Biology

THE SOCIETY OF GENES by Itai Yanai and Martin Lercher. Cambridge, MA: Harvard University Press, 2016. x + 282 pages. Hardcover; $27.95. ISBN: 978-0674425026.

I begin with a confession (a good Christian thing to do): I am neither a geneticist nor an expert on genes, so I am not qualified to comment on some of this book's more technical aspects. However, as the authors state, they "wrote this book for a general audience, assuming no background in biology on the part of the reader" (p. 3). That said, while most aspects of the presentation are straightforward, at various points a willingness to delve into some of the more technical language of genetics (such as FOXP2, SOX9, BRCA1, SINE, LINE1, Alus, MIR) is required. General readers may be familiar with some of these terms, such as BRCA1 and BRCA2 (BReast CAncer genes 1 and 2), but are unlikely to be familiar with all, especially those whose designations are less obvious.

Yanai and Lercher state that they were motivated to write this book in the spirit of Richard Dawkins's book *The Selfish Gene*, published forty years ago, which they admire and describe as "essentially correct." So why write another book on genes? Genetics has moved on a long way since Dawkins wrote *The Selfish Gene*, so that much that was unknown then is now known. In particular, the authors focus on what has been discovered about how genes interact and the results of their interactions, a fascinating area of research. For this reason, they choose the metaphor of "the society of genes," genes collaborating and competing along the lines of the economic model proposed by Adam Smith in the eighteenth century. In Smith's model, selfish (self-interested) individuals compete and collaborate. Here, selfish genes compete and collaborate in a society of genes to their own benefit; this is an extension of Dawkins's selfish gene metaphor.

Yanai and Lercher state that "the genome … is best seen as a conglomerate of selfish genes, held together by an intricate network of cooperation" (p. x). Despite their disclaimer that "[a]nthropomorphising provides a convenient shorthand … we need to remember the full description behind the shorthand," I am not convinced that this metaphor, as with Dawkins's original metaphor, is helpful (p. 38). Genes are not active agents in the sense that human beings are in Smith's economic model. When the authors state that "each allele 'works' toward its own advantage when cooperating with its peers, exemplifying Adam Smith's hypothesis that self-interest, if channelled appropriately, maximises the common good," I think they are in danger of being misled by their own metaphor (p. 46). If organisms are "survival machines" for genes (to use Dawkins's terminology), then which common good are the genes maximizing? Not necessarily that of the organism, or even that of the so-called community of genes. For example, cancer genes will kill the organism and so destroy themselves and their fellow genes without exhibiting the slightest qualm. Yanai and Lercher's use of Adam Smith's economic model as an analogy for how genes work seems problematic. In the case of cancer genes, the analogy of a suicide bomber seems much more appropriate.

The flavor of the book can be obtained by considering a selection of topics from various chapters. Chapter 1 is a clear description of the genetics of cancer. This is the springboard for chapter 2, which examines "how your enemies define you." This chapter begins with an explanation of how bacteria incorporate information into their own genome from viruses that are attacking them, thus becoming better able to defend themselves from similar attacks in the future. While this works well for single cell bacteria, the authors point out that it is not a technique that will work for a more complex organism such as a human being. Instead, human genes allow us to manufacture antibodies to deal with intruders in our body (the authors then describe the genetics of this process).

The next chapter explores the genetics of sex. The authors say that the point of sex is that it allows the members of the society of genes to continually form new alliances and to work together more efficiently in the long run (p. 77), although what "more efficiently" means in this context is unclear. Through sexual recombination, harmful mutations can be left behind and helpful ones consolidated into the genome. An interesting conclusion is that if a man wants to reduce the mutational load passed on to the next generation, he should have children while he is young, when few mutations have accumulated in his sperm.

Chapter 4 examines the question: why does the small 0.1% difference in the genome of two individuals lead to such large differences among humans? Here, the authors seem to stray into dangerous territory, suggesting that "a small number of selfish genes (or even selfish ideas) are enough to underpin racist behavior" (p. 126).

The issue of how some genes manage and regulate other genes, turning them on or off, is described in chapter 7. This regulation allows for the develop-

ment of a wide range of organismal characteristics (phenotypes) from the same set of genes. Chapter 8 describes gene duplication and horizontal gene transfer, whereby genomes can be enriched and enlarged. For example, horizontal gene transfer between bacteria has been shown to account for the spread of resistance to drug treatments. Chapter 9 explores the evolution of eukaryotic cells (ones with a nucleus, such as those in the human body) as a merger of an archaebacterium and a eubacterium.

The final chapter describes genetic "freeloaders," genes that seem to serve no useful purpose except to ensure their own survival. Occasionally these genes do take up a new function (exaptation in Stephen J. Gould's terminology). In the human genome, the freeloaders hugely outnumber useful genes. Yanai and Lercher link this to the beginning of life on Earth around hydrothermal vents at the bottom of the ocean, where RNA freeloaders could have been abundant.

The book concludes with a paraphrase: "it is the society of genes that has brought us this far, but it is our humanity that must now bring us home." I do not share Yanai and Lercher's faith in humanity and prefer the original: "'Tis grace hath brought me safe thus far, and grace will lead me home" (from the hymn "Amazing Grace"). God's grace is a surer foundation for humanity's future than a purported society of selfish genes.

Overall, the book is a good introduction to modern genetics from a Dawkins-like perspective. A key message of the book is that many aspects of human biology are controlled by a number of genes acting together, rather than by a single gene. This exposes the lie of popular misconceptions such as our having a "god gene," a "gay gene," or an "alcoholism gene." Yanai and Lercher see their book as Darwin saw his *On the Origin of Species*, as "one long argument" (p. 258).

In the tradition of one long argument, they conclude that "this book exhibits the explanatory power that comes from viewing the genetic makeup of a species as a society of genes" (p. 258). I would dispute that conclusion, not only because their argument does not seem to be sustained chapter by chapter, but also because I find the metaphor itself to be questionable.

Nevertheless, this is a generally readable book, giving an updated view of developments in genetics since Dawkins wrote his popularizing book on the same topic. The book's major limitation is its gene-centric view of genetics. Other perspectives exist, such as the systems biology approach of Denis Noble (a colleague of Dawkins at Oxford), as exemplified in his book *The Music of Life: Biology beyond Genes.* Likewise, Jablonka & Lamb's book *Evolution in Four Dimensions: Genetic, Epigenetic, Behavioral and Symbolic Variation in the History of Life* provides a broader perspective. That Yanai and Lercher do not go beyond their gene-centric view might be due to a space constraint, but it might also be due to the constraint of their choice of metaphor.

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Mathematics

REDEEMING MATHEMATICS: A God-Centered Approach by Vern S. Poythress. Wheaton, IL: Crossway, 2015. 200 pages, bibliography, index. Paperback; $21.99. ISBN: 9781433541100.

Challenged by Kuyper's declaration that faith affects all of life, Poythress begins his book with a keen interest in exploring how faith applies to mathematics. There are other books on the subject, but in this short book, Vern Poythress adds his own view to the mix. He introduces some of the theological and philosophical work of the Reformed theologian John M. Frame, for example, *The Doctrine of the Knowledge of God*, and he acknowledges the influence of the Reformed philosopher Dirk Vollenhoven. He challenges the notion that mathematics is merely secular; instead, to cite one argument, arithmetic laws are "in essence personal" and imply a lawgiver. Poythress observes that the rules and order of mathematics demonstrate the biblical principle that God upholds the world. He attributes mathematics to God's law, a divine command, for the universe. Poythress tries to develop a philosophical position that steers away from both Christian Platonism and Christian empiricism.

While available in hardcover, *Redeeming Mathematics* is one of 20 free ebooks that Poythress has written. The list includes *Chance and the Sovereignty of God, Logic, Redeeming Science, Redeeming Sociology,* and *Symphonic Theology*. Many of his books share a variation of the subtitle "A God-Centered Approach" with the book under review. In this mathematics edition, Poythress leans heavily on his other work, such as *Redeeming Science*. In fact, some paragraphs are borrowed verbatim, and some of these words also appeared in his 2003 article "Why Scientists Must Believe in God: Divine Attributes of Scientific Law." In other places he encourages the reader to consult his other works to get the full details of his argument. In the end, I would have preferred that the book