as the pigeons are the only nature some of them ever experience. Interestingly, Robbins posits that the love for pigeons may be vital to protecting the rest of the world's biodiversity. Robbins continues Part IV with chapters about the transformational power of owls and other raptors, including how at-risk inner-city youth were able to return the bald eagle to its historic nesting areas along the Anacostia River in Washington, DC. Robbins concludes with a discussion of ethno-ornithology, a relatively new field of study that looks at the holistic relationship between some tribal societies and their avian companions. As Robbins puts it, "Understanding the relationship between native cultures and birds may lead us back to a sustainable world in which their fate—and ours—is no longer in doubt" (p. 295).

This is a book that would appeal not only to fans of honeyguides, corvids, vultures, eagles, hawks, owls, linnets (house finches), penguins, chickens, hummingbirds, zebra finches, chickadees, egrets, flycatchers, waterfowl, starlings, bluebirds, ratites, pheasants, or any of the other myriad birds described in the book, but also to anyone who wants to learn more about birds and their roles in our lives. Robbins's use of swear words on two occasions might be distracting or offensive to some readers, but all in all, Robbins has produced a thoroughly researched and well-written book on the ecological, economic, and spiritual value of birds to humankind. The book reminds us of the value of biodiversity, and although Robbins is writing for a secular audience, his scientific approach to the subject matter and ability to weave the science into an entertaining narrative can help *PSCF*'s readers and other Christians to understand more fully and to appreciate more deeply the responsibility we bear in having dominion over creation.

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History of Science

DARWIN'S FIRST THEORY: Exploring Darwin's Quest to Find a Theory of Earth by Rob Wesson. New York: Pegasus, 2017. xxi + 383 pages, including endnotes, index, and 62 figures. Hardcover; $29.95. ISBN: 9781681773162.

DARWIN'S FOSSILS: The Collection That Shaped the Theory of Evolution by Adrian Lister. Washington, DC: Smithsonian Books, 2018. 215 pages, including sources, references, index, 16 figures, and 9 maps. Paperback; $19.95. ISBN: 9781588346179.

Charles Darwin, while en route to authoring *On the Origin of Species*, was widely appreciated as an explorer and as an observant field geologist. His geological and paleontological observations and inferences influenced his approach to nature as well as his appreciation for the significance of history for interpreting what we see today. The two volumes reviewed here narrate and interpret the effort, physical and mental, that Charles Darwin exerted as a young and vigorous naturalist while on board *H.M.S. Beagle* (1831–1836). *Darwin's First Theory* also covers Darwin's tutelage in field geology under Adam Sedgwick in the weeks prior to setting sail, and his field excursions in Scotland and Wales following his return. Together, the two books complement one another, revealing Darwin's growing understanding of Earth function, the implicated depth of geologic time, and the relationships of past biotas to those of today. These three subjects arguably provided the young scientist with a foundation for his later work on the mechanisms channeling the history of life.

The young Darwin was a keen geologist. His first book (1839) was his *Journal of Researches into the Geology and Natural History of the Various Countries Visited by H.M.S. Beagle*, only later retitled by a publisher as the *Voyage of the Beagle*. On the title page, the author's name is subtended by his credential as a scientist: "Secretary, Geological Society." This may have been meant in part as a claim to professional status, but it also declared the author's identity as a geologist. Wow! Darwin dedicated the second edition (1845) of the *Journal of Researches* to the geologist Charles Lyell, explicitly referencing Lyell's *Principles of Geology*. Darwin's debt to Lyell while a young scientist has been noted by many historians, but the intellectual link has often been developed merely to underscore Darwin's developing uniformitarian approach to natural history. This thinning of Darwin's early fascination with geology has been remedied by the biographies of Darwin by Desmond and Moore (1991) and by Janet Browne (1995; 2003). Further rehabilitation of Darwin the geologist and paleontologist has been provided by Richard Darwin Keynes, in *Fossils, Finches and Fuegians* (2003), a thorough account of the voyage of the *Beagle*; and by Sandra Herbert, in *Charles Darwin, Geologist* (2005), which examines many facets of Darwin's development as a scientific observer and communicator. The books by Lister and Wesson, here under review, continue this revelation of Charles Darwin, field geologist.

Darwin's Fossils, as the title suggests, is focused on the kinds of fossils that Darwin collected while on the *Beagle* expedition. A preliminary chapter introduces us to Darwin's associates on the *Beagle* and

the paleontologists and zoologists to whom Darwin forwarded his fossils while en route. Following this chapter are three long chapters treating fossil mammals, fossil plants, and fossil marine life. The penultimate chapter takes a look at Darwin's examination of coral reefs while on the return voyage across the Pacific. The last chapter is a brief exposition of Darwin's development as a scientist following his return, and the significant impact of his paleontological collecting on his development as an evolutionary biologist. The numerous illustrations include many photos of the very specimens collected by Darwin. There are also photos of Darwin's South American landscapes and collection sites, as well as modern South American organisms relevant for comparison to the fossils. The illustrations are in color and uniformly well executed, resulting in an attractive volume that grabs and sustains the reader's attention. In addition, the several maps are clear and make the narrative much more understandable.

Darwin's First Theory is a more complicated read. It is actually three interwoven narratives. The fundamental narrative is that of Darwin's field geological researches in South America and in the Pacific. In this respect, there is great overlap between this volume and *Darwin's Fossils*. But the book also looks at the effects of plate tectonics—earthquakes, tsunamis, and volcanism—on contemporary life (and death) along the Pacific margin of South America, a significant chunk of what is often termed the "Ring of Fire." The third interwoven component is that of author Rob Wesson's geophysical researches into tectonism in southern South America, plus his personal retracing of Darwin's inland excursions. The common theme to these three narratives is that of motions in Earth's crust, and the decipherment of the cause(s) of said motions. Wesson explicates the gamut of geologic and paleontologic phenomena (including the great Conceptión earthquake of February 1835) that Darwin encountered, which convinced him that Earth's crust had experienced a long but punctuated history of localized vertical motions. Darwin pondered over what he was seeing and continued to ponder after his return to England, where he wrote up his geological discoveries. Among his realizations was the necessary role of protracted crustal subsidence in the evolution of coral atolls.

Wesson demonstrates how Darwin grappled with geologic data. The eastern and western South American coastlines as well as the Argentinian coastal plain bore features indicating that in some places, land surfaces had bobbed down while in other places, they had been elevated. Confusingly, some localities provided evidence of complex motions in both directions. Lacking an understanding of plate tectonics and of underlying mantle dynamics, Darwin and his contemporaries attempted to resolve the whys of vertical crustal translations. In the process, Darwin developed a preliminary sketch of the geologic history of the Andes. Darwin also was drawn into the debates surrounding massive glacial advances and retreats in the past. In these efforts, Darwin relied on Lyell's work as a compendium of background information and as a foil.

The new volumes by Lister and by Wesson underscore Darwin's strenuous and sometimes risky journeys along shorelines or cross-country and often at high altitude, driven by his realization of the opportunity with which he had been presented. Darwin collected all manner of marine invertebrates, terrestrial plants, mammals, fishes, reptiles, birds, and fossils, which were periodically sent back to England to be referred to specialists. The fossil mammals went to Richard Owen. One of the helpful aspects of both of these books is to highlight the respectful friendship between Darwin and Owen during Darwin's early career, countering the common perception of Darwin and Owen as perennial intellectual adversaries. Darwin learned much from Owen's store of anatomical knowledge. Lister's book makes clear the personal impact upon Darwin that his up-close encounter with fossils provided: it was apparent that the fossils in more recent sedimentary layers resembled their modern counterparts more than the fossils in earlier strata. And the recent fossils of South America, including monster ground sloths and giant armadillo-like glyptodonts, were obviously more closely related to the modern biota of South America than to those of other continents. There were biogeographic patterns as well as historic patterns to be found, hidden in the rocks.

Darwin was poised at an interesting point in history. The preceding generation had elucidated the fact that fossils occurred in an order within the strata; Darwin's contemporaries were deploying that discovery to chronicle the major contours of the history of life. Meanwhile, the origins of major Earth features such as continents, ocean basins, and mountain chains remained highly problematic. Darwin was propelled into the study of natural history during this exciting period. His growth as a natural scientist while on the *Beagle* expedition has often been flattened to a two-dimensional perspective, focused on the revelatory power of biogeography linked to his evolutionary tool-kit. The volumes at hand help restore the third dimension and illuminate Darwin the historical scientist, pondering processes and time.

Readers of *PSCF* who wish to better understand the logical train of reasoning that led to the *On the Origin*

of Species, and to remediate the distortions of the history and role of biostratigraphy that have been and continue to be put forth by the proponents of flood geology, will profit from these volumes.

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THE GREAT RIFT: Literacy, Numeracy, and the Religion-Science Divide by Michael E. Hobart. Cambridge, MA: Harvard University Press, 2018. xiv + 506 pages, with appendices, endnotes, and index. Hardcover; $39.95. ISBN: 9780674983632.

Michael Hobart's book *The Great Rift* presents a novel and provocative perspective on the age-old conflict between religion and science. In his words:

> My central thesis may be baldly and succinctly stated: the shift between two distinct information technologies—literacy and numeracy—resides at the source of how science and religion went their separate ways, producing the Great Rift between them. (p. 4)

To be clear, Hobart does not specifically address the alleged discord between science and religion but delineates how a chasm (his word) opened up to drive them apart. Nevertheless, Hobart holds that as life became ever more secularized, religion became less relevant to science and was "not so much conquered as ignored" (p. 10), so that "from the late nineteenth century to our own times we have reached the point where observers and participants alike … have come to view the widening separation between science and religion as an impasse, or even a war zone" (p. 323).

To support his thesis, Hobart fleshes out and refines some research begun two decades earlier with a colleague on transitions between the three stages in the history of information technology: literacy, numeracy, and computerized information processing. The result here is a well-researched book, based on a lifetime of work, that extensively examines medieval and Renaissance developments in mathematics as well as Galileo's seminal role in the rise of modern science. The detailed scholarly treatment given these topics, which we cannot adequately recapitulate here, makes the book well worth its modest price, completely aside from its take on the science-religion divide.

Hobart begins his narrative with a brief look at the ancient world, which introduced and developed the information technology of recorded language. Greek writing is epitomized by its literature and philosophy, which make extensive use of definition and classification to capture the essence of things. Aristotle systematically codified forms of deductive reasoning based on this type of thinking in his logic. Medieval schoolmen later adopted this mode of knowledge acquisition in their educational practices and intellectual debates. Classification and fine distinctions permeated the writings of those who studied the quadrivium (arithmetic, music, geometry, and astronomy) as well as the writings of those dedicated to more advanced topics in theology and philosophy.

During this time period, there was a methodological unity overall to science and religion. Thinkers described the observed behavior of natural phenomena in terms of causes related to their essential natures, leaving room for divine purposes at the head of it all. They employed the same sort of reasoning that explained the structure of the natural world to incorporate religious ends and means. Science and religion in medieval Europe formed a fairly harmonious whole.

As people began to use mathematics more consistently in the late Middle Ages and Renaissance in order to relate things in everyday arenas such as commercial transactions, music, perspective painting, and astronomy, the explanatory focus for natural phenomena moved away from appealing to the intrinsic nature of things to demonstrating how they functioned quantitatively. Mathematically relating numerical features of events or activities via ratio and proportion (the rule of three was an omnipresent mainstay) became the new mode of accounting for natural phenomena. This approach was fruitfully employed by Galileo in his scientific analysis of terrestrial motion, yielding his times-squared law for falling bodies and parabolic paths for projectiles. Such an approach left both traditional philosophy and theology on the outside, creating a fault line between science and religion. Galileo's clash with the Roman Catholic Church over the factual status of Copernican astronomy, the nature of scientific demonstration, and the legitimacy of theological incursions into science only exacerbated this rift.

Hobart attributes the new analytic approach in natural philosophy to changes in information technology, indeed, to the rise of numeracy. He sees developments within mixed/applied mathematics during the Renaissance and early modern period as embodying a new understanding of the nature of mathematics and the role of symbols. Using terms proposed in 1959 by Jagjit Singh (but for distinguishing formalistic late nineteenth- and twentieth-century mathematics from its more concrete antecedents), Hobart brands classical and medieval mathematics as "thing mathematics" and Renaissance and early