not clear how "learning disabilities" (listed as a potential consequence) were associated with the exposure. There is minimal information about the 1997 court ruling that no exposure link could be made in Midway Village,[1] and there is no significant discussion as to why the EPA has stated that the current exposure to toxic agents in that neighborhood "probably [does] not constitute a significant health risk to the residents."[2] In other words, the case study is not balanced in its data presentation, which significantly reduces the quality of this book section.

The book ends with a lengthy, but quite good, explanation of how government agencies have expanded their testing arsenal with such techniques as microarray analysis and the development of large databases (such as the Chemical Effects in Biological Systems database). A history of the often tense relationship between the environmental justice movement and scientists who perform molecular genetic testing is also explored.

The book has some very good aspects, such as an explanation of the various agencies involved in environmental science, as well as a thorough history of the environmental justice in the setting of social disparity. However, I think the book is significantly weakened by using the one example of Midway Village. A review of the NIEHS web site (www.niehs.nih.gov) revealed quite interesting research, including air pollution and United States life expectancy, the economic benefits of prevention of methylmercury exposure in Europe, and *in utero* tobacco exposure and plasma lipid levels in adult women (just to name a few topics). I think the book would have benefited greatly from a discussion of similar research projects sponsored by governmental agencies, such as the NIEHS. The lack of case studies in this book considerably weakens an otherwise interesting topic.

Notes

[1]San Francisco Chronicle, http://www.sfgate.com/health/article/Daly-City-housing-complex-haunted-by-toxic-past-3170203.php#page-1.

[2]California Environmental Protection Agency, http://www.calepa.ca.gov/envjustice/Documents/2007/MidwyVillage.pdf.

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History of Science

REREADING THE FOSSIL RECORD: The Growth of Paleobiology as an Evolutionary Discipline by David Sepkoski. Chicago, IL: University of Chicago

Press, 2012. 432 pages; includes list of references cited and index. Hardcover; $55.00. ISBN: 9780226748559.

In his jacket recommendation, Niles Eldredge comments, "I give his description and analysis of the history of paleobiology a five-star rating; to my mind, this actually was the way it was." And for good reason. David Sepkoski, a historian of science, is the son of the late University of Chicago quantitative paleobiologist Jack Sepkoski (1948–1999). The elder Sepkoski is largely credited with sparking the use of computerized databases to analyze long-term trends in biodiversity during Earth's history. David's perch within the social and intellectual circle of his father grants him an empathic understanding to several of the leading actors in the transformation of paleontology which occurred between the late 1960s and today. And, thanks to his timeliness, he was able to interview many of the major protagonists as well. For those potential readers interested in the history of the diversification of life on Earth and/or those biologists interested in the impact of such paleontologically derived concepts such as punctuated equilibrium, mass extinctions, or species selection, this book is extremely important.

Paleontology straddles the standard disciplinary boundaries of geology and biology, and its practitioners must be evenly trained in both. However, academic paleontology typically has been housed in university departments of geology due to two factors: a historic close association of paleontology with stratigraphy (i.e., biostratigraphy); and the long reliance for employment of most trained paleontologists in the fossil hydrocarbon industry. Sepkoski devotes the first two chapters of his book to explaining how paleontology became more and more distanced from academic biology during the early twentieth century, terming this situation "paleontology's identity crisis" (p. 52). The prominent student of fossil mammals George Gaylord Simpson and the invertebrate paleontologist Norman Newell are given credit for bucking this trend; notably both were museum scientists, associated with the American Museum of Natural History.

Chapters 3, "The Rise of Quantitative Paleobiology," and 4, "From Paleoecology to Paleobiology," describe two highly significant mid-twentieth-century inputs to paleontology that would trigger a metamorphosis of that science. Chapter 3 narrates several developments: the adoption of statistical techniques (collateral with the shift to population rather than typological taxic definitions) by workers such as G. G. Simpson, Everett C. Olson, and John Imbrie to understand evolutionary trends; the influence of D'Arcy Thompson's mathematical study of form on what would be termed "theoretical morphology"; and the signal role played by David Raup (then at the University of Rochester) during the 1960s to pioneer morphometric studies of molluscan groups (gastropods, cephalopods) utilizing early computers. In 1971, Raup would author, with Steven Stanley, the influential textbook, *Principles of Paleontology*, which promoted more quantitative and biological approaches to the treatment of fossils.

Chapter 4 lays out the profound influence of ecological thinking on approaches to the fossil record during the 1960s and beyond, particularly following the publication of Robert MacArthur and E. O. Wilson's *The Theory of Island Biogeography* (1967) and MacArthur's *Geographical Ecology* (1972). Sepkoski describes the personal impact that the paleontologist Lee McAlester and the polymath ecologist G. E. Hutchinson had on a large clique of graduate students in paleontology at Yale University during this interval. Many of these Yale products, including the aforementioned Steven Stanley, Jeremy Jackson, Richard Bambach, Jeffrey Levinton, Geerat Vermeij, and others, would become pioneers of new ecological and morphological approaches to fossils conducted from the 1970s to the present. Sepkoski also nicely details the early personal history of James Valentine (eventually housed at the University of California, Berkeley) and his writing of the seminal volume *Evolutionary Paleoecology of the Marine Biosphere* (1973). Beginning with fundamental concepts of organismal ecology, Valentine erected an interpretative scheme for the history of biological communities over time, addressing such important topics as the significance of mass extinctions in the history of life (which Norman Newell had notably drawn attention to during the early 1960s), and adaptive models for increasing organismal complexity.

Here I register one major gap in Sepkoski's history of the paleobiological movement. Ecological interpretation, in fact, had been a prominent exercise for many sedimentary geologists and paleontologists following World War II, as evidenced, for example, by the massive two-volume *Treatise on Marine Ecology and Paleoecology*, collectively Memoir 67 of the Geological Society of America, published in 1957. Each of these volumes is over 1,000 pages long; an introductory essay outlines the tradition, extending back to the mid-nineteenth century, of linking studies of sea-floor ecology to interpretations of the sedimentary record and the reconstruction of ancient communities. And the study of marine paleoecology had many influential practitioners in Europe during the 1950s and 1960s, including Adolf Seilacher, Derek

Ager, Anthony Hallam, and Wilhelm Schäfer, among others, who are largely ignored in this volume. Dolf Seilacher, certainly one of the most influential paleontologists of the twentieth century, is only mentioned in passing. Schäfer is not mentioned; his *Ecology and Palaeoecology of Marine Environments* was published in German in 1962 and then translated into English in 1972, and was widely read. In my opinion, *Rereading the Fossil Record* could have been greatly enriched by the addition of one long chapter to accommodate an overview of this significant history. Against this larger backdrop, Valentine's masterful review can more properly be seen as a timely and comprehensive summation of decades of prior research. Sadly, major syntheses following Valentine's lead for the marine biota, such as Vermeij's *Evolution and Escalation* (1987) and Levinton's *Genetics, Paleontology and Macroevolution* (2001), as well as paleobotanical counterparts such as Karl Niklas's *The Evolutionary Biology of Plants* (1997), are not mentioned.

Chapters 5 through 10 detail the blossoming of paleobiology, beginning during the 1970s and continuing up until about 1990. Conceptual momentum begins to grow, and the stream of paleobiological analyses begins to flood in multiple anastomosing channels.

Chapter 5 details the history of the "punc eek" controversy following the publication of the paper "Punctuated Equilibria: An Alternative to Phyletic Gradualism" by Niles Eldredge and Stephen Gould, as a chapter in the volume *Models in Paleobiology* (1972), edited by Thomas J. M. Schopf. Both Gould and Eldredge had been doctoral students of Norman Newell in New York, Gould going to Harvard and Eldredge remaining at the American Museum of Natural History. The intricacies of the Gould-Eldredge interaction, their efforts to address their critics, and the relationship of their proposals concerning speciation models and in particular concerning Ernst Mayr's allopatric speciation model are thoroughly and fairly explicated. This chapter is a fascinating read and by itself justifies the reason for this book's creation.

Chapter 6 recounts the founding and early history of the journal *Paleobiology* (first issue published March 1975) under the guidance of Tom Schopf and Ralph Gordon Johnson. Schopf, after an early career at Lehigh University, had joined Johnson at the University of Chicago in 1969, and would remain there until his death in 1984. Schopf, although somewhat skeptical of the punctuated equilibrium hypothesis, encouraged publication of papers defending it by Gould; perhaps the strongest was Gould's 1980 resume, "Is a New and General Theory of Evolution Emerging?" Herein, Gould's confidence that new data and concepts from the study of the fossil record would revolutionize evolutionary theory is notoriously contained in his claim "if Mayr's characterization of the synthetic theory is accurate … then that theory, as a general proposition, is effectively dead, despite its persistence as textbook orthodoxy" (p. 201). Wow!

Chapters 7 and 8 describe the hard but exciting task of developing mathematically representative models of the diversification of life through time and the corresponding collating of enormous databases of fossil taxa distributions in space and in the stratigraphic record. These two prongs of a quantitative approach to "big picture" dynamic interpretations of life's history are yet under refinement today.

Chapter 7, the longest of the book, details the history during the 1970s of what became known as the "MBL group" (the acronym being that of the Marine Biological Laboratory at Woods Hole, where the group periodically met to hash out alternative methods and interpretations). The group consisted of Gould, Schopf, Raup, and the young ecologist Daniel Simberloff. Using computer programs largely developed by Raup, the group modeled the diversification through time of theoretical clades (evolutionary units) of organisms, permitting these to branch or go extinct through randomized (Markov) processes. These idealized random diversification pictures, forming a series of "null models," could then be compared to samples of real clades of organisms to gain hints as to the significance of extinction or the filling of available ecospace. Equilibrium models analogized from MacArthur and Wilson's basic island biogeography, plus Leigh Van Valen's "Red Queen" picture of evolution and the risk of extinction, provided a theoretical basis for the development of the "null model" approach.

Near the end of its existence as a working entity, the MBL group entertained Gould's graduate student Jack Sepkoski to hear him explain how their models might be refined. Sepkoski, nominally producing a standard dissertation on Cambrian biostratigraphy, was immersing himself in studies of computer science and statistics. After completing his PhD in 1974, he joined Raup at Rochester. In 1978 he would relocate to the University of Chicago. Eventually, Raup himself joined the University of Chicago group, after a stint at the Field Museum, placing the University of Chicago on the map as the geographical focal point for the new quantitative paleobiology.

The events of chapter 8, "A Natural History of Data," parallel those of chapter 7, also taking place during the 1970s. The story begins with a sparring match during the early 1970s between Raup and Valentine on what the biostratigraphic occurrences of taxa were empirically telling us regarding the overall diversification of life. For Valentine, the available fossil data clearly demonstrated an overall upward trend in diversification from the earliest Paleozoic until the present. This could be interpreted as greater partitioning of potential ecospace over time (despite occasional setbacks due to extinctions). Raup countered with a model in which biotic diversity blossomed during the early Paleozoic but then had only marginally increased, if at all, from the mid-Paleozoic onward; Valentine's increased diversity was thought to be an artifact of the record. Others such as Richard Bambach and Karl Flessa offered yet other viewpoints. Eventually, with the addition of trace fossil data and advice from Seilacher, and Jack Sepkoski's computer skills and his expanding database, a consensus model was achieved (Sepkoski, Bambach, Raup and Valentine, "Phanerozoic Marine Diversity and the Fossil Record" in *Nature* 293 [1981]: 435–7). In retrospect, a major cottage industry within paleontology had been birthed. Newly minted icons of this industry include Sepkoski's "spindle diagrams" of taxic diversity, in which clade diversity is depicted as the width of the spindle while the long axis is time—many such spindles being set side by side so as to see which ones expand while others thin and wane; and Sepkoski's famous diversity curve for the Phanerozoic broken into his "three evolutionary faunas" (Cambrian, Paleozoic, Modern).

Chapter 9 provides a wonderful resume of the realization during the 1980s of the significance of large-scale mass extinctions for the history of life. Early biostratigraphers, such as Cuvier, Omallius, Sedgwick, and Phillips (typically labeled "catastrophists"), had great appreciation for the role of extinction; but paleontologists in the later nineteenth and early twentieth centuries had tended to downplay major extinctions, convinced that the severity of mass extinctions was an artifact of an imperfect record. However, this situation was to change. Norman Newell and notably Derek Ager, in his classic *The Nature of the Stratigraphical Record* (1973, 1981), had provocatively urged that paleontologists needed to go back to their roots and realize the empirical reality of mass extinction. (However, British paleoecologist Ager is absent from Sepkoski's volume.) This became unavoidable when Walter Alvarez and colleagues published the outrageous proposal in 1980 that a large impact with an extraterrestrial body was responsible for the major loss of taxa at the end of the Cretaceous. That story in itself took decades to play out and is, in fact, not perfectly understood, but that a very large impact occurred at the end of the Cretaceous period and that it had a severe effect on the planetary biota is now unquestioned. As a graduate student during the 1980s, I experienced the furor that this notion caused and the near violent disagreements over the quality and significance of such data items as shocked quartz fragments in deep-sea sediments.

Coinciding with this controversy was the revelation provided by Sepkoski's growing database demonstrating ever-more-clearly demarcated episodic major losses of taxa. Raup developed the stochastic notion of mass extinctions in several significant scientific papers and in his gem of a popular book, *Extinctions: Bad Genes or Bad Luck?* (Norton, 1991). Read the book if you want to know the answer! By 1990, it is safe to say that the data from the fossil record were indeed forcing neontologists to modify standard approaches to what governed the history of life—and probably engendering more questions than answers. Anthony Barnosky would later (1999) dub the notion that spasmodic changes in abiotic factors (including impacts by extraterrestrial objects) strongly force evolutionary history as the "Court Jester hypothesis." (For fun, see the review article by Michael Benton, "The Red Queen and the Court Jester: Species Diversity and the Role of Biotic and Abiotic Factors through Time," *Science* 323 [2009]: 728–32.)

All histories must find a stopping point. Chapter 10, "Toward a New Macroevolutionary Synthesis," runs out the clock by tackling other ways in which standard gradualistic Neo-Darwinian evolution was challenged (or was imagined to be challenged, depending on one's point of view) by new paleobiological perspectives. The author begins by explicating the role assumed by Gould as the spokesperson for the new paleobiology. In articles such as "Is a New and General Theory of Evolution Emerging" (see above) and his book *Wonderful Life* (Norton, 1990), Gould argued that multiple levels of selection, the phenomenon of mass extinction, and early diversification of major phyletic groups followed by culling, all undermined the heretofore simplistic and gradualistic standard Neo-Darwinian story. And in articles such as "The Hardening of the Modern Synthesis" (in *Dimensions of Darwinism*, edited by Marjorie Grene, Cambridge University Press, 1983), he attempted to explain just how the main architects of the New Synthesis of the 1930s

and 1940s, including G. G. Simpson, oversimplified their own positions for ideologic reasons. (Joe Cain diagnosed this aspect of Gould's writing as "ritual patricide," in "Ritual Patricide: Why Stephen Jay Gould Assassinated George Gaylord Simpson," in *The Paleobiological Revolution*, ed. Sepkoski and Ruse, described below.)

Chapter 10 continues and concludes its story of the further development of paleobiology's promise by examining the development and promulgation of a more hierarchical theory of evolution, championed again by Gould, with colleagues Richard Lewontin, Elizabeth Vrba, and Steven Stanley. Along the way, simplistic views of adaptation come in for some bashing with Gould and Lewontin's now-standard "The Spandrels of San Marco and the Panglossian Paradigm," a critique of an over-reliance on the concept of adaptation as a shortcut to understanding all of biology. Stanley's concept of "species selection" was initially expressed in a short paper in 1975, but then greatly expanded in his *Macroevolution: Pattern and Process* (1979). Simplified, the notion is that some taxa leave many more descendant taxa, not because they are better adapted to their environment(s), but rather because there are aspects to their biologies which tend to promote speciation.

A short conclusion, "Paleontology at the High Table?" argues that the events described between 1960 and 1990 contributed to an evolution of sorts within evolutionary theory itself. The Darwinian framework is held to be robust enough to accommodate these additional insights.

> Paleobiology is no more a repudiation of Darwinism than is molecular genetics, or evo-devo, or any of the other countless developments in evolutionary biology that have come about since 1859. (p. 394)

I would have to agree, but certainly the paleobiological revolution has opened our eyes to a diversity of explanation in the history of life. Just as quantum theory has shown us that in physics nature does not demonstrate a rigid Laplacian determinism, so too the history of life appears to be more dynamic and full of messy particulars than a rigid application of Mendelian particle genetics can explicate.

Of course, all this did not come to a halt after the early 1990s. Throughout the twenty-plus years since, a flood of articles and a new edited compilation every other year with titles such as *Biodiversity Dynamics* or *Macroevolution: Diversity, Disparity, Contingency* have been generated. But tackling this newer round of forcing information from the record would take yet another volume.

Overall, the book is a great read. For those with an interest in getting the details of the history of evolutionary thought right, this is a must-read. I should add that an excellent supplement exists in the form of the earlier volume edited by Sepkoski and Michael Ruse, *The Paleobiological Revolution: Essays on the Growth of Modern Paleontology* (University of Chicago Press, 2009). This volume includes retrospective essays by Valentine, Bambach, Art Boucot, Anthony Hallam, and several others; and an interview with Raup.

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DARWIN DELETED: Imagining a World without Darwin by Peter J. Bowler. Chicago, IL: University of Chicago Press, 2013. 328 pages. Hardcover; $30.00. ISBN: 9780226068671.

According to the well-known Harvard biologist Ernst Mayr, Charles Darwin's theory of evolution actually consists of five separate theories. Darwin's own, distinctive contribution to Mayr's list is well known: natural selection. Darwin's name is irrevocably linked to "selectionism" and this view has shaped evolutionary theory to a remarkable extent. What would biology have been like without Darwin's *On The Origin of Species*? Or to use Peter Bowler's scenario, what if the young Charles Darwin had been swept off the deck of the *Beagle* in a storm? This "counterfactual history" is the focus of Peter Bowler's latest book, *Darwin Deleted.*

In the opening pages of his book, Bowler defends the idea that a counterfactual history can shed light on the contributions of a historical figure and rejects the view that Darwin's theory of selectionism was "in the air" and would have emerged regardless. No, Darwin was in a unique position to influence public and scientific opinion, given his contacts with animal breeders and farmers, his knowledge of the ideas of Thomas Malthus, his ability to secure the publication of a book, and his membership in the Victorian upper class with its commitment to economic competition. Alfred Russel Wallace, on the other hand, posited similar ideas—the story of their simultaneous publication is so well known it does not bear repeating—but was not in a position to make a similar impact. In a world without Darwin, Bowler states, "Evolutionism would eventually have flourished—but it would have been an evolutionism based on non-Darwinian ideas, not on natural selection" (p. 70).

What ideas would have shaped evolutionary theory in Bowler's counterfactual world? Purpose in evolution would have received more attention, with, perhaps, more emphasis on orthogenesis (an innate drive for linear complexification). For some European thinkers, internal forces would direct evolution in a purposeful direction. Others supported formalism, another nonselectionist approach, in which "law-like processes governed the development of living structures" (p. 141). However, for Bowler, the chief candidate in a non-Darwinian world is Lamarckism.

Peter Bowler is a respected author of the history of biology, *Darwin Deleted* being his fifteenth (or so) book. In many of his writings, Bowler has emphasized the influence of Lamarckism. Jean-Baptiste Lamarck (1744–1829), from whom Lamarckism draws its name, suggested that there are two trends in nature: an upward, unidirectional trend of complexification (orthogenesis), and the inheritance of acquired characteristics ("use and disuse" for Darwin) that would explain an organism's adaptation to environmental conditions. In his books, *The Eclipse of Darwinism* (1983) and *The Non-Darwinian Revolution* (1988), both published by The Johns Hopkins University Press, Bowler describes how Darwin's theory of evolution was accepted by many thinkers of his time, particularly theologians. However, they did not necessarily accept his selectionism; some preferred to "Lamarckianize" Darwin's theories, inserting tendencies of direction and purpose into evolutionary theory. In *Darwin Deleted*, Bowler suggests that, in the absence of Darwin, it is this kind of thinking that would have greatly influenced evolutionary thought.[1]

Bowler submits that in a world without Darwin, evolutionary theory would nevertheless have been established, thanks to fossil and morphological evidence. Selectionism would not have been absent, but rather would have become part of an existing evolutionary paradigm. It would have played a more moderate role. As a consequence, the idea of natural selection might have been less disruptive to the relationship between science and religion, and acrimonious debates would have occurred less often. One has the impression that Bowler supports the idea of natural selection, but not its all-encompassing role. In my view, this sheds an interesting light on the topic of natural selection, a topic that is receiving renewed attention.[2]

The names of Herbert Spencer and Charles Darwin have often been linked to negative social practices and views, such as racism, militarism, and eugenics. The label "social Darwinism," although often used, is somewhat of a misnomer because Spencer wrote before Darwin, and Darwin did not espouse these objectionable views. Spencer, whose faith was placed in progress and Lamarckism, was influential at the time Darwin wrote. If Darwin had not have written *On The Origin of Species,* Bowler suggests, the negative social views mentioned would nevertheless have become prevalent, because they are based on views that were prevalent at the time.

Darwin Deleted is a dense, detailed book; it may be intimidating to some readers. However, Bowler has worthwhile contributions to make. It may be helpful to start with some of his previous books mentioned above. *Darwin Deleted* is of interest because it puts the mechanisms that drive evolution, particularly natural selection, under the microscope. Furthermore, it is a commendable contribution to the religion-science debate. Finally, it points out to us that theory shapes scientific concepts to an extent that is often not recognized. I recommend the book and, in fact, all of Bowler's books to *PSCF* readers.

Notes

[1]See also Harry Cook and Hank D. Bestman, "A Persistent View: Lamarckian Thought in Early Evolutionary Theories and in Modern Biology," *Perspectives on Science and Christian Faith* 52, no. 2 (2000): 86–96.

[2]See, for example, Conor Cunningham, *Darwin's Pious Idea: Why the Ultra-Darwinists and Creationists Both Get It Wrong* (Grand Rapids, MI: Wm. B. Eerdmans Publishing, 2010), chap. 3.

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Origins & Cosmology

LIFE'S RATCHET: How Molecular Machines Extract Order from Chaos by Peter M. Hoffmann. New York: Basic Books, 2012. 278 pages, notes, index. Hardcover; $27.99. ISBN: 9780465022533.

Peter Hoffmann takes the educated reader on an amazing journey, interweaving physics, chemistry, biology, history, and philosophy to explain how the molecular storm and molecular machines, driven by chance and necessity, define life and living. The questions posed by the author have been discussed throughout history in various forms: "What creates 'purposeful motion' in living beings? … How do we go from assemblies of mere atoms to the organized complex motions in a cell?" (p. 5). His argument is that chaos (the molecular storm, otherwise known as the immense number of random collisions of molecules to each other and energy transfers between

each) is the life force harnessed by molecular machines (proteins) to do work within each cell. He also argues that this molecular chaos, mixed with chance and necessity (or mutation and natural selection), is able to transform DNA and alter the overall structure and function of the molecular machines that do work in the cell.

The book is divided into four parts, each part building on the earlier chapters. In part 1 (chaps. 1–2), the author describes the agonizing struggle to define life by philosophers, theologians, and scientists throughout history. In chapter 1, he introduces the evolution of various philosophies of life in Western civilizations, especially with regard to the turmoil between religion and science. In chapter 2, he describes the introduction of statistics and chance in the mid-1800s through the 1900s, and the impact that chance and randomness had on defining life. In part 2 (chaps. 3–4), he introduces the reader to basic concepts in physics, molecular biophysics, and nanoscience, which are the author's areas of expertise. In chapter 3, he uses a remarkable analogy of a robber taking and spending money to redefine (for biologists!) entropy and the second law of thermodynamics. This chapter is the foundation for understanding his arguments about the molecular storm and molecular machines, as well as refuting one of the commonly used arguments in favor of intelligent design. In part 3 (chaps. 5–7), he very carefully explains the development of the concept of molecular machines from macroscopic machines through "thought experiments," scientific experiments, and detailed examples of well-studied molecular machines (i.e., kinesin, myosin, helicase, ATP synthetase). In part 4 (chaps. 8–9, epilogue), he tackles head on the arguments for intelligent design and creationism, in particular how molecular machines actually use the chaos of the molecular storm to allow mutations, which are then selected out of necessity. His conclusion is that the life force that has been vigorously debated and scientifically examined over human history is the random force of atoms, and "… the molecular machines of our bodies tame the molecular storm and turn it into the dance of life" (p. 243).

What makes this argument more successful than the arguments of others who have tried to answer this question is Hoffmann's expertise in molecular biophysics and nanoscience. He is a professor of physics and materials science, and the founder and director of Biomedical Physics at Wayne State University in Detroit, Michigan. Instead of using biology to argue for the underlying life force, he clearly and succinctly explains how physics, in particular energy, is a crucial part of defining life and making strong, logical arguments against an intelligent designer. For example, molecular machines harness the chaos of the molecular storm through physical laws using a bottom-up process that engages the chaos, in contrast with our macroscopic machines (i.e., cars, computers) that are designed to resist chaos. Science has also suggested that the chaos from the Big Bang predates the first molecules, so a logical deduction is that these first molecules would need to harness the chaos and be able to be molded by it in order to arrive at the versions of macromolecules that are studied by scientists today. His numerous detailed examples show the application of these concepts to specific molecular machines, especially kinesins, and how different kinesins have been altered for different functions in the cell.

His explanations and arguments are the first time that someone has clearly explained to me why learning physics is required for understanding biology, and as such should be required reading for anyone interested in biology. Hoffmann goes to great lengths to explain physics to an educated reader by incorporating easily understood analogies and examples, such as how chance and necessity have a role in snowflake formation. Another strength of this author is that he does not water-down the science, but states in the introduction that this book is written for a more educated (college-level) audience. I particularly appreciated this after reading numerous nonfiction science texts for less educated readers in the past year, which usually left me (and my undergraduate students) wanting more.

A weakness of this book is that it was very challenging to be engaged in the early chapters. The first chapter is essentially a laundry list of different philosophies of life, which I appreciate in hindsight, but struggled to get through as I started reading the book. It takes approximately half the book to start discussing biology, which made reading the first half seem long and laborious since my interest is biology. He seems to anticipate this by trying to use more simplified language, analogies, and diagrams, to spur the reader on to continue reading, but at times it is challenging to continue. A physicist may feel the same way in reverse, and find the second half of the book little more than a list of different machines. However, the application of the basic concepts is important to his argument and to the reader's learning of molecular machines.

In conclusion, I recommend this book to undergraduate students as well as scientists who wish to gain a better understanding of the role of physics

in understanding life and biology. Overall, *Life's Ratchet* was well written for individuals without a strong background in physics, helped me to integrate physics into my teaching of molecular biology, and further developed my own thoughts on evolution.

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PHILOSOPHY & THEOLOGY

GOD AND THE WORLD OF SIGNS: Trinity, Evolution, and the Metaphysical Semiotics of C. S. Peirce by Andrew Robinson. Boston, MA: Brill, 2010. xiii + 381 pages. Hardcover; $168.00. ISBN: 978-9004187993.

Andrew Robinson spent a decade plus in the field of medicine before turning to theology. So although this volume is a revision of a 2003 PhD dissertation, it reflects a level of mature thinking not usually found in the "first book" category. Its ideas were initially developed under the tutelage of Exeter advisor Christopher Southgate (an established scholar at the interface of science and religion), and further honed over the last eight years, in part through a series of substantial grants jointly to author and mentor from the John Templeton Foundation. In short, *God and the World of Signs* is a substantial contribution to the theology and science conversation.

The central thesis unfolded over the first four chapters (two-thirds of the book) is that the semiotic philosophy of Charles Sanders Peirce (1839–1914) not only illuminates perennially difficult theological topics (the doctrines of the Trinity, incarnation, and theological anthropology are discussed) but also contributes to contemporary discussions in evolutionary biology (in particular, biosemiotics and origins-of-life research) and philosophy of mind (including the arena of teleosemiotics). This leads, in the fifth chapter, to a trinitarian theology of nature wherein it is argued that the contingency, naturalism, and continuity of evolutionary processes are not merely analogies (which remain at the epistemological level) but actual vestiges of the trinitarian God imprinted in the world (thus having ontological purchase) through the very activity of divine creation. The last three chapters (about a fifth of the book) turn to epistemological matters (defending both metaphysical and theological reflection), argue that the proposed semiotic model of the Trinity is more adequate than classical psychological or social models, and provide a creative retelling of the fourth-century debates about the Trinity in semiotic perspective.

Those familiar with the philosophy of Peirce will appreciate the various moves made herein. Space constraints prohibit any extended summary, so I will focus my explication in two directions, one theological and the other scientific. Theologically, Peirce's fundamental triadic categories of Firstness (possibility), Secondness (actuality), and Thirdness (mediation) are suggested as providing a semiotic model for the classical Christian understanding of the Trinitarian perichoresis. Others, including this author (in Yong, *Spirit-Word-Community: Theological Hermeneutics in Trinitarian Perspective*, Ashgate, 2002, part I), have made suggestions along similar lines. What is new is Robinson's extension of this semiotic model into both the immanent and economic Trinity. With regard to the incarnation and the mission of Jesus, for instance, Peirce's semiotic taxonomy clarifies how various aspects of Jesus's ministry can be understood as sign embodiments. The last supper in this Peircean schema is an *iconic legisign*, which signifies through the fellowship around the table (hence iconically) by virtue of being a token or type produced according to a rule, in this case of eating together (what Peirce meant by *legisign*). By way of contrast, the cleansing of the temple is an *iconic sinsign*, which signifies in this singular instance (what Peirce meant by *sinsign*) through the overturning of the tables (hence iconically presaging the destruction of Jerusalem, according to many biblical scholars). More comprehensively, the life and ministry of Jesus as a whole, which included these two major sign-events, can be understood as an *iconic qualisign*, an embodiment of the very quality of the Father. Thus is Jesus the qualitative representation of the image, presence, and the very being of Israel's God in the flesh.

Robinson goes on to argue—successfully, I believe—for the superiority of his semiotic interpretation of the incarnation over current proposals on offer, in particular, Rahner's "real-symbolic" understanding of Jesus as revelatory of God. The latter is metaphysically robust in terms of its neo-Thomistic ontology, but its minimalist theory of symbolic interpretation results in the inability of humans to refer to Christ in any other than a conventional manner. By contrast, a Peircean-inspired semiotic theology of the incarnation advances beyond neo-Thomistic models—and even existential and Whiteheadian ones, I might add—not only by overcoming the binary and mostly dyadic formulation of how symbols connect with reality, but also by showing how

semiosis or interpretive mediation is part of how reality is constituted and signifies.

On the anthropological side, Robinson's discussion includes the evolution of human semiosis (from competence with *legisigns* through to conventional symbols) and shows how the "gift of abduction" enables human sign-interpreters to infer, discern, and engage, however fallibly, the revelatory signs of God's presence and activity in the world. Intriguingly, an expansion of such considerations into the field of evolutionary biology invites viewing all dynamic and living processes semiotically and teleologically. To be sure, evolutionary biologists are extremely reticent to suggest that either evolution itself (considered as a whole) is purposeful or even that its processes can be understood interpretively. Yet natural selection itself presumes that nature selects, through its various codes, signals, and information-rich interactions, that which has reproductive and adaptive advantage; hence much energy has been expended on how such processes are goal-directed but not necessarily agential. Peircean semiosis comes to the rescue here, Robinson suggests—and not outlandishly, I think—in terms of showing how Thirdness manifests itself not only in terms of mediation but also in interpretation, and how nature's selection for general outcomes neither implies vitalism nor risks undermining the integrity of nature's processes. Applied to origins-of-life research, then, such an approach invites considerations of how protobiotic systems and environments might have facilitated both interpretive and misinterpretive processes (the capacity to make mistaken inferences) being central to semiosis, resulting not only in metabolism and localization but also in reproduction. Both empirical and theoretical ramifications are specified; it remains to be seen whether these suggestions can generate new research projects or complement existing inquiries in these arenas.

Robinson acknowledges that he has not been formally trained as a Peirce scholar, and he relies heavily on T. L. Short's magisterial *Peirce's Theory of Signs* (Cambridge University Press, 2007). While I also do not consider myself a Peirce specialist, I did not notice any obvious misinterpretations or misapplications of Peirce's ideas. I do have one minor quibble with Robinson's eschatology, recognizing that this pertains only to an extension of his ideas and does not touch on its central elements. His speculative proposal is that even upon the passing away of the space-time universe, human beings "will subsist as eternal centres of Firstness [qualities] in the presence of God's glory" (p. 336). This leaves unsaid, though, that such eternal qualitative realities would be dynamically constituted in relationship to others and especially to God. Such interrelational constitution suggests that creaturely Firstness does not leave behind Secondness or Thirdness. This should not be surprising since the divinity of the triune God also is triadically constituted by Father, Son, and Spirit. If that is the case, then Robinson's vestiges of the Trinity in creation are eternal, remaining even after the passing away of the space-time universe.

As a philosophical theologian, I view *God and the World of Signs* as a theology of nature (not a natural theology) that makes a significant contribution to the twenty-first century quest for a "grand unified theory" that includes rather than ignores metaphysics. In Robinson's hands, this view of the whole is best unraveled semiotically, and in that sense, it can be read as an update on what Peirce a century ago called a "guess at the riddle." Philosophers interested in theological metaphysics, those engaged in the theology and science conversation, and theologians who have some familiarity either with Peirce or with semiotic theories in general are in the best position to benefit from this book. Yet, because of the vast amount of ground that is covered, most readers will have to work through the volume patiently and carefully. Those persisting through it will be rewarded with a trinitarian and semiotic philosophy that may in due course prove to have explanatory power superior to other metaphysical systems for which Christian faith has sought.

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MIND AND COSMOS: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False by Thomas Nagel. New York: Oxford University Press, 2012. 144 pages. Hardcover; $24.95. ISBN: 9780199919758.

Though brief, this book is profound and provocative. Nagel's thesis is that the reigning materialist version of neo-Darwinism has come up empty in its quest to explain the rise of life, consciousness, cognition, and value in terms of physics and chemistry. This is a particularly interesting thesis given that Nagel is neither a creationist nor ID advocate but an atheist. And while he claims that it is not his purpose to "propose a solution" (p. 15) to the inadequacy of a reductionist Darwinian framework, he favors a non-intentional Aristotelian natural teleology (p. 91).

First, Nagel wishes to propose that mind is not an accidental side consequence of material forces

but is a basic aspect of nature (p. 16). Nagel derives this position from the procedures and successes of science itself. The world studied by science is intelligible and that fact stands in need of explanation; its intelligibility cannot be waved away with the statement, "this is just how things are" (p. 20). Materialist science simply assumes the existence of the laws that govern inorganic and organic life, but Nagel wishes to know "why the laws that do hold hold" (p. 20). Though Nagel proposes that mind is a fundamental part of nature, he rejects the notion that there is a Mind or Intention behind the universe. This option is unavailable because theism does not furnish an explanation of the intelligibility of the world but only "pushes the quest for intelligibility outside the world" (p. 26). We shall consider Nagel's revived natural teleology later.

Consciousness, claims Nagel, cannot be explained by the neo-Darwinian account of nature. This account ignores the first-person perspective of the conscious subject. Evolutionary process has produced "subjective individual points of view" (p. 44), and while any number of physical correlations can be produced by science to identify the effect termed "consciousness," there is little, if any, understanding concerning "why the cause produces the effect" (p. 45). In her book, *Science and Poetry*, British philosopher Mary Midgley has argued cogently that overly literal use of atomistic metaphors has eclipsed the first-person perspective and distorted our understanding of the human person.

Having rejected reductive accounts of mind, Nagel considers emergence and panpsychism as explanatory frameworks for the historical rise of consciousness. He favors emergence with a teleological twist and argues that natural selection will favor those physical characteristics that give rise to consciousness. Thus, though for Nagel the evolutionary process is not guided by God, there is a certain directedness built into the natural order orienting it to the production of conscious beings (pp. 60–1, 66–7). Here, we see his appreciative nod toward Aristotle's concept of nature.

Next, Nagel claims that a materialist evolutionary account cannot explain human cognitive capacities. As a realist, Nagel has something at stake regarding evolutionary explanations of reason since he claims that, transcending the sensory world of biological routines, we make contact with "the timeless domains of logic and mathematics" as well as the realm of value (p. 72). The antirealist is not as upset with materialist explanations of reason because truth, for her, is a human construction with no "judgment-independent" status (p. 75).

Nagel claims that the neo-Darwinian's argument that reason is reliable "because it is consistent with its having an evolutionary explanation" is circular and self-refuting. It is circular because we presuppose reason's validity in appealing to it for the making of that very judgment.

> It is not enough to be able to think that *if* there are logical truths, natural selection might very well have given me the capacity to recognize them. That cannot be my ground for trusting my reason, because even that thought implicitly relies on reason in a prior way. (p. 81)

The materialist version of evolution, if correct, would undermine our trust in reason's ability to have true beliefs about the world because natural selection does not track for truth, only for survival. But we do have true beliefs and can transcend our own biological routines, because "[s]omething has happened that has gotten our minds into immediate contact with the rational order of the world …" (p. 83). Perception may be a "truth-preserving algorithm" and for that we have natural selection to thank, but reason is "a mechanism that can see that the algorithm it follows is truth-preserving." This critical distance we have from our own algorithm, he says, "is a kind of freedom …" and that, says Nagel, cannot be explained by evolutionary naturalism (p. 82).

Human consciousness is a part of the history of the emergence of consciousness in general, "of the universe gradually waking up and becoming aware of itself" (p. 85). The historical rise of consciousness, says Nagel, is best explained through an "Aristotelian idea of teleology without intention," in which nature's evolutionary unfolding is (quoting Roger White's lovely phrase) "biased toward the marvelous." Such a bias, according to Nagel, "would probably have to involve some conception of an increase in value," since "not just any outcome could qualify as a *telos*" (p. 92). Nagel's conception of nature has interesting parallels with Canadian philosopher/theologian Bernard Lonergan's notions of finality and emergent probability as applied to natural processes.

Nagel agrees with the influential article by Sharon Street that the realist account of value is incompatible with Darwinian naturalism. Natural selection may be able to track for reproductive fitness, but it cannot "detect any mind-independent moral or evaluative truth," since that has no survival value (p. 107). However, whereas Street holds that moral realism is false, Nagel thinks there is something "missing from Darwinism" (p. 111). The realist account of value is true, claims Nagel, for we can be motivated by reason to pursue what is good

for its own sake and avoid what is bad because it is bad: "We are the subjects of judgment-sensitive attitudes, in Scanlon's phrase, and those judgments have a subject matter beyond themselves" (p. 114). Value, Nagel claims, is internal to life itself and the rise of life must include some account of the genesis of value. Again, Nagel appeals to a natural teleology to account for the historical rise of value. Thus, natural selection "would have a propensity to give rise to beings of the kind that have a good—beings for which things can be good or bad," because it is in this way that the evolving process could introduce value to the world (p. 121).

Nagel has graced us with a deep and engaging work, a rich source of reflection—and controversy. Highly recommended.

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Religion & Science

GOD AND THE ATOM. From Democritus to the Higgs Boson: The Story of a Triumphant Idea by Victor J. Stenger. Amherst, NY: Prometheus Books, 2013. 332 pages including index. Hardcover; $25.00. ISBN: 9781616147532.

The success of atomic theory, and science in general, is presented as evidence for materialism, reductionism, and atheism. According to Stenger, atomic theory is incompatible with a belief in God: "everything is simply atoms and the void, with no divine creation or purpose …" (p. 12). Stenger declares, "Atomism is atheism" (p. 13). This book is consistent with Stenger's earlier books, *God and the Folly of Faith* and *God: The Failed Hypothesis*.

Victor J. Stenger has degrees in engineering and physics. He is an emeritus professor of physics at the University of Hawaii. He is well known for his work in high energy physics and writing general audience articles on topics of religion and science.

Stenger defines atomism as the idea that there are small particles, molecules, atoms, or subatomic particles, of which all things are made. To discuss these particles, he arranged the book into a preface and thirteen chapters. Twelve of the thirteen chapters are a narration of the evolution of atomic theory, though he also includes discussions of thermodynamics and electromagnetism. The early chapters focus on ancient philosopher-scientists and the concept of atomism, while the later chapters discuss more recent theories involving subatomic particles such as the Higgs boson. The philosophical basis for the declaration that atomism is atheism is discussed primarily in the preface and the last chapter.

Ancient atomist philosophers such as Epicurus (see Acts 17:18), Lucretius (whose poem Stenger devotes considerable attention to), Leucippus, and Democritus are discussed with respect to both their science and their religious worldviews. These atomistic philosophers are contrasted with Aristotle, the Stoics, and the Neo-Platonists whose philosophies were adopted by the Christian church. Stenger claims the early atomists were materialists, who felt that "matter and natural forces are all there is to observable reality" (p. 22).

Stenger also denies the concept of emergence, citing the concept of wetness, which appears to emerge only when there is a bulk amount of molecules. Though wetness is a bulk property, it is only possible due to the properties of individual molecules, and so can be reduced to the smallest indivisible molecule.

Conflicts between church fathers such as Augustine, and atomists such as Epicurus, are also discussed. Augustine is quoted as opposing the idea of "infinitely small objects that can neither be divided nor perceived" (p. 47). This debate is about philosophies of the eternal, purposeless world of the atomist and the Christian view of a world created by an immanent God. Stenger claims that the church's resistance to atomism was due to a rejection of reductionism and materialism, philosophies which logically follow from the atomistic models. Though Stenger paints an overall negative picture of Christianity he does praise one theist and scientist, Pierre Gassendi, who lived in the latter part of the seventeenth century.

The remaining chapters of the book, except for the summary, make less reference to religion. These chapters narrate the scientific revolution from Newton to the discovery of the Higgs boson, providing historical context to scientists such as Newton, Boltzmann, Gibbs, and others. In addition to discussions of atomic theory, these chapters also look at discoveries in electromagnetism and thermodynamics.

The strength and value of the book are in the later chapters devoted to historical narratives of the scientific revolution. Stenger is an excellent storyteller and offers wonderful explanations of thermodynamics and high energy physics. He also includes many historical insights into the personal philosophy and lives of scientists.

The weakness of the book lies in Stenger's hypothesis that atomism is atheism; his argument is not well developed. The argument may work well in denying the superstitions of volcano gods and may be used to refute claims of fiat creation by intelligent design advocates, but it does not go any deeper.

Though the book does not present a strong thesis for atheism, it may be of value to those who have an interest in science history and recent developments in modern particle physics. For those who are teaching in the sciences, portions of the book may be good sources for qualitative explanations of quantum mechanics, thermodynamics, and modern physics.

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EINSTEIN'S JEWISH SCIENCE: Physics at the Intersection of Politics and Religion by Steven Gimbel. Baltimore, MD: Johns Hopkins University Press, 2012. viii + 245 pages. Hardcover; $24.95. ISBN: 9781421405544.

Just two days before Albert Einstein spoke to the French Philosophical Society on April 6, 1922, one of his fiercest German opponents, Johannes Stark, a Nobel Prize physicist, lamented the fact that "since the end of the war the French have suppressed the German people in the most brutal manner … And just at this very time, Herr Einstein travels to Paris to deliver lectures." The tension in the air was rife and Einstein was fully cognizant of the sustained efforts of his detractors, such as the Nobel laureate Philipp Lenard, an early architect of the *Deutsche Physik* movement, who questioned the viability of Einstein's theory of relativity derogatively calling it "Jewish physics," a work of fiction "which never was intended to be true." Einstein's somewhat cynical comment in his Paris lecture succinctly captures the cultural situation:

> If my theory of relativity is proven successful, Germany will claim me as a German and France will declare that I am a citizen of the world. Should my theory prove untrue, France will say that I am a German and Germany will declare that I am a Jew. (p. 1)

The opposition to Einstein's "Jewish physics" reached fever pitch once his work (on the general theory of relativity) was confirmed and described as "one of the greatest—perhaps *the* greatest of achievements in the history of human thought" by J. J. Thomson, the English Nobel Prize winner in 1906 for his discovery of cathode rays. Almost overnight Einstein became a celebrated international hero—the scientific genius, intellectual rebel, *enfant terrible*, untainted by the war and of dubious nationality. He had revolutionized our conception of the universe by offering new interpretations of time and space, and had done so in a style that only a handful of scientists could understand. Not only had old conservative and militaristic heroes been bypassed after the war in the government of Weimar Germany, but experimental scientists, such as Lenard and Stark, were being challenged by new quantum approaches in physics. The intellectual pressure to change was a bridge too far to cross for many conservative scientists; they sought to privilege the experimenter rather than the theoretician, who was seen as a mere "loner" sitting in an office with pen and paper.

In this stimulating and provocative book, Steven Gimbel, the chairman of the philosophy department at Gettysburg College, recreates the historical, scientific, and political contexts in Einstein's Germany. In *Einstein's Jewish Science: Physics at the Intersection of Politics and Religion*, Gimbel provocatively argues that the Nazis, in their support of a *Deutsche Physik* and denigration of Einstein's "Jewish science," may have been on to something. This book is an exploration of the diverse ways in which Einstein's physics may have reflected Jewish characteristics. Perhaps, Gimbel argues, there is more to the epithet "Jewish science" then we have ever assumed or expected to uncover. Was Einstein's science "Jewish"? If one could get past the anti-Semitism, Gimbel suggests, one could make an argument for a "Jewish science." But Gimbel's answer is both a qualified yes and no; as he says, a typical Jewish response. Not Jewish in the sense that the Nazis would argue *ad nauseam*, namely, that this style of thinking influenced the content of relativity theory or that its style maliciously tainted the theory. Rather, Jewish as a style of thinking analogous to the argumentation and approach of Talmudic scholars. "While there is certainly no direct link between Einstein's work and the rabbinic tradition, there is an interesting resemblance between their approaches to problems" (p. 86). The resemblance is one of analogy rather than a causal link.

> The heart of the Talmudic view is that there is an absolute truth, but this truth is not directly and completely available to us. We can only see it through our experience, which is limited to a context. In our search for deeper meaning, we must try to understand how the limited view of the truth fits together with seemingly contrasting views of the truth from other perspectives and contexts. It turns out that exactly the same style of thinking occurs in the relativity theory and in some of Einstein's other research in the period. (p. 96)

Scholars do weigh the "absolute" but in a manner that does not claim final, complete, or comprehensive knowledge. Such weighing always involves a path of tentative steps, of feeling one's way.

Gimbel compares this Jewish approach to what he calls "Christian" approaches, which exemplify a "single sort of rationality." He calls to mind the "single absolute truth" approach of René Descartes (top-down Catholic style, hierarchical, the pope as CEO and epistemological officer) with deductive truth flowing downhill, giving us certainty. By contrast, Isaac Newton's "Protestant bottoms-up inductive style," also fitted with certain absolute pretensions (think of Newton's notion of absolute space and time). There is much in this historical analysis that one could, and perhaps should, question, but the contrast Gimbel sketches, in some detail, is a revealing one.

What are we to make of this perceived Jewish style of inquiry? Is it simply a disguised postmodern method of inquiry, replete with a relativistic strand, coupled to an inherent loss of objectivity? Gimbel appeals to feminist philosopher Sandra Harding to argue that her standpoint theory provides a way of maintaining a strong sense of objectivity, which is required in science, while still recognizing the role different approaches and perspectives play (pp. 215–7). Clearly, this suggestion of a Jewish style in science raises similar issues for readers of *PSCF*. Does it make any sense, at all, to speak of a "religious" science? Not in the sense that religion and science are compatible (which often leaves one feeling shortchanged), but rather do religious ways, styles, sensibilities, commitments shape one's approach in science? Would we dare speak of a "Christian" science? Is there a "Christian" style of doing science, or a Christian scientific practice? Gimbel's book provides a viewpoint readers cannot dismiss easily; it calls for deeper reflection and more far-reaching considerations on our part.

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WALKING WITH GOSSE: Natural History, Creation and Religious Conflicts by Roger S. Wotton. Southhampton, UK: Clio Publishing, 2012. 214 pages. Paperback; $19.00. ISBN: 9780955698392.

Roger Wotton is an Emeritus Professor of Biology at University College London (England). The main focus of his teaching and research has been in zoology and aquatic biology, interests he has in common with those of Philip Henry Gosse. He states in the preface of this book that his interest in Henry Gosse was kindled by the biography, *Glimpses of the Wonderful: The Life of Philip Henry Gosse* by Ann Thwaite (2002). Thwaite's book introduced him to "the man behind the Natural History; his profound belief in the literal truth of the Bible, and the complex and difficult relationship he had with his son, Edmund." All three of these topics are revisited in Wotton's more recent book *Walking with Gosse*.

Henry Gosse was a self-taught English nineteenth-century writer and lecturer who popularized natural history. Stephen Jay Gould described him as the nineteenth-century's answer to Sir David Attenborough! Much of his work was focused on the aquatic life of the south Devon coast where Gosse lived for a number of years. He is regarded as one of the inventors of the modern aquarium and his experiments with aeration enabled marine organisms to survive in captivity for long periods of time. His book, *The Aquarium: An Unveiling of the Wonders of the Deep Sea*, published in 1854, provided the general public with the information needed to set up an aquarium in one's home. He also popularized the use of the microscope, which became an instrument of entertainment in many wealthy Victorian households. His book, *Evenings at the Microscope; or, Researches among the Minuter Organs and Forms of Animal Life*, published in 1859, remained in print for some forty-six years. In addition to describing and illustrating various aspects of the natural world for the general public, he published numerous books and articles in journals for the scientific community. He also attended meetings of various scientific societies until the late 1850s and was made a Fellow of the Royal Society in 1856, despite the fact that he had no formal university training.

Gosse's contact with the scientific establishment changed dramatically in 1857 after the death of his first wife and the publishing of his most controversial book, *Omphalos: An Attempt to Untie the Geological Knot*. This book was an attempt to reconcile his belief in the literal biblical account of creation with the geological and fossil evidence, which supported an evolutionary process that took place over a very long period of time. His solution to the problem was to make a distinction between organisms that have had an actual existence (diachronic) and those that only appear to have existed prior to the act of creation (prochronic). Prochronic organisms, which may be represented at any point in the circle of their life cycle, were created at the same time as all the living diachronic creatures during the week of creation described in the book of Genesis. While Gosse thought his explanation perfectly understandable, hardly anyone else did. The scientific community

of his day thought that his argument was absurd, and the Christian community disliked the implication that God was a deceiver if he created the earth in a way that only appeared to be very old. The twentieth-century English novelist John Fowles described Gosse's hypothesis as "the most incomprehensible cover-up operation ever attributed to divinity by man."

Gosse's dogmatic religious beliefs led not only to his being cut off from the scientific community and from the wider Christian community; they also had a negative effect on Edmund, his only child. Wotton devotes a large section of his book to this relationship between father and son. While Edmund always respected his father's reputation as a naturalist and illustrator, he could not accept his rigid brand of Christianity. Edmund eventually became a famous literary figure and was knighted for his contribution to the arts. His best known work, *Father and Son: A Study of Two Temperaments*, describes the major differences between himself and his father. The book ends with a powerful attack on his father's position, and his description of Henry as a religious oppressor is one of its dominant themes. *Father and Son* was recognized as a literary masterpiece when it was first published, and it continues to have that status today.

While *Walking with Gosse* is primarily about Henry's life as a naturalist and evangelical Christian, Roger Wotton has also included a fair amount of autobiography. The first chapter documents his own upbringing in a church setting similar to the one that Edmund Gosse experienced. Like Edmund, he also has rejected the Christian faith, so he obviously can identify and empathize with Edmund's struggles. Although he admits that he is an atheist and an evolutionist (p. 194), he still holds Henry Gosse in high esteem as a writer and illustrator of natural history. While his religious views are similar to those of Edmund, his interest in zoology and aquatic biology provides a deep connection with Henry. He even grew up exploring the same south Devon shores that Henry had investigated years before. It is this unique combination of connections that makes Wotton's book such an interesting read.

Anyone interested in natural history, the history of science, or the relationship between science and Christian faith should consider reading this book. Included in the book are many pictures, copies of Henry Gosse's own illustrations, and a bibliography of his publications. While Wotton does not share Gosse's religious beliefs, he does not resort to ridiculing them either. The book ends with a plea for tolerance of opposing views about the origins of life on earth. The overall tone of the book is well summarized when Wotton writes,

> Some suggest all talk of creation should be squashed, based as it is on the supernatural, but I want to be inclusive. We can marvel at Natural History, whatever our explanations for the existence of living things, and this is a view that has been reinforced by studying Henry Gosse, one of the great Natural Historians. Paradoxically, Henry was not capable of such apparent tolerance. (p. 194)

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Book Notice

THE TEMPLETON SCIENCE AND RELIGION READER by J. Wentzel van Huyssteen and Khalil Chamcham, eds. West Conshohocken, PA: Templeton Press, 2012. v + 243 pages, index. Paperback; $19.95. ISBN: 9781599473932.

This reader comprises a play on the number nine: a collection of nine essays (plus an introduction written by the editors) from nine different fields representing selected chapters from the nine volumes in the Templeton Science and Religion Series, published from 2008 to 2011. Contributors and their topics (in the successive nine chapters) are Joseph Silk (cosmology), Ian Tattersall (paleontology), R. J. Berry (environmental science), Malcolm Jeeves and Warren S. Brown (neuroscience and psychology), Denis R. Alexander (genetics), Justin L. Barrett (cognitive science), Javier Leach (mathematics), Noreen Herzfeld (technology), and Harold G. Koenig (medicine). Four of the original volumes by Berry, Jeeves and Brown, Leach, and Tattersall have been reviewed in previous issues of *PSCF*.

This single edited volume offers one a good understanding of scientific developments in a wide range of fields. No scientific background is presupposed. The editors provide a rationale for the readings in their introduction. The selected readings give evidence of "a 'complementary' approach to science and religion, which implies that each has territories with limits, much as human knowledge will have limits" (p. 7). The book should give the general reader a springboard for participating in broader philosophical and theological discussions.

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