



Damned if You Do and Damned if You Don't

The Problem of God-talk in Biology Textbooks

Stephen Dilley and Nicholas Tafacory

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Abstract

We argue that a number of biology (and evolution) textbooks face a crippling dilemma. On the one hand, significant difficulties arise if textbooks include theological claims in their case for evolution. (Such claims include, for example, God would never design a suboptimal panda's thumb, but an imperfect structure is just what we'd expect on natural selection.) On the other hand, significant difficulties arise if textbooks *exclude* theological claims in their case for evolution. So, whether textbooks include or exclude theological claims, they face debilitating problems. We attempt to establish this thesis by examining 32 biology (and evolution) textbooks, including the Big 12—that is, the top four in each of the key undergraduate categories (biology majors, non-majors, and evolution courses). In Section 2 of our article, we analyze three specific types of theology these texts use to justify evolutionary theory. We argue that all face significant objections. In Section 3, we step back from concrete cases and, instead, explore broader problems created by having theology in general in biology textbooks. We argue that the presence of theology—of whatever kind—comes at a significant cost, one that some textbook authors are likely unwilling to pay. In Section 4, we consider the alternative: Why not simply get rid of theology? Why not just ignore it? In reply, we marshal a range of arguments why avoiding God-talk raises troubles of its own. Finally, in Section 5, we bring together the collective arguments in Sections 2–4 to argue that biology textbooks face an intractable dilemma. We underscore this difficulty by examining a common approach that some textbooks use to solve this predicament. We argue that this approach turns out to be incoherent and self-serving. The poor performance of textbooks on this point highlights just how deep the difficulty is. In the end, the overall dilemma remains: God-talk or no God-talk?

1 Introduction

In his groundbreaking work, *The Structure of Scientific Revolutions*, Thomas Kuhn argued that textbooks play a crucial role in educating both scientists and non-scientists about science. “[B]oth the layman’s and the practitioner’s knowledge of science is based on textbooks and a few other types of literature derived from them,” he wrote.¹ On Kuhn’s view, textbooks play a regulative role: they show citizens and scientists the contours of the field, including the puzzles that remain to be solved, what counts as an acceptable solution, proper procedures for arriving at these solutions, and the like. As Kuhn memorably puts it, textbooks are “pedagogic vehicles for the perpetuation of normal science.”² That is, they give readers the correct vocabulary, values, standards, and so on—all the goods of the regnant paradigm. Textbooks even show readers how to think about the history of science, its cumulative progress to the present day, and its (glowing) prospects for tomorrow. In brief, textbooks are a window to the past, a guide to the future, and a defining ideal of the present. On Kuhn’s view, they show us what science is.

It comes as something of a surprise, then, that quite a few biology textbooks articulate a paradigm that is beset by a theological muddle. The muddle itself centers on the presence (and absence) of theological claims in arguments for evolutionary theory. It turns out that difficulties arise either when God-talk is included *or* when it is excluded.

In this article, we defend three primary claims. First, we argue that the presence of theology in biology textbooks is problematic. Second, on the other side of the coin, we contend that the absence of theology in biology textbooks is likewise problematic. These two points lead directly to our third main claim: textbooks are thus left in a crippling dilemma—they are damned if they include theology and damned if they don’t.

¹Thomas Kuhn, *The Structure of Scientific Revolutions*, third edition (Chicago: University of Chicago Press, 1996 [1962]), 137.

²Kuhn, *Structure*, 137.

1.1 Textbooks

Our analysis focused on the following texts:

- Audesirk, Teresa, Gerald Audesirk, and Bruce E. Byers. *Biology: Life on Earth, with Physiology*. 11th ed. Boston: Pearson, 2017.
- Barton, Nicholas H., Derek E.G. Briggs, Jonathan A. Eisen, David B. Goldstein, and Nipam H. Patel. *Evolution*. 1st ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2007.
- Belk, Colleen and Virginia Borden Maier. *Biology: Science for Life*. 5th ed. Boston: Pearson, 2016.
- Bergstrom, Carl T., and Lee Alan Dugatkin. *Evolution*. 2nd ed. New York: W.W. Norton, 2016.
- Brooker, Robert J., Eric Widmaier, Linda Graham, and Peter Stiling. *Biology*. 3rd ed. New York, NY: McGraw-Hill, 2014.
- Freeman, Scott, Kim Quillin, Lisabeth Allison, Michael Black, Greg Podgorski, Emily Taylor, and Jeff Carmichael. *Biological Science*. 6th ed. Boston: Pearson, 2017.
- Futuyma, Douglas J. and Mark Kirkpatrick. *Evolution*. 4th ed. Oxford, UK: Oxford University Press, 2017.
- Gunstream, Stanley E. *Explorations in Basic Biology*. 12th ed. San Francisco: Benjamin Cummings, 2012.
- Hall, Brian Keith and Benedikt Hallgrímsson. *Strickberger's Evolution*. 5th ed. Sudbury, MA: Jones and Bartlett Learning, 2014.
- Herron, Jon C. and Scott Freeman. *Evolutionary Analysis*. 5th ed. San Francisco, CA: Benjamin Cummings, 2014.
- Hillis, David M., David Sadava, Richard W. Hill, and Mary V. Price. *Principles of Life*. 2nd ed. Sunderland, MA: Sinauer Associates, 2014.
- Hoefnagels, Marielle. *Biology: Concepts and Investigations*. 4th ed. New York, NY: McGraw-Hill Education, 2018.
- Krogh, David. *Biology: A Guide to the Natural World*. 5th ed. Boston: Pearson, 2014.
- Mader, Sylvia S. *Biology*. 10th ed. New York: McGraw-Hill Higher Education, 2010.
- Mader, Sylvia S. and Michael Windelspecht. *Essentials of Biology*. 4th ed. New York: McGraw-Hill Education, 2014.
- Mason, Kenneth A., George Johnson, Jonathan Losos, and Susan Singer. *Understanding Biology*. 1st ed. New York, NY: McGraw-Hill, 2015.
- Miller, Kenneth R. and Joseph S. Levine. *Miller & Levine Biology*. Boston: Pearson, 2010.
- Morris, James et al. *Biology: How Life Works*. 3rd ed. New York: W.H. Freeman and Company, 2019.
- Phelan, Jay. *What Is Life?: A Guide to Biology*. 4th ed. New York: W.H. Freeman and Company, 2018.
- Raven, Peter H., Kenneth A. Mason, Jonathan B. Losos, Susan R. Singer, and George B. Johnson. *Biology*. 10th ed. Dubuque, IA: McGraw-Hill, 2014.
- Ridley, Mark. *Evolution*. 3rd ed. Malden, MA: Blackwell, 2011.
- Russell, Peter J., Paul E. Hertz, and Beverly McMillan. *Biology: The Dynamic Science*. 3rd ed. Pacific Grove, CA: Brooks Cole, 2013.
- Sadava, David, David M. Hillis, H. Craig Heller, and Sally D. Hacker. *Life: The Science of Biology*. 11th ed. Sunderland, MA: Sinauer Associates, Inc. 2017.
- Simon, Eric J. *Biology: The Core*. 2nd ed. Boston: Pearson, 2017.
- Simon, Eric J., Jean L. Dickey, and Jane B. Reece. *Campbell Essential Biology*. 7th ed. New York: Pearson, 2019.
- Singh-Cundy, Anu, Michael L. Cain, Jennie Dusheck, and Richard Symanski. *Discover Biology*. 5th ed. New York: W.W. Norton & Company, 2012.
- Shuster, Michèle, Janet Vigna, Matthew Tontonoz, and Gunjan Sinha. *Biology for a Changing World, with Physiology*. 2nd ed. New York: W.H. Freeman and Company, 2014.
- Solomon, Eldra Pearl, Charles Martin, Diana W. Martin, and Linda R. Berg. *Biology*. 11th ed. Australia: Cengage Learning, 2018.
- Stearns, Stephen C. and Rolf F. Hoekstra. *Evolution: An Introduction*. 2nd ed. Oxford, UK: Oxford University Press, 2005.
- Taylor, Martha R., Eric J. Simon, Jean L. Dickey, Kelly Hogan, and Jane B. Reece. *Campbell Biology: Concepts and Connections*. 9th ed. New York: Pearson, 2018.

- Urry, Lisa A., Michael L. Cain, Peter V. Minorsky, Steven A. Wasserman, and Jane B. Reece. *Campbell Biology*. 11th ed. New York: Pearson, 2017.
- Zimmer, Carl, and Douglas John Emlen. *Evolution: Making Sense of Life*. 2nd ed. New York: W.H. Freeman and Company, 2016.

While our analysis examined a variety of chapters in each textbook, we paid particular attention to two types of chapters (or sections). The first of these areas sought to articulate the historical context surrounding the advent of Darwin’s theory. Notably, authors invariably attempted to show the plausibility of Darwin’s theory relative to other theories (or claims) available at the time. Thus, these background sections function as part of textbooks’ overall justification of evolutionary theory as the correct account of biological unity and diversity. Second, in a similar vein, we analyzed sections that directly presented the evidence and arguments for (contemporary) evolutionary theory. Often these areas were simply labeled “The Evidence for Evolution.” In sum, instead of looking at one-off remarks here and there in a text, we especially focused on areas in which authors explicitly offered historical or contemporary material that they regard as firmly establishing evolutionary theory. It is in these areas that we often found theology-laden arguments and justifications.³

A critic might immediately demur, however. He might argue that the presence of theology is not really problematic. After all, any God-talk in biology textbooks is just window dressing. Claims about ‘what a Creator would do’ are only an historical element in the story of the rise of evolution; theological claims are not part of evolution’s epistemic justification—the real reasons why evolution is worthy of acceptance. That is, one might think that textbook authors use God-talk only for rhetorical effect, while the ‘real’ evidence for evolution lies elsewhere. On this view, ‘real’ evidence has to do with natural laws, entities, and processes, including natural selection, random mutation, homological similarities, and the like. Creationism only enters the picture as a type of (historical) object lesson; it’s nothing more than an erstwhile and ersatz view that has been overcome by evolutionary theory and its explanatory success.

By way of reply: there is a great deal to say on this score. In a sense, our article as a whole functions as a response to this objection. But for now, we offer a distinction that at least makes an initial step toward our broader case: there

³In addition, we are cognizant of the difference between explanations or illustrations of evolutionary theory, on the one hand, as distinct from epistemic justifications or arguments for that theory on the other. Our focus is on instances of theology in the latter rather than the former.

is a difference between the evidence for evolution per se versus the evidence for evolution *as presented in textbooks*. Our goal is to examine textbooks as *they* portray the case for evolutionary theory. Our task is not to analyze the case for evolution as it appears in some other medium or in an idealized form. Rather, we focus on what textbooks actually say. Whatever else might be the case, a reader can hardly be faulted for thinking that what appears in “the evidence for evolution” chapter (or section) is precisely what textbooks present as the evidence for evolution. So even if, in some proper sense, God-talk is irrelevant to the justification of evolution per se, this fact is beside the point. What matters for present purposes is the textbooks as they stand.

1.2 Methodology

Before turning to the argument itself, however, a brief word about our methodology may be helpful. In particular, how did we decide which texts to include on our list? Our primary interest is in undergraduate biological education in the United States. In this domain, there are three main categories: textbooks for biology majors, non-majors, and evolution courses, respectively. We intentionally included the *top four* textbooks in each of these categories in 2017-2018.⁴ Thus, we directly examined the Big 12. Any study that purports to have robust conclusions must analyze the leading textbooks; that is precisely what we have done.

Yet we did not simply limit our study to the top titles in each category. In the interest of intellectual diversity, we wanted to hear more than just the most visible voices. As such, we looked at a range of books: some are recent, others are over a decade old; some are for high school, but most are for college; some are single author, others are multiple authors; some are alive and well, others are now discontinued; some are fairly basic, others much more advanced.⁵ And so

⁴While publishers tend to be cagey about releasing sales information, NAVSTEM helpfully tracks enrollment figures each year in biology courses (and their associated textbook selections) in over 350 colleges and universities across the United States. Arguably, their data are the best available. See their market briefs for “Biology-Majors,” “Biology for Non-Majors,” and “Evolution,” respectively (www.navstem.com). According to their research, the top four titles in 2017-2018 in biology courses for majors are Urry et al., *Campbell Biology*; Freeman et al., *Biological Science*; Morris, *How Life Works*; and Sadava et al., *Life*, respectively. The top four titles in biology courses for non-biology majors are Taylor et al., *Campbell Biology: Concepts and Connections*; Simon et al., *Campbell Essential Biology*; Phelan, *What Is Life?*; and Shuster, *Biology for a Changing World*, respectively. The top four titles in evolution courses are Heron and Freeman, *Evolutionary Analysis*; Zimmer and Emlen, *Evolution*; Bergstrom and Dugatkin, *Evolution*; Futuyma and Kirkpatrick, *Evolution*, respectively.

⁵We did not exclude any book after consideration except for two

on. Readers familiar with the broad landscape of biology textbooks will recognize that our list nicely represents the field.⁶

1.3 Other Preliminaries

A few other matters will clarify the terminology and scope of our study. First, we realize that a given textbook does not always say precisely what the author (or authors) believe. To some extent, textbooks represent combined efforts and compromises between authors, reviewers, the publisher, school boards, and so on. Accordingly, when we use phrases like “textbook authors say” or “textbook authors believe,” we have in mind either the text itself or the relevant community behind it.

Second, by “evolutionary theory,” “Darwinian evolution,” or just plain “evolution,” we mean the standard account found in biology textbooks, typically a contemporary version of Darwin’s theory (i.e. an updated version of the Modern Synthesis).

Third, by “theology,” we mean propositions about any supernatural deity. These propositions need not be systematic, justified, or connected with any particular tradition. They need not approach the rigor or precision typical of professional theologians. Instead, by “theology,” we simply have in mind propositions, of whatever sort, about any supernatural god. For stylistic variety, we will sometimes use the term “religious claims” (or something similar) instead of the term “theological claims.”

Fourth, it must be said that our argument does not imply that there is something wrong with evolutionary theory itself or with the comprehensive justification for it. Simply because we contend that *textbooks* are caught in a debilitating dilemma does not imply that evolution cannot be defended elsewhere with greater vigor and precision. Our concern is not with the theory itself nor its general grounding, but only with textbook accounts.

Finally, in what follows, by “the presence of theology” or “the absence of theology,” we actually have in mind the presence (or absence) of (i) theological propositions (ii) as part of the evidence for evolution—as part of a given argument or justification for evolutionary theory—in (iii) sections of biology textbooks that self-consciously provide grounds for the truth of evolution. But rather than spell out these three

instances in which the books in question essentially mirrored the line of thought already found in other books we were considering.

⁶According to NAVSTEM, even if we consider *only* the Big 12 textbooks, these alone comprise 64.7% of student enrollments in biology major, non-major, and evolution undergraduate courses in 2017-18.

features every time, for brevity and stylistic reasons, we will abbreviate by using phrases like “the presence of theology” or “the absence of theology,” or even shorter phrases like “include theology” or “exclude theology,” and so on. The context should make matters clear in each case.

1.4 Overall Structure and Thesis of the Article

Having covered preliminaries, we now turn to a general map of our article, including a guide to our key claims. Recall that our overall contention is that biology textbooks face an unhappy dilemma: problems arise if they include or exclude theology.

We attempt to establish this claim in four parts. In Section 2, we examine concrete examples of three different types of theology used to justify evolutionary theory in biology textbooks. We argue that all face significant difficulties. In Section 3, we step back from concrete cases and, instead, explore broader problems created by having theology in general in biology textbooks. We argue that the presence of theology—of whatever kind—comes at a significant cost, one that some textbook authors are likely unwilling to pay.⁷

In Section 4, we consider the alternative: Why not simply get rid of theology? Why not just ignore it? In reply, we contend that attempts to avoid God-talk raise difficulties of their own. For many textbooks, this option is equally unattractive.

Finally, in Section 5, we bring together the collective arguments in Sections 2–4 to argue that biology textbooks face an intractable dilemma. Problems abound whether they include or exclude theology. We underscore this difficulty by examining a common approach that some biology textbooks use to try to solve this predicament. We argue that their approach is incoherent and self-serving. The poor performance of textbooks on this point shows just how deep the difficulty is. In the end, the overall dilemma remains.

⁷As it happens, we are not in principle opposed to the presence of God-talk in biology textbooks. We personally think that this approach has some merit. Some textbook authors may agree with us on this score. But, as we will argue, others will find that this approach is deeply unwelcome.

2 The Problematic Presence of Theology—Concrete Examples

In this section, we analyze three types of theology in biology textbooks. We call them: straw god theology, presumptive theology, and indeterminate theology.⁸ Each type functions as a crucial element in various arguments that directly or indirectly support evolutionary theory. Unfortunately, each type also suffers serious difficulties. These difficulties undermine the pro-evolution arguments that contain them. More generally, the failure of these arguments nicely illustrates the broader problem of incorporating God-talk into biology textbooks.

Two qualifications must be made at the outset. First, this section of our article is not a comprehensive analysis of all types (or instances) of theology that appear in the textbooks on our list. There is more God-talk afoot than we highlight, both here and in other biological texts.⁹ Such cases strengthen our argument, but are beyond the present scope. Second, in this section, we argue that the strong majority of textbooks on our list include theology of one kind or another. But beyond this particular segment, our overall argument in this article focuses on the *dilemma* of including or excluding God-talk, rather than on problems that arise from the sheer amount of theology in biology textbooks. Thus, while Section 2 focuses on (many) instances of theology, our broader argument emphasizes the deeper predicament surrounding the general presence or absence of theology. In this sense, our argument is qualitative rather than quantitative.

⁸We borrow the term “straw god” theology from Jonathan Wells, “Darwin’s Straw God Argument,” *Journal of Interdisciplinary Studies* 22 (2010): 67–88. However, our use of the term is not identical to his. As far as we know, the terms “presumptive theology” and “indeterminate theology” are unique to our discussion.

⁹The seminal work on the role of theology in the justification of evolution is Paul Nelson, “The Role of Theology in Current Evolutionary Reasoning,” *Biology and Philosophy* 11 (1996): 493–517. See also Gregory Radick, “Deviance, Darwinian-style,” *Metascience* 14 (2005): 453–57, esp. 455; Stephen Dille, “Charles Darwin’s use of theology in the *Origin of Species*,” *British Journal for the History of Science*, vol. 45, no. 1 (2011): 29–58; Stephen Dille, “Nothing in Biology Makes Sense Except in Light of Theology?” *Studies in History and Philosophy of Biological and Biomedical Sciences* 44 (2013): 774–86; Abigail Lustig, “Natural Atheology,” *Darwinian Heresies*, ed. A. Lustig et al. (Cambridge: Cambridge University Press, 2004), 69–83; Casey Luskin, “Zeal for Darwin’s House Consumes Them,” *Liberty University Law Review*, vol. 3, no. 2 (Spring 2009): 403–89; Casey Luskin, “Darwin’s Poisoned Tree,” *Trinity Law Review*, vol. 21, no. 1 (Fall 2015): 130–233; Wells, “Darwin’s Straw God,” 67–88; Cornelius Hunter, *Science’s Blind Spot* (Grand Rapids, MI: Brazos, 2007); Cornelius Hunter, “Darwin’s Principle: The Use of Contrastive Reasoning in the Confirmation of Evolution,” *HOPOS* 4 (Spring 2014): 106–49; Cornelius Hunter, *Darwin’s God* (Grand Rapids, MI: Brazos, 2001); Cornelius Hunter, “The Random Design Argument” *Communications of the Blythe Institute*, vol. 1, issue 2: 23–36 [this issue].

2.1 Straw God Theology

The first type of theology we label “straw god theology” because it mischaracterizes certain rivals to evolution, making them easier to knock down. More specifically, this mischaracterization is typically part of a line of reasoning that indirectly supports evolutionary theory by attacking opponents such as special creation or young-Earth creationism. Eighty-four percent of the textbooks on our list deploy straw god theology.¹⁰

The Classical Scene

While our primary interest is the contemporary scene, we begin by briefly noting two broad caricatures of nineteenth-century special creation. First, a number of textbooks we studied characterize special creation as holding a young-Earth view.¹¹ Some of these texts seem to have taken Bishop Ussher as the authoritative voice on the matter, while others do not mention him by name but nonetheless nod in the same direction. The authors of *Biological Science* write, for example:

When Darwin published his theory in 1859 in a book called *On the Origin of Species by Means of Natural Selection*, it unleashed a firestorm of protest throughout Europe. At that time, the leading explanation for the diversity of organisms was an idea called special creation. Special creation held that: (1) All species are independent, in the sense of being unrelated to each other; (2) life on Earth is young—perhaps just 6000 years old; and (3) species are immutable, or incapable of change. These beliefs were explained by the instantaneous and independent creation of living organisms by a supernatural being.¹²

In fact, the discussion of a young Earth as a central matter of dispute between creationism and Darwinian evolution did

¹⁰See Figure 1 for a full list.

¹¹While some textbooks explicitly claim that special creation included a young-Earth view, others imply a close connection to one degree or another, often by characterizing young-Earth creationism as Darwin’s primary rival. For example, Hoefnagels, *Biology: Concepts and Investigations*, p. 238; Urry et al., *Campbell Biology*, p. 467–68; Mader, *Biology*, p. 266; Raven et al., *Biology*, p. 11; Belk and Maier, *Biology*, p. 207; Miller and Levine, *Miller & Levine Biology*, p. 450, 453–54; Phelan, *What Is Life?*, p. 300–304, 336–37; Herron and Freeman, *Evolutionary Analysis*, p. 38, 62, 66; Freeman et al., *Biological Science*, p. 435, 438; Mader and Windelspecht, *Essentials of Biology*, p. 238; Zimmer and Emlen, *Evolution*, p. 29–34, 52; Simon et al., *Campbell Essential Biology*, p. 247; Taylor et al., *Campbell Biology: Concepts and Connections*, p. 260–61.

¹²Freeman et al., *Biological Science*, p. 435.

not occur until the twentieth century. Early critical reviews of the *Origin of Species* by an array of prominent thinkers simply ignored this topic.¹³ Moreover, the most prominent 'creationist' work of the time, William Paley's *Natural Theology*, did not advocate a young Earth view.¹⁴ Instead, the most notable "age of the Earth" attack was from William Thomson (later, Lord Kelvin) who contended that the Earth was between 20 and 400 million years old, with the most probable time landing at 98 million.¹⁵

Second, some textbooks erroneously state (or imply) that a literal reading of Genesis was basically the only one available for Christian creationists in the centuries (or years) leading up to the *Origin of Species*.¹⁶ Consider, for example, Douglas Futuyma's well-known textbook, *Evolution*. In the opening pages, the text juxtaposes Darwinian evolution with pre-Darwinian views of flora and fauna. According to Futuyma, these early views included Plato and Aristotle's idea that "species have fixed properties."¹⁷ After this Greek notion came Christian ideas: "Later, Christians interpreted the biblical account of Genesis literally and concluded that each species had been created individually by God in the same form it has today. (This belief is known as 'special creation.')¹⁸ In the rest of the narrative, Futuyma gives no hint that other views were available to Christian thinkers. Similarly, in a passage that provides the historical backdrop to the rise of evolutionary theory, the authors of *Discover Biology* assert: "The literal interpretation of scripture, especially the book of Genesis, shaped Judeo-Christian views about the origins of life, and these were embellished by a succession of biblical scholars. James Ussher, a seventeenth-century archbishop of Armagh in Northern Ireland, claimed to know the exact date that all life was created: October 23, 4004 BC."¹⁹ In the rest of the pas-

sage, the authors are silent about other Christian views on the matter, which suggests to readers that a "literal interpretation of scripture, especially the book of Genesis" was the only option available prior to and during Darwin's era.

Of course, untold numbers of Christians (and special creationists) did interpret Genesis in this manner in the centuries (or years) prior to the *Origin*. And it is true, as some textbooks observe, that developments in geology during the early-to-mid nineteenth century did cause many Christian thinkers to give up literalist claims about Genesis, including a so-called universal flood.²⁰ However, our concern is that Futuyma and other like-minded authors do not give any indication that, by Darwin's day, non-literal interpretations of Genesis were well known in Christian (and creationist) circles and, more directly, a literal interpretation of Genesis was not a crucial issue among most scientists who were Christians. In his seminal study, *Charles Darwin and the Problem of Creation*, historian Neal Gillespie observed that during the evolution controversy, the dispute about the presence of biblicist thinking in science "was not whether literalism in biblical interpretation should survive, nor was it whether science contradicted the Bible.... The point of conflict, rather, was the intellectual autonomy of science."²¹ It is unsurprising, then, that an array of elite Christian men of science of that era accepted views of creation that did not require a literal interpretation of Genesis.²² Moreover, as Rev. William Hayden estimated in 1851, even among the "Christian public," fully half did not believe that Genesis was to be taken literally.²³ None of this was without precedent, of course. The Christian tradition includes a long history of non-literal interpretations, which date back to the Church Fathers. In the fourth century, St. Augustine, who ranks as one of the most influential theologians of all time, adopted a metaphorical view of "days" in his commentary on Genesis.²⁴ Other Church Fathers, like

ceding the 23rd day of October" in 4004 B.C.; biological life did not appear until October 25. Contrary to Singh-Cundy et al., Ussher did not claim that God created "all life" on "October 23."

²⁰The classic study is Charles Coulston Gillespie, *Genesis and Geology* (New York: Harper & Row, 1951).

²¹Neal Gillespie, *Charles Darwin and the Problem of Creation* (Chicago: University of Chicago Press, 1979), 47.

²²The ranks of Christian (or Christian-leaning) thinkers whose views of creation did not require a literal interpretation of Genesis included Georges Cuvier, William Paley, Adam Sedgwick, William Hayden, John William Dawson, Arnold Guyot, Asa Gray, William Whewell, John Herschel, James Dwight Dana, and others.

²³William B. Hayden, *Science and Revelation; or, The Bearing of Modern Scientific Developments upon the Interpretation of the First Eleven Chapters of Genesis* (Boston: Otis Clapp, 1852), 77. Hayden himself was disappointed that the number was not greater. See also Ronald Numbers, "Creating Creationism: Meanings and Uses since the Age of Agassiz," *Evangelicals and Science in Historical Perspective*, eds. David Livingstone et al. (Oxford, UK: Oxford University Press, 2014), 236.

²⁴One must be careful about the terms 'literal' and 'metaphorical'

¹³See the fine collection in David L. Hull, *Darwin and His Critics* (Chicago: University of Chicago Press, 1973).

¹⁴William Paley, *Natural Theology*, twelfth edition (London: J. Faulder, 1809); Adam Shapiro, "William Paley's Lost 'Intelligent Design,'" *History and Philosophy of the Life Sciences*, vol. 31, no. 1 (2009): 55-77; Adam Shapiro, "Darwin's Foil: The Evolving Uses of William Paley's *Natural Theology* 1802-2005," *Studies in History and Philosophy of Biological and Biomedical Sciences*, vol. 45 (2014): 114-23.

¹⁵William Thomson (Lord Kelvin), "Of Geological Dynamics," *Popular Lectures and Addresses*, vol. 2 (1869): 73-131. Thomson was supported by Fleming Jenkin, one of the critics most worrisome to Darwin. Fleming Jenkin, "The Origin of Species," [1867] in *Darwin and His Critics*, 303-44.

¹⁶For example, Singh-Cundy et al., *Discover Biology*, p. 386-87; Belk and Maier, *Biology*, p. 207; Bergstrom and Dugatkin, *Evolution*, p. 33; Simon, *Biology*, p. 152; Simon et al., *Campbell Essential Biology*, p. 244-48, esp. 245, 247; Taylor et al., *Campbell Biology: Concepts and Connections*, p. 260-61, esp. 260.

¹⁷Futuyma and Kirkpatrick, *Evolution*, p. 9.

¹⁸Futuyma and Kirkpatrick, *Evolution*, p. 9.

¹⁹Singh-Cundy et al., *Discover Biology*, p. 386. As a minor detail, this quote slightly mischaracterizes Ussher's view. Ussher held that God began creating the heavens and the earth on the "evening pre-

Clement of Alexandria, Origen, and St. Cyprian, likewise accepted figurative interpretations of Genesis.²⁵ Contrary to the claims of some textbooks, Christian creationists held diverse approaches to Scripture.

Unfortunately, other mischaracterizations of special creation surfaced as well.²⁶ Even so, our concern in pointing out these errors is not to defend special creation. On the contrary, we think the biological data run counter to this view. Yet these mischaracterizations concern us. In each case above, the caricature in question is part of a larger passage (or chapter) in which textbook authors seek to show that special creation is empirically inferior to Darwin's theory. That is, these mischaracterizations play a key role in indirect arguments *for* evolution. The problem, of course, is that these arguments are rife with straw gods.

The Contemporary Scene

Unfortunately, we also found mischaracterizations of contemporary versions of creationism. These mischaracterizations are not simply innocuous misrepresentations. They appear in sections of the text that are meant to provide support for current evolutionary theory. For example, like a number of textbooks, Mark Ridley's *Evolution* misconstrues the locus of divine activity.²⁷ Ridley juxtaposes evolutionary explanations for adaptation with creationist ones:

Creationism, by contrast, has no explanation for adaptation. When each species originated, it must have already been equipped with adaptations for life, because the theory holds that species are fixed in form after their origin. An unabashedly

when used to delineate the exegetical methods of Church Fathers. In *The Literal Meaning of Genesis*, Augustine purported to give the proper meaning of the text rather than a metaphorical or so-called literal one (in the modern sense). Using this approach, he concluded that "day" in Genesis should not always be viewed as a 24-hour time period. Augustine, *On Genesis*, trans. Edmund Hill (Hyde Park, NY: New City Press, 2004).

²⁵While the Church Fathers overwhelmingly thought the Earth was young, nonetheless they were of different minds about the so-called literal interpretation of Genesis. See Clement of Alexandria, *Stromata* 6.16; Origen, *Contra Celsum*, Book 6.50, 60; St. Cyprian, *Treatise* 11.11.

²⁶For example, Russell et al., *Biology*, p. 440; Phelan, *What Is Life?*, p. 300-304, 336-37; Krogh, *Biology*, 285; Freeman et al., *Biological Science*, fifth edition, Appendix A:24; Shuster et al., *Biology for a Changing World*, p. 322-24.

²⁷We found that very few textbooks recognize that modern creationism (and intelligent design) hold that God (or a designer) is not limited to creating only at the taxonomic level of species (or lower). Better texts include, for example, Futuyma and Kirkpatrick, *Evolution*, which sometimes avoid this error (p. 578) and sometimes does not (p. 44). And, despite some inaccuracies, Ridley, *Evolution*, includes helpful nuances, esp. p. 43-70. See also the discussion below.

religious version of creationism would attribute the adaptiveness of living things to the genius of God.²⁸

In this passage, Ridley implies that, according to creationism, God created at the level of "species" (ostensibly equipping each species with necessary adaptations for their respective environments). In fact, for quite some time, many creationists, including even young-Earth creationists, have explicitly rejected the claim that God created exclusively at the species taxonomic level. In 1947, young-Earth creationist Frank Lewis Marsh noted, "On every occasion creationists will continue to make the matter very clear that the modern 'species' is not usually the same sort of group of organisms as is the Genesis kind."²⁹ In *The Genesis Flood*, the 1961 seminal text of modern creationism, John Whitcomb and Henry Morris claimed that God created "kinds," which they regard as a taxonomic level distinct from "species."³⁰ And in the present-day, Andrew Snelling's two volume work, *Earth's Catastrophic Past*, which is perhaps the most sustained defense of young-Earth creationism available, holds that Genesis kinds "may be identical with the genus or even the family."³¹ Moreover, Michael Behe, the most prominent scientist in the intelligent design movement in the past two decades, argues that *unaided* natural processes can account for some biological phenomena at the level of species and genera. In these cases, it is unnecessary to posit an intelligent cause.³²

The cases mentioned above are hardly unusual. As historian Ronald Numbers observes in his analysis of creationism and speciation, "By the 1970s, most of the leading special creationists had long since abandoned belief in the fixity of species and had embraced extensive—and extremely rapid—organic evolution within the originally cre-

²⁸Ridley, *Evolution*, p. 67, see also p. 263-64. N.B. Ridley uses the term "adaptiveness" rather than "adaptedness."

²⁹Frank Lewis Marsh, *Evolution, Creation, and Science*, second edition (Washington, D.C.: Review and Herald Publishing Association, 1947), 199; see also 197-98. More than a decade earlier Byron Nelson made a similar point. Byron C. Nelson, "After Its Kind": *The First and Last Word on Evolution*, fourth edition (Minneapolis, MN: Augsburg Publishing House, 1931), 18-25.

³⁰John C. Whitcomb and Henry M. Morris, *The Genesis Flood* (Phillipsburg, NJ: P & R Publishing, 1961), 66-69, especially 69.

³¹Andrew A. Snelling, *Earth's Catastrophic Past*, 2 vols. (Dallas, TX: Institute for Creation Research, 2010), vol. 1: 215. John Morris, son of creationist icon Henry Morris, and president emeritus of the Institute for Creation Research, regards Snelling's 1500-page work as the sequel to *The Genesis Flood*. See Morris, "Foreword," *Earth's Catastrophic Past*, vol. 1, ix-xi.

³²Michael J. Behe, *Darwin Devolves* (New York: HarperOne, 2019), esp. 141-70. While intelligent design theory itself does not identify the 'designer' as 'God' per se, biology textbooks generally hold that the theory (tacitly) posits a supernatural designer. Accordingly, in an effort to take these texts on their own terms, we will treat ID as a theology-laden theory.

ated 'kinds' mentioned in the first chapter of Genesis."³³ He further points out: "Despite the popular image of creationists being wedded to the fixity of species, no one argued for more rapid speciation by means of natural selection . . . [than] the creationists."³⁴ Whatever else may be the case, modern creationism (and intelligent design) do not restrict the creator's activity exclusively to the species-level.

A second and related concern now surfaces. In presenting the case for evolutionary theory, a number of texts seem to assume that arguments which favor evolution over nineteenth century special creation, as they construe it, likewise favor evolution over contemporary creationism or intelligent design.³⁵ But arguments that address a past foe are not always relevant to a present adversary. To be sure, *some* of the classic arguments obviously apply to the present context. For example, empirical data about the ancient age of Earth are highly relevant to assessing the plausibility of current versions of young-Earth creationism.³⁶ Nonetheless, many textbooks do not make clear how other arguments for the superiority of evolution over special creation also demonstrate evolution's superiority over key contemporary rivals, notably old-Earth creationism and intelligent design. Textbooks need not nuance every jot and tittle of creationism, of course. Yet all too often, textbook authors seem to assume that if creationists of yesteryear believed such-and-such, then creationists of today must as well. Yet in his preeminent study of creationism, Ronald Numbers observes that, even among relatively informed individuals, a "common assumption seems to be that one creationist is pretty much like another." But, as he says bluntly, "nothing could be further from the truth."³⁷

Stepping back, we have noted several instances of "straw god" theology in biology textbooks. This theology mischaracterizes rivals to evolution, such as special creation or young-Earth creationism, making them easier to knock down. Moreover, this mischaracterization is typically part of a line of reasoning that directly or indirectly supports evolutionary theory. Caricatured God-talk thus serves as

³³Ronald Numbers, "Ironic Heresy: How Young-Earth Creationists Came to Embrace Rapid Microevolution by Means of Natural Selection," *Darwinian Heresies*, eds. Abigail Lustig et al. (Cambridge, UK: Cambridge University Press), 84-100, see esp. 87.

³⁴Numbers, "Ironic Heresy," p. 100.

³⁵Fortunately, a few textbooks are better on this score. They include, for example, Futuyma and Kirkpatrick, *Evolution*, 573-84, 600, although see p. 44; Ridley, *Evolution*, p. 44, 67-69; Raven et al., *Biology*, p. 432-33. Curiously, the first edition of Zimmer and Emlen, *Evolution*, is better on this score than the second edition (see p. 320 of the first edition).

³⁶Further discussion about the "appearance of age" and "uniformitarianism" are relevant, of course.

³⁷Ronald L. Numbers, *The Creationists: From Scientific Creationism to Intelligent Design*, expanded edition (Cambridge, MA: Harvard University Press, 2006), 9.

part of the positive case for evolution.

2.2 Presumptive Theology

We now turn to a second type of theology, which we label "presumptive theology." This type includes highly confident statements about God's nature or ways. We regard these claims as "presumptive" not simply because of their level of certitude but *also* because they are typically asserted without any justification whatsoever. Over 60% of the textbooks we analyzed deployed this theology in some of their positive arguments for evolutionary theory.³⁸

Example 1

Several textbooks draw on presumptive theology as part of their positive case for common ancestry. For example, one textbook argues:

An engineer would never use the same underlying structure to design a grasping tool, a digging implement, a walking device, a propeller, and a wing. Instead, the structural homology exists because mammals evolved from the lungfish-like ancestor that had the same general arrangement of bones in its fins.³⁹

A few observations are in order. First, consider how an

³⁸Notably, the content and form of presumptive theology can vary widely from case to case. Sometimes it is articulated in rhetorical questions; other times it takes the form of tacit approval of Darwin's use of it in his own arguments for evolution; still other times, textbook authors appeal to what is "reasonable," and so forth. More generally, presumptive theology typically involves one or more of the following: (i) direct claims about God, a Creator, etc., (ii) claims about an engineer, designer, etc. in contexts in which the most likely referent is a divine engineer or designer, (iii) claims about what we would expect given a (particular) creationist or ID view, or (iv) claims about what we would expect had the phenomenon in question arose "from scratch" (or some other phrase that, in context, has creational overtones). Examples can be found in Russell et al., *Biology*, p. 440, more elliptically on p. 475; Simon, *Biology*, p. 161; Bergstrom and Dugatkin, *Evolution*, p. 115; Herron and Freeman, *Evolutionary Analysis*, p. 56, see also 98; Krogh, *Biology*, p. 293-95; Audesirk et al., *Biology*, p. 265-66, 270-71; Zimmer and Emlen, *Evolution*, p. 40; Mader and Windelspecht, *Essentials of Biology*, p. 248, elliptically; Barton et al., *Evolution*, p. 75, 81; Futuyma and Kirkpatrick, *Evolution*, p. 45: "... many features that no intelligent engineer would be expected to design"; Simon et al., *Campbell Essential Biology*, p. 250; Urry et al., *Campbell Biology*, p. 477-78, elliptically, but see p. 467-68 for context; Taylor et al., *Campbell Biology: Concepts and Connections*, p. 264, elliptically; Mason et al., *Understanding Biology*, p. 9-11, esp. 11; Mader, *Biology*, p. 277, elliptically; Raven et al., *Biology*, p. 9, 432-33, elliptically. A full list can be found in Figure 1.

³⁹Freeman et al., *Biological Science*, p. 442-43.

“engineer” is described. Such an individual would “never” use the same design plan as a basis for very different tools. The assumption in play is:

Under no circumstances would an engineer ever modify a single structure for an array of different functions.

A second observation relevant to the passage is that its broader context contends that homologous features count as evidence for common ancestry over creationism. For example, the opening paragraphs of the homology section, which frame the entire passage, state that “advocates of special creation... could not explain why striking similarities existed among certain organisms” whereas “common ancestry” can explain these similarities.⁴⁰ Likewise, the final paragraph of the section, which summarizes the overall point, says in full, “The theory of evolution by natural selection predicts that homologies will occur. If species were created independently of one another, as special creation claims, these types of similarities would not occur.”⁴¹ Accordingly, in this context, the claim about an “engineer” refers to a supernatural Creator. As such, the argument contains a theology-laden assumption:

If God designed different species with biological structures analogous to a grasping tool, a digging implement, a walking device, a propeller, and a wing, respectively, then he would *never* use the same underlying structure, modifying it specially for the particular needs (and limbs) of each new species.

A final observation, already implied, is that the passage makes a comparative argument. The data of “structural homology” are said to favor common ancestry over the divine engineer hypothesis. Stated a bit more precisely, the argument appears to be:

1. If evolutionary theory is true, then we would very much expect to find some mammals with the “same general arrangement of bones” in their appendages (due to their descent from a “lungfish-like ancestor”).
2. If God engineered different species with biological structures analogous to a grasping tool, a digging implement, a walking device, a propeller, and a wing, respectively, then he “would never use the same underlying structure,” modifying it specially for the particular needs (and limbs) of each new species.

⁴⁰Freeman et al., *Biological Science*, p. 441.

⁴¹Freeman et al., *Biological Science*, p. 443.

3. As a matter of fact, we have discovered that some mammals have the “same general arrangement of bones” (or “underlying structure”) in their appendages.
 4. If the evidence is very much expected on one hypothesis but totally unexpected on another, then the evidence strongly supports the former over the latter.
-
5. Thus, the fact that some mammals have the “same general arrangement of bones” (or “underlying structure”) in their appendages strongly supports evolutionary theory over the divine engineer hypothesis.

Premise two is crucial. It makes a claim about what a divine engineer would never do. Accordingly, the argument as a whole includes a substantive theological assertion. We will examine this assertion shortly. But first another example may be helpful.

Example 2

Some textbooks use subtler language but nonetheless marshal an argument with much the same level of confidence. *What is Life?*, for example, states the following:

Among adult animals, several features of anatomy reveal the ghost of evolution in action. Many related organisms show similarities that can be explained only through evolutionary relatedness. The forelimbs of mammals such as bats, porpoises, horses, and humans are used for a variety of very different functions (FIGURE 10-39). If each had been designed for the uses necessary to that species—flying, swimming, running, grasping—we would expect dramatically different designs. And yet, all of these species possess the same bones—modified extensively—revealing that they share a common ancestor.⁴²

This passage makes a claim about what a designer would do: “If each [mammalian forelimb] had been designed specifically for the uses necessary to that species... we would expect dramatically different designs.” On this view, a designer would make “dramatically different designs” rather than designs that are ‘somewhat different’ or even ‘notably different.’ Given that the surrounding context of the passage clearly points to a divine designer,⁴³ the argument rests on the following assumption:

⁴²Phelan, *What Is Life?*, p. 332-33. “FIGURE” refers to a drawing in the original text.

⁴³The text frames the rise and justification of Darwin’s theory in contrast to key creationist claims, inter alia. See Phelan, *What Is Life?*, p. 300-304, 336-37.

If God had designed each mammalian forelimb specifically for the uses necessary to its particular species, then he would have made dramatically different forelimb designs.

Notice that the author does not qualify this key assumption about a divine designer. Apparently, readers are to believe that, if God had directly designed each mammalian forelimb, He would always make dramatically different designs. At first glance, the argument seems less stalwart than our earlier example, yet closer inspection shows a familiar level of theological certitude.

Observations and Evaluation

We turn now to macro-level analysis of these cases. Each of the examples above functions as a crucial premise in a positive argument for evolution. These arguments vary in particulars but nonetheless follow a basic form:

1. If evolutionary theory is true, we would expect X.
2. If God directly designed each species (or limb, etc.), then we would “never” expect X.
3. We have found X.
4. If the evidence is very much expected on one hypothesis but highly unexpected on another, then the evidence strongly supports the former over the latter.
5. Thus, X strongly supports evolutionary theory over the hypothesis that God directly designed each species (or limb, etc.).

Premise two is of keen interest. In the examples analyzed above, premise two took various forms, depending on a given textbook's specific language. Yet the general idea in both cases is that God would not do such-and-such—in this case, the deity would not use a common template to fashion new appendages for new species.

A few observations are in order. Although our observations will focus on the two cases in question, these observations apply to cases of presumptive theology in other textbooks as well.⁴⁴ First, in whatever form, premise two is crucial for the argument. If it is removed, the argument is logically invalid, and the conclusion no longer follows. For the pro-evolution argument to be successful, premise two has to be present and justified.

⁴⁴As Figure 1 makes clear, 20 out of 32 textbooks contain presumptive theology.

Second, the argument is part of the positive case for evolutionary theory. It is not simply a critique of contemporary creationism (or intelligent design). Instead, as the conclusion makes clear, the whole point of the argument is to show that evolution better explains the empirical data.

Third, as far as we can tell, premise two is not entailed, or made probable, by young-Earth creationism or intelligent design, for example. In particular, nothing in these views holds that God (or a designer) would never use a template for multiple designs. In fact this very notion has been challenged by creationists as far back as the 1930s.⁴⁵ Intelligent design theorists have likewise openly disputed this claim since the early years of the movement.⁴⁶ The upshot is that textbook authors have not accurately represented contemporary creationist or intelligent design tenets and shown that these tenets conflict with the empirical data.

Instead, textbook authors have brought their *own* claims to the table, including their own partisan God-talk. They presuppose that God would create brand new bone structures, never drawing on a common template. As philosopher Paul Nelson observes in a similar context, their underlying assumption is that “[i]f the creator is free to do as he pleases, the appearance of [a] plan can become the appearance of limitation or constraint, suggesting an unimaginative or even slavish repetition of structures along some predetermined pattern.”⁴⁷ These textbook authors assume that the “apparent uniformity of certain biological patterns is inconsistent with the freedom of a creator to act as he wishes.”⁴⁸ On this view, the deity's free will necessitates originality. The Almighty loves novelty.

But textbook authors overwhelmingly fail to provide justification for their sectarian theology. They do not cite any sources, whether secular or religious. Instead, their partisan claims function as brute assertions unaccompanied by evidence, reason, or argument. Just where one would ex-

⁴⁵Byron Nelson actually made this a pivotal element in his challenge to evolutionary theory. See Nelson, “*After Its Kind*,” 37-51, 61-68. In the 1940s, Frank Lewis Marsh raised the matter with Theodosius Dobzhansky in *The Dobzhansky-Marsh Correspondence, 1944-1945*, p. 42-43.

⁴⁶Nelson, “The Role of Theology,” 493-517. Phillip E. Johnson, *Defeating Darwinism* (Downers Grove, IL: InterVarsity Press, 1997), 62-64, 73-75, 80, 114. This point has been raised in more recent publications as well: Jonathan Wells, *Icons of Evolution* (Washington, D.C.: Regnery Publishing, 2000), 67-70, 281. Paul Nelson and Jonathan Wells, “Homology in Biology: Problem for Naturalistic Science and Prospect for Intelligent Design,” *Darwinism, Design, and Public Education*, John Angus Campbell and Stephen C. Meyer, eds. (East Lansing, MI: Michigan State University Press, 2003), 303-22. Winston Ewert, “The dependency graph of life,” *BIO-Complexity*, vol. 3 (2018): 1-27, doi:10.5048/BIO-C.2018.3.

⁴⁷Nelson, “The Role of Theology,” p. 511, emphasis altered.

⁴⁸Nelson, “The Role of Theology,” p. 511; cf. Lustig, “Natural Atheology,” p. 75-76.

pect textbooks to give good grounds—after all, arguments for evolution are central to modern biology—these texts instead offer precisely nothing.

Fourth, as far as we can tell, religious students in general are not rationally obligated to accept the theology in question. While we are surely not experts in world religions, these partisan theological claims do not appear to be entailed, or made probable, by any of the Abrahamic traditions. Moreover, they do not appear to be entailed, or made probable, by a number of other serious religious views, including process theism, henotheism, polytheism, religious pluralism, Confucianism, religious Taoism, Theravada Buddhism, Mahayana Buddhism, and Nirguna Brahman-oriented Hinduism. This is not to say that a reader who adheres to one of these views cannot accept the theological claims in question. Rather, it's only to say that, as far as we can tell, a given religious reader is entirely free to reject these textbooks' partisan theological claims, all things being equal.⁴⁹

Moreover, atheist or agnostic readers are not rationally obligated to accept the theology in question either. Of course, a given atheist or agnostic reader could in principle accept the counterfactual 'were a god with certain properties to exist, he would never use a common template.' But the fact that this assertion might fit within a given atheist's or agnostic's worldview is beside the point. Instead, the central matter is that, all things being equal, there is nothing about the content or justification of atheism or agnosticism per se that rationally mandates acceptance of this counterfactual. As with religious readers, non-believers can regard textbooks' partisan theology as entirely optional. They can take it or leave it.

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Let us pause briefly to consider the ramifications of our analysis. In each case above, presumptive theology was brought to bear in an argument for evolution. While presumptive theology is not limited to any particular type of argument for evolution, the two examples given are both versions of the homology argument. This is no small matter. The homology argument is widely regarded as one of the best arguments for evolutionary theory.

Of course, not all versions of the homology argument draw upon God-talk. Nonetheless, some clearly do. Our concern

⁴⁹If we consider a believer of a particular religious tradition *qua* believer in *that* particular tradition, then, all things being equal, she is epistemically justified in rejecting the presumptive theology in question either because (i) her tradition does not conceive of divine action in this manner or (ii) her tradition does not require its adherents to accept the claim that, were a monotheistic God to exist, he would "never" use a common design, or the like.

is with these versions, particularly those that depend upon "presumptive" theology—strident assertions about the divine unaccompanied by any justification. They highlight, once again, problems that arise when God-talk is present in biology textbooks.

2.3 Indeterminate Theology

Is there another way forward? One possibility is to opt for statements that are more circumspect. "Indeterminate theology," as we call it, achieves this goal. This theology claims that God *can* create in various ways without specifying that he definitely *would* have created in a specific way.⁵⁰ Twenty-five percent of the textbooks on our list contain indeterminate theology.⁵¹ We analyze two examples below.

Example 1

In a section on the evidence for evolution, the authors of *Biology* argue:

An excellent example of an imperfect design is the eye of vertebrate animals, in which the photoreceptors face backward toward the wall of the eye. . . . As a result, the nerve fibers extend not backward, toward the brain, but forward into the eye chamber, where they slightly obstruct light. Moreover, these fibers bundle together to form the optic nerve, which exits through a hole at the back of the eye, creating a blind spot.

By contrast, the eye of mollusks [*sic*]—such as squid and octopuses—are more optimally de-

⁵⁰For stylistic reasons, we sometimes employ the pronoun "he" when referring to "God." Of course, our argument does not hinge upon thinking of God in masculine terms as opposed to feminine or neuter terms.

⁵¹In total 8 textbooks include indeterminate theology, which typically involves one or more of the following: (i) direct claims about God, a Creator, etc., (ii) claims about an engineer, designer, etc. in contexts in which the most likely referent is a divine engineer or designer, (iii) claims about what we might expect given a (particular) creationist or ID view, or (iv) claims about what we might expect had the phenomenon in question arose "from scratch" (or some other phrase that, in context, has creational overtones). See Figure 1 for a full list. Note that some texts are less clearly theological than others: Mason et al., *Understanding Biology*, p. 442, for context see p. 9-11, 446-47, 451; Morris, *How Life Works*, 393; Sadava et al., *Life*, p. 420, 443; Hillis et al., *Principles of Life*, p. 291; Krogh, *Biology*, p. 8 uses indeterminate theology, or something like it, to argue that certain appeals to an "intelligent designer" fall outside of science. In addition, a few examples surfaced in earlier editions of the textbooks on our list, notably, Audesirk et al., tenth edition, *Biology*, p. 273; Futuyma, *Evolution*, third edition, p. 639: "... a thoughtful designer could arrange."

signed: The photoreceptors face forward, and the nerve fibers exit at the back, neither obstructing light nor creating a blind spot. . . .

Such examples illustrate that natural selection is like a tinkerer, working with whatever material is available to craft a workable solution, rather than like an engineer, who can design and build the best possible structure for a given task. Workable, but imperfect, structures such as the vertebrate eye are an expected outcome of evolution by natural selection.⁵²

A few observations are in order. First, the authors write that an engineer “can” design and build the best possible structure for a given task. Notice that the language of “can” does not say that it is *likely* an engineer would do so. Instead, this passage only comments on what an engineer is capable of doing. An engineer is able to do X; he is free to do X. This is a claim about possibility, not probability.

Second, the broader context clearly indicates that this passage is part of the authors’ justification for evolutionary theory over and against creationism and intelligent design.⁵³ As such, the authors’ claim about an engineer is meant to apply to a divine Creator.⁵⁴ So, given that the argument quoted above focuses on the eye of vertebrate animals, a key claim of this argument is:

God “can design and build the best possible” eye for vertebrate animals.

Or, to put the matter in a conditional statement:

If God were to create the vertebrate eye, then he “can design and build the best possible” eye for vertebrate animals.

Or, equivalently:

If God were to create the vertebrate eye, then *perhaps* he would “design and build the best possible” eye for vertebrate animals.

The language of ‘perhaps’ captures the provisional nature of the statement that God “can” do such-and-such as opposed to the assertion that he *would* do such-and-such. God’s actions are ‘indeterminate,’ as we say, given that the statement (and argument) in question only asserts what God is able to do rather than what he would definitely do or probably do.

We will explore this claim, and the argument it serves, in due course. But first we turn to another example.

Example 2

In a summary of “The Evidence for Evolution,” another textbook gives empirical arguments that common ancestry is superior to “the alternative hypothesis,” which holds “that species have been individually created by a supernatural being.”⁵⁵ Among these arguments is the famed homology argument, which, in this case, draws on indeterminate theology from a different angle:

Similarity of structure despite differences in function follows from the hypothesis that the characteristics of organisms have been modified from the characteristics of their ancestors, but it is hard to reconcile with the hypothesis of intelligent design. Design does not require that the same bony elements form the frame of the hands of primates, the digging forelimbs of moles, the wings of bats, birds, and pterosaurs, and the flippers of whales and penguins.⁵⁶

In this passage, the authors give a clear argument that a similar bone structure in various limbs counts as evidence in favor of common ancestry over intelligent design. That is, ‘similarity’ is a natural prediction of the common ancestry hypothesis—it “follows from” descent with modification.

⁵²Raven et al., *Biology*, p. 428-29.

⁵³On the next page, the authors state: “It is difficult to understand vestigial structures such as these as anything other than evolutionary relicts, holdovers from the past” (Raven et al., *Biology*, p. 430). Two pages later, they drive home their message: “inefficiencies of certain designs, such as the vertebrate eye and the existence of vestigial structures, do not support the idea of an intelligent designer” (p. 432-433). Clearly, the authors argue that the data of inefficient or imperfect structures, like the vertebrate eye, count as evidence for evolutionary theory over intelligent design. Moreover, in the opening pages of the textbook, the authors indicate that a perennial rival to evolutionary theory is creationism: “In Darwin’s time, most people believed that the different kinds of organisms and their individual structures resulted from direct actions of a Creator (many people still believe this)” (p. 8). The next several pages reinforce the notion that creationism is a key opponent of evolution (p. 9-12).

⁵⁴Presumably, their claim applies to non-divine higher intelligences as well. In fact, their claim apparently applies to any intelligent being who is capable of creating an eye and who knows the principles of engineering (at least as the authors understand these principles). So, while their claim about “an engineer” applies to more than just God, it does not apply to less.

⁵⁵Futuyma and Kirkpatrick, *Evolution*, p. 44.

⁵⁶Futuyma and Kirkpatrick, *Evolution*, p. 44.

By contrast, design “does not require” similar structural elements.

Three elements are worthy of our attention. First, in a recent article, Warren Allmon and Robert Ross regard this argument as the “most compelling argument for interpreting homologous similarities as evidence of evolution.”⁵⁷ In our view, Allmon and Ross’s conclusion is especially notable because it arises from a thoughtful and fair-minded analysis of various attempts to render the homology argument in its strongest and most accessible form. If they are correct, then any flaws in this version of the homology argument are particularly significant.

Second, this homology argument hinges upon God-talk. The reference to “intelligent design” in the main passage above is, for the authors, an implied reference to a supernatural hypothesis. In the opening paragraph of the passage, which frames how the homology argument is to be understood, the authors compare common ancestry to “the alternative hypothesis”—namely, that “species have been individually created by a supernatural being.”⁵⁸ Elsewhere in the text, intelligent design is likewise characterized as creationism in “camouflage.”⁵⁹ So, a creationist deity is in the picture.

Third, the authors’ portrayal of this creationist hypothesis is quite provocative. The authors do not say that, on the God hypothesis, similarity is ‘unexpected’ or ‘improbable’ or ‘surprising.’ Instead they claim that this hypothesis “does not require” similarity. In other words, God does not have to use a common design plan; he is capable of creating each species (and each concomitant limb) *de novo*, in which the limbs of every species have a unique underlying bone structure. That is, the Almighty *can* create different structures each time. He is not required to reuse a similar pattern. So the argument depends upon a crucial assumption:

If God created each species individually, then he was not required to use a common design pattern from which to fashion the limbs of different species.

This is another way of saying:

If God created each species individually, then he

⁵⁷Warren D. Allmon and Robert M. Ross, “Evolutionary remnants as widely accessible evidence for evolution,” *Evo. Edu. Outreach*, vol. 11, no. 1 (2018), p. 9. See the discussion on p. 8 as well. (doi.org/10.1186/s12052-017-0075-1.)

⁵⁸Futuyma and Kirkpatrick, *Evolution*, p. 44.

⁵⁹Futuyma and Kirkpatrick, *Evolution*, p. 578.

can create unique bone structures for limbs of different species.

Once again, we have the language of possibility. God is not required to do such-and-such; he is free to do the opposite. As we have seen, this idea can be expressed in the statement:

If God created each species individually, then *perhaps* he would create unique bone structures for limbs of different species.

This is indeterminate theology from another angle.

Observations and Evaluation

While each argument above has its particular focus, pro-evolution arguments that draw on indeterminate theology generally have the same basic structure:

1. If evolutionary theory is true, then X is highly expected (or virtually inevitable).
2. If God directly created each species (or organ, etc.), then *perhaps* he would create not-X.
3. X is true.
4. If X is highly expected (or virtually inevitable) on one hypothesis, but not-X is possible on another hypothesis, then X strongly supports the former over the latter.

5. Thus, X strongly supports evolutionary theory over the hypothesis that God directly created each species (or organ, etc.).

In our view, premise two makes a rather modest claim that it is *possible* for God to create not-X. Both in general and in biology textbooks, the term “God” typically refers to a Being who is omnipotent. Even in cases in which texts mention a generic “supernatural being,” rather than the God of monotheism per se, it is generally understood that a deity of this sort has the ability to do quite a lot. One of the perks of divinity, we gather, is having a fair bit of power at hand.

So, the claims that, for example, ‘God *can* design and build the best possible eye for vertebrate animals’ or that ‘he *can* create dissimilarity rather than similarity’ are trivialities. They involve nothing contrary to God’s powerful nature and they do not express or entail a logical contradiction.

These statements are true, but only in the most uninformative way, like saying that a normal human is capable of blinking. Unremarkably, premise two passes muster.

At this point, however, a critic might worry that our assessment has been unfair. He might say that our interpretation of “can” is too literal. When textbook authors state that God “can” do such-and-such, they really mean that God “would” do such-and-such. In this sense, indeterminate theology is actually just poorly articulated presumptive theology.⁶⁰

By way of reply: in our view, it is better to give textbook authors the benefit of the doubt by taking seriously what they actually say rather than to speculate about what they allegedly intend to say. Competent users of the English language know the difference between “can” and “would.” They also know that the former does not imply the latter: if a free agent has the ability to do X, it simply does not follow that they will do X. (Most adults in the United States have the ability to vote Libertarian in every election, for example, yet that hardly means they will.) So, we plainly disagree with the objection. But even if we are wrong—that is, even if indeterminate theology collapses into presumptive theology—then the only thing that follows is that there are even more cases of presumptive theology than we had previously counted. And these cases are plagued by all the problems that accompany this type of theology. So, deep difficulties remain. Thus, our broader argument about the problematic presence of theology continues unabated.

In any case, for now let us suppose we are correct that indeterminate theology is a genuine means by which some textbook authors argue in favor of evolution. As noted, we analyzed premise two of this type of argument above. It passed inspection. Unfortunately, premise four does not. Recall the premise:

If X is highly expected (or virtually inevitable) on one hypothesis, but not-X is possible on another hypothesis, then X strongly supports the former over the latter.

To see why this premise is false, imagine that we have evidence E and two hypotheses, H_1 and H_2 , which are competing accounts of E. Suppose further that H_1 predicts E to a very high degree, so much so that the denial of E is unthinkable. Suppose also that H_2 predicts E to a very high degree as well, yet the denial of E is logically possible given H_2 . If we discover E, this evidence barely favors H_1

⁶⁰Alternatively, a critic might say that authors don't necessarily have in mind what God “would” do, but perhaps only what he would “probably” do. We address this idea in Section 3 below.

and H_2 , if at all. It's virtually a dead heat. This means that premise four is false. When applied to this scenario, premise four mandates that E would “strongly support” H_1 over H_2 . But E does no such thing. It favors H_1 by just a whisker. As a result, premise four is flawed. It articulates (or entails) an epistemic principle that falls prey to a clear counterexample.

A colorful example may help illustrate this point. Suppose two scientists, Kopp and Schoss, each champion their own new theory in physics, respectively. These theories are in competition to explain a new datum. Kopp's theory, let us say, is deterministic. And, much to Kopp's delight, it predicts the datum to a very high degree. In fact, given the deterministic nature of Kopp's theory, as well as other relevant factors, it is unthinkable that his theory would not predict the datum. So, given Kopp's theory, the datum has a probability of 1, let us say. By contrast, Schoss's theory is indeterministic in a narrow sense; it allows the slimmest possibility of indeterminate events in certain conditions on the rarest of occasions. Schoss's theory also happens to predict the datum to a very high degree, in this case to a probability of .99. So which theory does the datum favor? The answer is that it barely favors Kopp's theory over Schoss's theory.⁶¹ The former predicts the datum with certainty; the latter almost to the same degree. Clearly, it would be flatly wrong to conclude that the datum “strongly supports” Kopp's theory over Schoss's theory. Instead, it's nearly a dead heat.⁶²

The upshot is that premise four is false. And this is significant because premise four, or something like it, is required for the logical validity of the argument. If the premise (or its near equivalent) were removed, then the conclusion would no longer follow from the remaining premises. So, removal of premise four destroys the argument. On the other hand, keeping the premise saddles the argument with a false claim. This renders the argument as a whole unsound. Thus, whether premise four is retained or jettisoned, the argument has fallen short.⁶³

Of course, it is possible to modify premise four in order to make it passable. An improved version would have to say something like: data strongly favor one hypothe-

⁶¹Likelihoods, or something like them, are in play here: empirical data D favor competing hypothesis H_1 over hypothesis H_2 if and only if $Pr(D|H_1) > Pr(D|H_2)$.

⁶²In fact, this example is overly sympathetic to premise four. Schoss's theory allows the *physical* possibility of the denial of the datum, whereas premise four only allows the *logical* possibility of not-X. Premise four has an even greater burden to bear.

⁶³Of course, one can salvage premise four by getting rid of the “strongly supports” language and, instead, opting for “barely supports.” However, doing so means that the biological data barely support evolution over creationism. But this runs emphatically contrary to textbook presentations of “the evidence for evolution.”

sis over another just in case the data are expected on one but not the other. That is, the data formidably support one over the other (only) if there is a clear contrast in expectations between the two hypotheses. Unfortunately, this is where indeterminate theology rears its head. Under its mantle, premise two neither expects nor prohibits the data. It merely states what God would *perhaps* do. But without a clear expectation, textbooks cannot make a contrastive claim that one hypothesis definitely expects the data *more* than the other does. Thus, indeterminate theology in premise two undercuts precisely the requirement needed for a persuasive version of premise four. If an improved version of premise four is to succeed, textbooks must compare clear expectations of each hypothesis. But if they cannot form a clear expectation of the God hypothesis, then they cannot compare it to the expectations of an evolutionary hypothesis. As such, they cannot say that data favor the expectations of the latter over the former. As a result, they cannot claim that the evidence supports evolutionary theory over the God hypothesis. The argument as a whole fails, and indeterminate theology strikes the fatal blow. Thus, even with a defensible version of premise four, the argument remains unsalvageable.⁶⁴

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Let us pause for a moment to summarize our argument. Recall that, in the previous section, we analyzed “presumptive theology.” This approach makes unsupported assertions about what God would do or would not do—for example, God would “never” use a common design plan for different limbs in various species. Claims like this are bold, especially when unaccompanied by any justification. The natural corrective to this combination of high confidence and low justification is a bit more circumspection about God’s purported actions. A humbler approach is to note that God “can” do such-and-such, rather than to assert that he must do such-and-such. Yet, as we have seen, the language of “can” has problems of its own.

In fact, difficulties plague both approaches. Presumptive theology (coupled, as it is, with no justification) constrains a divine being’s actions too severely and so devolves into dogmatic certitude. By contrast, indeterminate theology

⁶⁴For more on the testability of God hypotheses with respect to evolutionary hypotheses, see Elliott Sober, *Evidence and Evolution* (Cambridge, UK: Cambridge University Press, 2008), 109-88; Elliott Sober, *Did Darwin Write the Origin Backwards?* (Amherst, NY: Prometheus Books, 2011), 121-54. Replies to Sober include Daniel Lim, “A Critique of Elliott Sober’s Goals and Abilities Objection to the Design Argument” Science and Religion: Historical and Contemporary Perspectives conference, Lancaster University, July 2007; Dillery, “How to Lose a Battleship,” 621-23. See also our discussion of the contrastive nature of scientific testing in Section 4 below.

does not constrain God’s actions at all and so never rises above triviality. Troubles abound either way.

3 The Problematic Presence of Theology—General Concerns

In this section, we extend our argument by turning to general reflections, rather than concrete cases, about the presence of theology in evidence-for-evolution sections of biology textbooks. To drive home our argument, we will first address three key objections.

First, a critic might point out that, even with our examples of straw god, presumptive, and indeterminate theologies, it still does not follow that God-talk *in general* is problematic in biology textbooks. Even if there are some rotten apples in the barrel, others may still be just fine. Can’t offending authors just clean up their sloppy theological language and get on with it?

Second, a critic might contend that authors can avoid our concerns by casting theology aside or by making more defensible theological claims. (We will address the suggestion about setting theology aside in a later section.) Otherwise, the path forward is for authors to give a defense of what God would *probably* do, rather than on what he definitely ‘would’ do or merely ‘could’ do. The focus on God’s probable actions, coupled with solid justification, is a mean between the extremes of triviality and dogma. It allows God-talk into the discussion in a defensible way.

Third, an alternative way forward is for textbook authors to ask, ‘What do various versions of creationism claim that God would probably do?’ This question is even more tractable than the question of what God would probably do. To answer this question, biologists do not have to moonlight as theologians; they need not plumb the heavens, nor discern things eternal and unseen. Instead, they only need to know what their creationist *rivals* claim about God.

In sum, the objections hold that (i) the ‘problem’ of theology in biology textbooks is merely a matter of sloppy language, (ii) this sloppiness can be dispensed with by focusing on what God would probably do, or (iii), more modestly, by focusing on what various creationists say God would probably do. Taken collectively, these three objections attempt to refute our overall contention that the presence of theology in biology textbooks is worrisome.

By way of reply: there is much to be said on this score. An initial note, mentioned earlier, is that we are not opposed in

principle to the presence of God-talk in biology textbooks. We personally think that this approach has some merit. But in what follows below, we argue that the presence of theology comes at a significant cost, one that quite a few textbook authors are likely unwilling to pay.

3.1 Rhetorical and Practical Concerns

We begin with objection three. It holds that textbook authors ought to focus on what creationists themselves say God probably would or would not do. We make two points in reply. First, a number of biologists are concerned that direct engagement with contemporary versions of creationism (or intelligent design) may give students the faulty impression that these hypotheses are legitimate contenders to evolutionary theory. Students may mistakenly come to think that these views are worthy of serious consideration. By analogy, would it be okay to give astronomy students the impression that astrology is a real contender to modern astronomy? To engage in any such discussion in a detailed way would be to give astrology too much credit. As far as we can tell, some textbook authors think the same concern applies to creationism.⁶⁵

Second, on a more practical level, textbook authors have the laborious task of deciding just what versions of creationism (or intelligent design) they wish to engage. What complicates matters is that not all versions are the same. Different versions make use of a differing array of conceptual content, explanatory resources, auxiliary hypotheses, and predictions. Some accept universal common ancestry, others more limited ancestry; some accept a global deluge, others see the flood as local; some accept an old Earth, others are satisfied with a young one; some place great stock in the power of selection and mutation, others accept a much more limited view of natural causation. And so on. At a minimum, wading through these differences requires a fair amount of study. This is especially true given that particular arguments for evolutionary theory conflict with some, but not all, versions of creationism. If textbook authors include God-talk (or, more modestly, if they acknowledge that some scientific facts logically imply the falsity of certain creationist claims), they should be clear on just *which*

⁶⁵This may explain why some authors tamp down their treatment of creationism (or of related metaphysical matters) in more recent editions of their textbooks. The apparent strategy is to delegitimize creationism or ID by giving them less air time. For example, see the differences between Zimmer and Emlen, *Evolution*, first edition, p. 40, 42, 44, 318, 320 versus parallel passages in the second edition; Miller & Levine *Biology* (2010) versus their earlier work, Kenneth Miller and Joseph Levine, *Biology: The Living Science* (Lexington, MA: D.C. Heath & Co., 1994), 148-61, esp. p. 161; and, less so, Futuyma, *Evolution*, third edition, p. 631-47 versus Futuyma and Kirkpatrick, *Evolution*, fourth edition, p. 573-84.

arguments (or facts) impinge on *which* versions of creationism. Yet from a practical point of view, one might protest that many textbook authors have neither the time nor interest to do so. That is precisely our point. The frequency of “straw god” theology, for example, highlights this concern in a very tangible way. Practically speaking, it’s not at all clear (to us) that textbook authors are generally willing or able to carry out the task in a sufficiently nuanced manner.⁶⁶

3.2 A Legal Concern

At the high school level, court rulings about the Establishment Clause may add yet another layer of complexity to the issues raised in all three objections above. While our primary focus is on college instruction, it is worth mentioning that (public) high school biology textbooks must contend with legal precedents in *Epperson*, *McLean*, *Edwards*, *Kitzmiller*, and the like. It may be that some instances of God-talk in the case for evolution run up against these legal rulings.⁶⁷ If that is true, then legal barriers hamper any approach that wishes to draw on (or critique) certain theological propositions. It has been quipped that a competent lawyer armed with these cases could go a long way toward getting the *Origin of Species* banned from public high school biology classrooms. (Darwin included theological claims in his “one long argument” for evolution, as noted below.) Strikingly, the same might be said for parts of the evidence-for-evolution sections of current biology textbooks. Perhaps organizations like the National Center for Science Education ought to take up the cause.⁶⁸

3.3 An Epistemological Concern

Shifting ground now, recall objection 2 above. It held that authors can legitimately include theology in their arguments for evolution by giving some principled grounds for what God would ‘probably’ do in organic history. This move is a solid step beyond mere assertions about what God ‘would’ or ‘could’ do. In this case, authors are not borrowing creationists’ theological tenets (as per objection 3); instead, they are bringing their *own* theological claims to the table. So the question is, what is the justification for

⁶⁶As we noted earlier, textbook authors need not canvass *every* species of creationism or intelligent design. Nonetheless, in general we are not optimistic that authors will have the time or interest to cover even mainstream rivals in adequate detail.

⁶⁷See Luskin, “Zeal for Darwin’s House Consumes Them”; Luskin, “Darwin’s Poisoned Tree.”

⁶⁸For more on the NCSE and various legal cases, see their website: https://ncse.com/library?f%5B0%5D=taxonomy_vocabulary_14%3A289.

these authors' particular claims about God? Do they have any special insight concerning what the Almighty is likely to have done in organic history?

These questions become more poignant for authors who do not accept that God somehow planned or guided the evolutionary processes.⁶⁹ On this view, human beings are not the result of a divinely-ordained plan. More directly, humans were not created by God in order to know God (in some sense) but were produced by mindless natural forces, such as random mutation and natural selection, that simply enabled them to survive and reproduce on the African savannah. In fact, it may be the case that, given this view of evolution, it's very difficult to say that humans have the kind of cognitive equipment that is suitable to do counterfactual theology. Did we really evolve cognitive powers to know (a priori) true subjunctive theological claims about what an all-powerful, perfectly free deity would probably do at distant episodes in the ancient past? Of course, it's *possible* that our lineage evolved this ability. But is it *probable*? It's hard to say. And that's just the point.

Darwin concluded as much in his mature reflections. Late in life, when trying to reason about the existence of God, he drew himself up short: "But then arises a doubt—can the mind of man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animal, be trusted when it draws such grand conclusions?"⁷⁰ Elsewhere he lamented, "A dog might as well speculate on the mind of Newton."⁷¹ Darwin, of course, is not alone in this sentiment.⁷² On an unguided view of evolution, it is likely inscrutable or improbable that human beings can do such theology. If we don't have cognitive access to such claims, then we are not justified in using such claims in arguments for evolution. This means that, if a non-theistic version of evolutionary theory is correct, then theology-laden arguments for evolution are illegitimate. We have reached beyond our ken. So, pace objection 2, we have no legitimate grounds upon which to say, "God would probably do such-and-such" in organic history.

⁶⁹See the brief arguments along these lines in Dilley, "Charles Darwin's use of theology"; Dilley, "Nothing."

⁷⁰Charles Darwin, *The Autobiography of Charles Darwin 1809-1882*, ed. Nora Barlow (New York: W.W. Norton & Co., 1958), p. 92-93.

⁷¹Francis Darwin, *The Life and Letters of Charles Darwin* (London: John Murray, 1887), vol. 2, p. 312. Darwin does not say in this letter that his theological muddle arose because of his theory of evolution. That connection became explicit later in his autobiography.

⁷²Patricia Churchland, "Epistemology in the Age of Neuroscience," *Journal of Philosophy*, vol. 84, no. 10 (1987): 544-53; Michael Ruse, "Belief in God in a Darwinian Age," *The Cambridge Companion to Darwin*, J. Hodge and G. Radick, eds. (New York: Cambridge University Press, 2003): 368-92. See also Thomas M. Crisp, "On Naturalistic Metaphysics," *The Blackwell Companion to Naturalism*, Kelly James Clark, ed. (Hoboken, NJ: John Wiley & Sons, Inc., 2016), 61-74.

Our deeper concern, of course, is not just with objection 2. Instead, our epistemological worry casts doubt on an array of theology-laden arguments for evolution. Whenever textbook authors bring their *own* partisan theology to bear—whether straw god, presumptive, or something else entirely—they run the risk of relying on unjustified premises. If unguided evolution is true, these arguments fail. (Recall that over 60% of the textbooks on our list use presumptive theology. That percentage increases when we consider other types of God-talk.) Even more pressing, *any* textbook that uses its own partisan theology falls prey to the same dynamic. In a profound way, unguided evolution erodes some of its own foundation. For those of this ilk, the presence of theology is indeed problematic.

3.4 A 'Science and Religion' Concern

Another significant cost arises when we consider two widely-known models of the relationship between science and religion. Both models posit something of a 'separation' between science and religion; this creates problems for all three objections above. The first model, Stephen Jay Gould's "non-overlapping magisteria" (NOMA), posits that science and religion "do not overlap."⁷³ Science "covers the empirical realm" whereas religion "extends over questions of ultimate meaning and moral value."⁷⁴ A second model, complementarity, holds that science and religion can overlap in the sense of studying the same phenomena, but do so at complementary levels. Given that science and religion always function at different levels, they maintain a principled level of separation.⁷⁵ Collectively, these two models hold (or imply) that (i) the propositional content of theology cannot affect the epistemic justification of a given scientific hypothesis or theory. That is, theology can't be used as evidence for or against scientific claims. (ii) Likewise, scientific theories and evidence cannot impact the epistemic justification of any religious belief. That is, scientific claims cannot support or refute religious claims. And, (iii) theological claims cannot function as premises in a scientific argument. Theology must remain separate from science. What man has cast asunder, let no one join together.

Yet two problems arise. First, if either of these models is correct, then all theology-laden arguments for evolution no longer belong in biology textbooks—particularly in sections that give the scientific "evidence for evolution." Claims about 'what God would probably do' (whether from cre-

⁷³Stephen Jay Gould, *Rocks of Ages: Science and Religion in the Fullness of Life* (New York: Ballantine Books, 1999).

⁷⁴Gould, *Rocks of Ages*, 6.

⁷⁵For example, Denis R. Alexander's brief, "Models for Relating Science and Religion," Faraday Report No. 3 (Cambridge, UK: Faraday Institute for Science and Religion), 4.

ationists or others) have no relevance to scientific justifications for evolution. As such, a lot of textbooks on our list ought to eschew some of their own arguments.⁷⁶

Second, if either model is correct, then scientific evidence is powerless to critique creationism (given that it is a theology-laden hypothesis). It is also powerless to favor evolution over creationism. Phenomena like anatomical similarities, vestigial organs, pseudogenes, and nested hierarchies, have nothing to say about the plausibility of evolution over creationism; nor do they even touch creationism. We will return to these crucial problems later. For now, the point is that, under NOMA or complementarity, textbooks cannot use scientific evidence against creationism nor can they use theology as evidence for evolution. The cost of separation is high: by sequestering God, one limits the reach of science.

3.5 Methodological Concerns

One last problem remains for all three objections.⁷⁷ By some lights, the presence of theological claims as part of arguments for evolution run contrary to the scientific method itself. To see why, consider that vast numbers of scientists accept “methodological naturalism” as an essential feature of science.⁷⁸ Methodological naturalism is roughly the idea that scientific explanation, argument, testing, research, and articulation should invoke *only* natural laws, processes, or

⁷⁶See the “Separation/HM” column of Figure 1.

⁷⁷The argument that follows has been developed in Dilley, “How to Lose a Battleship.”

⁷⁸For example, Eugenie Scott, *Evolution vs. Creationism* (Berkeley, CA: University of California Press, 2004), xi, 3, 50–51, 249–54; Francis Collins, *The Language of God* (New York: The Free Press, 2006), 165–166; Robert O'Connor, “Science on Trial: Exploring the Rationality of Methodological Naturalism,” *Perspectives on Science and Christian Faith* 49 (March 1997): 15–30; Darrel Falk, *Coming to Peace with Science* (Downers Grove, IL: InterVarsity Press, 2004), 39; Kathryn Applegate, “A Defense of Methodological Naturalism” *PSCF* 65, no 1 (March 2013): 37–45; Keith B. Miller, “An Evolving Creation: Oxymoron or Fruitful Insight?” *Perspectives on Evolving Creation*, ed. Keith B. Miller (Grand Rapids, MI: Eerdmans, 2003), 7; Conor Cunningham, *Darwin's Pious Idea* (Grand Rapids, MI: Eerdmans, 2010), 265; Denis Alexander, *Creation or Evolution: Do We Have to Choose?*, rev. and expanded ed. (Grand Rapids, MI: Monarch, 2014), 216–218; Holmes Rolston III, Denis Alexander, Jeff Schloss et al., “The Concept of ‘Intelligent Design,’” *The International Society for Science and Religion*, 2011, accessed March 28, 2017, <http://www.issr.org.uk/issr-statements/concept-intelligent-design/>; Kenneth Miller, *Finding Darwin's God* (New York: HarperCollins, 1999), 167–169, 218–219, 239–243; and Miller, *Only a Theory* (New York, Viking, 2008), 185–187; Ian Barbour, “Science and Scientism in *Why Religion Matters*,” ed. Huston Smith, *Zygon* 36, no. 2 (June 2001): 207–214, esp. 209–210; Richard T. Wright, *Biology through the Eyes of Faith*, rev. and updated ed. (New York: HarperCollins, 2003), 31–51, 74–75; Karl Giberson, *Saving Darwin* (New York: HarperCollins, 2008), 159–160.

entities rather than supernatural agents, entities, or processes.⁷⁹ While religious ideas may be a source of scientific inspiration for some scientists, scientific discourse *itself* should not use any religious ideas or language. This directly implies that scientific arguments for evolution should not use theology-laden claims. God-talk is not permissible as a premise in any scientific argument for evolution. It is a violation of the scientific method, therefore, to use premises such as ‘God would do X’ or ‘God can do X’ or ‘God would probably do X’ or the like. Theology may be legitimate in its own domain, and it may even overlap with objects or processes studied by science, but theological claims are not appropriate *within* scientific research and discourse proper.

The problem, of course, is that, if methodological naturalism is a necessary feature of modern science (or of the modern scientific method), as many believe, then *any* theology-laden argument for evolution automatically falls outside the bounds of science. They are beyond the pale. This is true across the board, from ‘good’ theology to ‘bad’ theology. A given theological claim may be plausible or implausible; it may be well-defined or nebulous; it may have long-standing precedent in an ancient tradition or may be brand new from HarperCollins. It doesn't matter. Any appeal to supernatural agents, entities, or processes is banned *in toto*. This means that all of the theology-laden arguments discussed in this paper—as well as others discussed elsewhere—have no place in scientific discourse and research. Pretty clearly, if methodological naturalism is canonical, then all God-talk ought to be excluded from biology textbooks' scientific case for evolution. Otherwise, the case for evolution runs counter to the scientific method itself. And that is no small thing.

Just as troubling, if methodological naturalism is canonical, it also means that, within the context of science, empirical evidence cannot refute any theology-laden hypothesis or theory. Given that theology is barred from scientific discourse, it cannot enter into this discourse long enough to be tested and falsified. As with NOMA and complementarity, methodological naturalism mandates that evidence of molecular sequences, biogeographical distribution, embryological similarity, and the like can *never* count as scientific evidence against any God-based claim, no matter what these data are. This, too, is problematic: science effectively loses its straightforward implications.

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⁷⁹The definition given is known as intrinsic methodological naturalism. Another, more mild version is so-called provisional methodological naturalism. For reasons why provisional methodological naturalism fails, see Dilley, “How to Lose a Battleship,” 620–21.

Stepping back for a moment, it is important to note that the power and relevancy of the problems explored above vary depending upon what a given textbook says or, more generally, what a given textbook author (or authors) take to be important. For example, an author who is not committed to methodological naturalism would avoid some of the problems above. As such, our list of concerns is not meant as a ‘one size fits all’ critique of *every* textbook on our list. Instead, it is a general tour of the problems that require reckoning. And, as we observe in Figure 1 and in our footnotes, a number of these problems apply in spades to many textbooks we have studied.

Recall now the three objections raised at the beginning of this section. They held, respectively, that (i) the ‘problem’ of theology in biology textbooks was merely a matter of sloppy language, (ii) this sloppiness can be dispensed with by focusing on what God would probably do, or (iii), more modestly, by focusing at least on what various creationists say God would probably do. Yet if our argument is correct, these objections falter. Instead, rhetorical, practical, legal, epistemological, demarcational, and methodological considerations all collectively ratchet up the price of including theology in textbooks’ arguments for evolution. While some textbook authors may be willing to accept these liabilities, for others they amount to a pound of biological flesh.

4 The Absence of Theology is Also Problematic

Having raised a number of worries about the presence of theology in arguments for evolution in biology textbooks, we now turn in the opposite direction. We argue that avoiding theology in these contexts is also problematic. This leads directly to the dilemma that we discuss further in Section 5. For now, we argue that there is a high cost to the absence of God-talk in biology textbooks. Some of the arguments we develop below are on the ‘other side of the coin’ to those articulated in Sections 2 and 3. Readers will notice that they have a parallel feel, but are developed from a different direction.

To make our case, we will first raise three objections that a critic might have in mind. In the course of answering these objections, we will lay out our positive reasons why the exclusion of God-talk is undesirable for a number of textbooks.

The first objection contends that theology is merely a dispensable foil. That is, a critic might think that textbook

authors use God-talk only for rhetorical effect; the ‘real’ evidence for evolution centers on purely natural phenomena, like homological similarities, molecular sequences, nested hierarchies, and the like. At most, creationism (and its associated theology) is just a historical artifact that is irrelevant to the true justification of evolutionary theory, especially in the present day.

Second, a critic might say that theology has no place within science. On this view, science is governed by methodological naturalism, NOMA, complementarity, or the like. These approaches accept some version of the ‘separation’ thesis: science cannot address religious claims, or such claims are not appropriate within scientific research or discourse proper.⁸⁰

Third, a critic might alternatively contend that textbooks do not even need to take a principled stance on methodological naturalism, NOMA, complementarity, or any version of the separation thesis. Each of these make some pronouncement about theology (e.g., ‘it occupies a separate magisterium than science’). Instead, why not just be silent on the matter? The path forward is to make *no* pronouncements at all. Just ignoring theology entirely.⁸¹

For brevity’s sake, we will label these as (i) the periphery objection, (ii) the separation objection, and (iii) the silence objection, respectively.

4.1 Evidence and Background Beliefs

One initial concern about all three objections is that, for many people, they do not adequately take into account the broader context of inquiry. In a narrow sense, the original inquiry is a seemingly simple question: Is evolutionary theory true? To answer this question, textbooks provide various lines of evidence. (Hence, the ubiquitous “evidence for evolution” sections.) Yet the matter becomes immediately complicated by the fact that evidence is typically relative to a set of background beliefs. What counts as evidence for one person, given her background beliefs, may not count as evidence for another person, given his background beliefs. Thus, background beliefs are in play when asking about the truth (and justification) of evolutionary theory. In the context of the Western tradition and American culture, claims about God’s alleged actions in organic history form key elements of some people’s background beliefs. In-

⁸⁰See Figure 1 for a full list of textbooks that accept the separation thesis (or halfway measures, a less overt version of the separation thesis. See our discussed below).

⁸¹The best example of this on our list is Gunstream, *Explorations in Basic Biology*. Hillis et al., *Principles of Life* apparently tries to be silent on all things theological as well, but perhaps less successfully.

deed, millions have held, and continue to hold, creationist beliefs of one kind or another. Moreover, many non-theists are in a similar epistemic position: some of them accept evolution in part because of theology-laden arguments.⁸² (We have seen some of these arguments in this article; there are more as well—for example, ‘God would never design a sub-optimal panda’s thumb, but an imperfect structure is just what we’d expect on natural selection.’) More broadly, as Cornelius Hunter has shown, theological claims have been central to the debate on biological origins for centuries.⁸³ In fact, the contest between natural and supernatural explanations of the physical world has been embedded in the Western tradition since its inception. As Cambridge classicist David Sedley has observed, the matter was considered “fundamental” by ancient thinkers like Socrates, Plato, Aristotle, Anaxagoras, Empedocles, Democritus, the Epicureans, and the Stoics.⁸⁴ The melee between natural and supernatural explanations continues to the present day, especially concerning matters of the origin of the universe, life, and the human mind. So, for many people, theology-laden background beliefs are crucial to evaluating the case for evolution. Thus, it is simplistic to hold, as the objections do, that theology is peripheral to the discussion, or science and theology are to remain separate, or discussions of evolution can just ignore theology altogether. For many, the seemingly simple question, “Is evolution true?” can only be answered by taking into account the divine.

4.2 The Failure of Halfway Measures

A parallel point concerns the ‘halfway measure problem.’ Halfway measures, as we use the term, are attempts to evaluate the empirical content of a theology-laden hypothesis, but only after separating it from its theological moorings.⁸⁵ The idea here is that textbooks can successfully make their case for evolution by ‘sticking to the facts’ without venturing into God-talk. This approach is very much in accord with the separation, silence, and periphery objections.

Consider, for example, *Miller & Levine Biology*.⁸⁶ In their presentation of the case for evolution, Miller and Levine avoid all mention of God, special creation, young-Earth creation, intelligent design, and the like. Indeed, even in

⁸²As noted in Dilley, “Nothing,” (p. 784), some atheists and agnostics have very strong beliefs about what actions in organic history are befitting of God, were He to exist.

⁸³Hunter, “Darwin’s Principle”; Hunter, *Science’s Blind Spot*.

⁸⁴David Sedley, *Creationism and Its Critics in Antiquity* (Berkeley: University of California Press, 2007), xvi.

⁸⁵Ironically, this strategy was championed by some modern creationists themselves. See Numbers, *The Creationists*, 7, 268-85. For Ridley’s halfway measure, for example, see Ridley, *Evolution*, p. esp. 43-70, esp. 44, 67-68.

⁸⁶This text is one of the top high-school biology titles.

their historical recounting of the *Origin*, they state that Darwin’s feat was to overthrow the view that species are fixed and the Earth is young—never mentioning creationism at all!⁸⁷ Evidently, Miller and Levine are quite serious when they say, “Scientific endeavors never concern, in any way, supernatural phenomena of any kind.”⁸⁸

But the matter is not so easy. It turns out that ‘empirical facts’ don’t just stick to themselves; they also stick to theology. For example, Miller and Levine state that Darwin’s “contribution to science” helped falsify claims that the Earth is young and that species are fixed.⁸⁹ They point out, for example, that modern geology has shown the Earth to be ancient:

Geologists now use radioactivity to establish the age of certain rocks and fossils. This kind of data could have shown that Earth is young. If that had happened, Darwin’s ideas would have been refuted and abandoned. Instead, radioactive dating indicates that Earth is about 4.5 billion years old—plenty of time for evolution by natural selection to take place.⁹⁰

So, according to Miller and Levine, the Earth is about 4.5 billion years old. Yet, if this claim is true, then any claim incompatible with it must be false. That is, let us plausibly suppose the following is true:

1. The Earth originated 4.5 billion years ago.

The truth of this claim entails the falsity of a competing claim—namely:

2. The Earth originated 6,000 to 10,000 years ago.

And, the falsity of (2) entails the falsity of third claim:

3. The Earth originated 6,000 to 10,000 years ago by a direct act of God.

The logic of these entailments is inescapable. If (1) is true, then (3) *must* be false. In effect, Miller and Levine have adopted a halfway measure in order to avoid the appearance

⁸⁷Miller and Levine, *Miller & Levine Biology*, p. 450-64, esp. 453-54.

⁸⁸Miller and Levine, *Miller & Levine Biology*, p. 5.

⁸⁹Miller and Levine, *Miller & Levine Biology*, p. 450-53.

⁹⁰Miller and Levine, *Miller & Levine Biology*, p. 466.

of evaluating a theology-laden claim. But this appearance is a façade. The plain reality is that the truth of evolutionary theory and its tenets logically entails the falsity of *any* theory that posits contrary claims. It doesn't matter whether the theory in question includes supernatural beings or not.⁹¹ It also doesn't matter if the theory is 'supposed' to be in a separate domain. A fact is a fact; any claim to the contrary is false. Accordingly, it is simplistic to issue an unnuanced pronouncement, as Miller and Levine do, that "[s]cientific endeavors never concern, in any way, supernatural phenomena of any kind." The direct implications of their own scientific assertions say otherwise.⁹² More deeply, it is likewise simplistic to claim that biology textbooks can 'stick to the empirical facts' and leave theological considerations aside in their case for evolution. In the end, the truth of certain empirical facts logically mandates the falsity of certain theological claims.⁹³

Combined with our discussion about background beliefs, this consideration sharpens the problems with all three objections, especially the 'separation' and 'silence' objections. For example, all versions of the 'separation' thesis hold that scientific claims cannot affect the plausibility of religious claims. The duo are said to occupy different domains (or complementary levels). Yet in light of American culture and the Western tradition, for many people, the data of an ancient Earth do affect the plausibility of claims about God's purported action 10,000 years ago. This is true not just of many evolutionists, but also for many young-Earth creationists; they recognize the basic logical dichotomy in

⁹¹To be clear, our point is *not* that Miller and Levine are tacitly "doing theology" in their textbook. Instead, our point is that they are doing *science*. Like it or not, their scientific claims have undeniable implications for the truth or falsity of some other claims, including some theological claims.

⁹²Surprisingly, in another textbook, Miller and Levine state: "Darwin knew that accepting his theory required believing in *philosophical materialism*, the conviction that matter is the stuff of all experience and that all mental and spiritual phenomena are its by-products." Philosophical materialism rejects the existence of God, gods, spirits, non-reductive souls, the One, Atman is Brahman, and the like. Apparently, then, the direct implication of Darwinian evolution is that virtually *every* major religion is false. That sounds rather unlike the claim that "[s]cientific endeavors never concern, in any way, supernatural phenomena of any kind." See Miller and Joseph, *Biology: The Living Science*, 148-61, esp. p. 161, original emphasis. One also wonders what Kenneth Miller was up to when he argued that radiometric data counters young-Earth creationism in *Finding Darwin's God* (New York: HarperCollins, 1999), 57-80.

⁹³Of course, a critic can avoid this conclusion by maintaining, for example, that there are different levels (or types) of truth. (Note that this is much different than the claim that there are different *theories* of truth.) For problems with this view, see Bradley Monton, *Seeking God in Science: An Atheist Defends Intelligent Design* (Peterborough, Ontario: Broadview Press, 2009), chapter 2. Other attempts to avoid our conclusion also incur additional problems: cf. John Worrall, "Science Discredits Religion," in *Contemporary Debates in Philosophy of Religion*, Michael L. Peterson and Raymond J. VanArragon, eds. (Malden, MA: Blackwell Publishing, 2004), 59-72, 87-90, esp. 59ff.

play: either ancient Earth data are correct *or* their view is correct, but not both. They simply believe that they have better grounds to accept the latter rather than the former.⁹⁴ More generally, wherever one falls on the dichotomy, the point here is that many people have theology-laden background beliefs about biological origins, and they also recognize the logical incompatibility of some scientific claims with some theological claims. For this group, halfway measures are a chimera.

Of course, some critics disagree. They maintain an unyielding form of the separation thesis (or of the silence or periphery objections). These individuals obviously hold different background beliefs than those mentioned above; they also deny that the logical incompatibility of some empirical data and certain theological claims is of much concern. Science, when rightly done, stays within its own realm; religion, when rightly interpreted, likewise minds its place. Neither impinge on the plausibility of the other.

By way of reply: there is, unfortunately, a high price to be paid for this approach. As we will explore more below, if science does not impinge upon theology, then scientific data cannot impinge upon the truth or falsity of *any* hypothesis about God's alleged actions in organic history. Textbooks cannot say, then, that scientific evidence disconfirms young-Earth creationism. More generally, they cannot say that scientific evidence favors evolution over creationism. Apparently, the data of embryology, biogeographical distribution, vestigial structures, and the like are of little or no use to show the empirical superiority of evolution over its supernatural rivals. Scientific evidence never crosses into the religious domain with any force. Instead, it is impotent. As mentioned, we will return to this point in due course. For now, we simply want to point out that maintaining any of the three objections, along with halfway measures, includes a significant cost.⁹⁵

⁹⁴Even if one allows that *philosophical* ideas like the "appearance of age" and "uniformitarianism," rather than empirical data, are highly relevant to testing young-Earth creationism, the empirical data still remain vital to the discussion. After all, the "appearance of age" and "uniformitarianism" become relevant precisely *because* the empirical data seem to run counter to a young Earth. If the data were the reverse, there would be no need to defend the "appearance of age" or to attack "uniformitarianism."

⁹⁵Some critics might protest that the best form of the separation thesis allows scientific evidence to affect some, but not all, theological claims. It only informs those that are incorrect interpretations of a given religious text. So, for example, science can in principle falsify young-Earth creationism given that, on this view, young earth claims are typically taken to be an incorrect interpretation of the Bible. The benefit of this version of the separation thesis is that it allows science to counter incorrect theologies, but (apparently) it cannot touch correct theology (whatever it happens to be). By way of reply: we quite agree that some religious claims are beyond the purview of science (e.g., religiously-oriented ethical claims about what humans *ought* to do). But this insight is compatible with models of science and theol-

Stepping back, if we are correct about our general argument in this section, then it is implausible to say—at least for many people—that theology is ‘peripheral’ to the justification of evolution. It is also implausible to say that science has no epistemic implications for religious claims or that simply being silent settles the matter in a satisfactory way. For many, God-talk is simply too relevant to ignore.

4.3 Mind-World Affinity

But the well goes deeper. Evidence has emerged in the last few decades that human beings are hardwired for belief in the gods and in the design of some of the features of the natural world. For example, one Oxford-led analysis involved 57 researchers who conducted 40 separate studies in 20 different countries, including countries that were traditionally theistic as well as others than were more significantly atheistic. The study concluded that humans are “predisposed” to believe in gods and an afterlife.⁹⁶ Other research indicates that preschool and elementary aged children naturally ascribe the origins of certain objects in terms of their function (‘this was made to do that’) and construe objects and events as intentionally caused (‘someone made this’). By 6-10 years, kids connect biological functionality in nature with “goal-directed design.”⁹⁷ As Alison Gopnik observes, “By elementary-school age, children start to invoke an ultimate God-like designer to explain the complexity of the world around them—even children brought

ogy that reject the separation thesis (e.g., the concord model). If the separation thesis is to be meaningful at all, it must claim that *theological claims that touch the natural world in a significant way* are, if correctly interpreted from Scripture, beyond the reach of science. But we wonder whether this can really be decided prior to looking at the empirical evidence itself. It seems possible in principle, for example, for archeologists to find evidence that confirms, to one degree or another, that Jesus existed (say, ancient inscriptions, ossuaries, structures, settlements, or the like that correspond to key events, people, and places in biblical accounts of the life of Jesus). All things being equal, this would count as confirming, even if slightly, a major claim of the New Testament: namely, that Jesus lived in first-century Palestine. On the other side of the coin, it seems possible in principle for archeologists to find evidence to the contrary (say, by finding a systematic pattern of error in Bible accounts of first-century places, geography, people groups, events, etc. that are central to the given descriptions of the life of Jesus). Thus, in our view, the ‘partial’ version of the separation thesis draws arbitrary boundaries around what religious claims can or cannot be affected by science. See also note 119.

⁹⁶Justin Barrett, *Cognitive Science, Religion, and Theology* (West Conshohocken, PA: Templeton Press, 2011); Justin Barrett, *Born Believers: The Science of Childhood Religion* (New York: Free Press, 2012); see also Oxford University’s press release, “Humans ‘Predisposed’ to Believe in Gods and the Afterlife,” 16 May 2011, available at: <https://phys.org/news/2011-05-humans-predisposed-gods-afterlife.html>.

⁹⁷Deborah Kelemen et al., “Young Children can be Taught Basic Natural Selection Using a Picture-Storybook Intervention,” *Psychological Science*, vol. 25, no. 4 (2014): 894.

up as atheists.”⁹⁸

Even veteran scientists, habitually trained to favor naturalistic explanations, cannot escape teleological thinking.⁹⁹ Psychology professor Deborah Kelemen summarizes these findings: “Even though advanced scientific training can reduce acceptance of scientifically inaccurate teleological explanations, it cannot erase a tenaciously early-emerging human tendency to find purpose in nature.”¹⁰⁰ If this is our natural way of thinking, then, at a very practical level, it will be exceedingly difficult to eradicate design-like reasoning in biology. And this will be true not just for theists, but for non-theists as well. From a cognitive point of view, the notion that theology can simply be avoided—especially in the context of biological origins—is psychologically implausible.¹⁰¹

It comes as little surprise, then, that even ardent evolutionary biologists wrestle with design-based thinking.¹⁰² Francis Crick’s admission is well known: “Biologists must constantly keep in mind that what they see was not designed, but rather evolved.”¹⁰³ And Richard Dawkins echoes this sentiment from the opposite direction: “It is almost as if the human brain were specifically designed to misunderstand Darwinism, and to find it hard to believe.”¹⁰⁴ The

⁹⁸Alison Gopnik, “See Jane Evolve: Picture Books Explain Darwin,” *Wall Street Journal*, 18 April 2014, available: http://www.bu.edu/cdl/files/2014/04/WSJ-Teaching-Tots-Evolution-via-Picture-Books-WSJ.com_.pdf. See also Rebekah A. Richert and Justin L. Barrett, “Do You See What I See? Young Children’s Assumptions about God’s Perceptual Abilities,” *The International Journal for the Psychology of Religion*, vol. 15, no 4 (2005): 283-95.

⁹⁹Deborah Kelemen, Joshua Rottman, and Rebecca Seston, “Professional Physical Scientists Display Tenacious Teleological Tendencies: Purpose-Based Reasoning as a Cognitive Default,” *Journal of Experimental Psychology: General*, 15 October 2012, advance online publication: doi: 10.1037/a0030399.

¹⁰⁰Art Jahnke, “The Natural Design Default,” *Bostonia* (Winter-Spring 2013): 22-23, esp. 23.

¹⁰¹See the penetrating argument along similar lines by Del Ratzsch, “Humanness in Their Hearts: Where Science and Religion Fuse,” *The Believing Primate*, eds. Jeffrey Schloss et al. (Oxford, UK: Oxford University Press, 2009), 209-45.

¹⁰²For example, Bruce Alberts, former president of NAS: “Why do we call the large protein assemblies that underlie cell function protein *machines*? Precisely because, like the machines invented by humans to deal efficiently with the macroscopic world, these protein assemblies contain highly coordinated moving parts. . . [just as] a machine of our common experience.” Bruce Alberts, “The Cell as a Collection of Protein Machines: Preparing the Next Generation of Molecular Biologists,” Review Issue: Macromolecular Machines, *Cell* 92 (6 February 1998): 291, italics in original. See also Annie Crawford’s helpful analysis of the defenses of teleological language in biology by Ernst Mayr and Michael Ruse, respectively: Crawford, “Metaphor and Meaning in the Teleological Language of Biology,” MA thesis, Houston Baptist University, 13 August 2018.

¹⁰³Francis Crick, *What Mad Pursuit* (New York: Basic Books 1990), 138.

¹⁰⁴Richard Dawkins, *The Blind Watchmaker* (New York: W.W. Norton and Company, 1996), xi.

‘design temptation’ no doubt arises in part because of the extraordinary complexity of biological phenomena. Crick and Dawkins (and many other evolutionists) acknowledge that much of the world *appears* to be designed. Of course, they think this is no actual design beneath it all. But the language of ‘appearance’ is itself significant. On their view, the mesmerizing flurry of a hummingbird’s wings and the delicate blush of an orchid look like artifacts of mind *prima facie*.

This sentiment becomes especially significant when tied to the psychological studies on human cognition just mentioned: the biological world looks designed and the human mind naturally tends toward design-based explanations. The organic realm and the human mind fit together like jigsaw pieces—at least if one accepts the self-reports of evolutionists as well as recent research on human cognition. This apparent mind-world affinity, when applied to the present case, suggests that it is simplistic to claim, as the three objections above do, that theology is peripheral to some of the arguments for evolution, or that science and religion are separate, or that textbook authors can manage the matter by saying nothing at all. The human mind, the appearance of design, and the close connection between the two indicate otherwise. Even more than the background beliefs supplied by American culture and the Western tradition, this ostensible mind-world affinity shows the virtual inevitability of theology in discussions of biological origins.

4.4 Arguments for Evolution Cast Aside

The absence of theology is problematic for another reason. From the *Origin* to the present, biologists have repeatedly invoked God-talk as part of their positive case for evolutionary theory. If theology is barred (or ignored), then this array of justifications goes by the wayside. Consider what this means. In the first place, the *Origin* itself is utterly unintelligible without theological language. Darwin’s primary objective was to show the superiority of evolution by natural selection over special creation.¹⁰⁵ His repeated attacks on this view, as well as on other versions of creationism, are explicit and unmistakable.¹⁰⁶ Moreover, as scholars have shown, Darwin’s conceptualization and justification of evolutionary theory itself include striking theological elements.¹⁰⁷

¹⁰⁵Charles Darwin, *On the Origin of Species* (London: John Murray, 1859), p. 1-6.

¹⁰⁶Darwin, *Origin*, 3, 6, 44, 55, 59, 95, 115, 129, 133, 138, 139, 152, 155, 159, 162, 167, 185, 186, 188, 194, 203, 244, 275, 303, 315, 352, 355, 365, 372, 389, 390, 393-94, 396, 398, 406, 413-14, 420, 434-35, 437, 453, 456, 465, 469, 470-71, 473-75, 478, 480-83, 486, and 488.

¹⁰⁷John Brooke, “The Relations between Darwin’s Science and His Religion,” *Darwinism and Divinity*, ed. John Durant (New York:

Second, a number of prominent biologists rely on theology in their scientific case for evolution in the present day. They contend that evolution better accounts for the data in part because a respectable deity would never create a suboptimal organ, for example, or would always create new species from scratch, or the like. Biologists who champion these arguments include luminaries such as Theodosius Dobzhansky, Niles Eldredge, Douglas Futuyma, John Avise, Neil Shubin, Jerry Coyne, Richard Dawkins, George Williams, Stephen Jay Gould, Francis Collins, Kenneth Miller, Dennis Alexander, and many others.¹⁰⁸ Their theology-laden

Oxford University Press, 1985), 40–75, esp. 48–49; Gillespie, *Charles Darwin and the Problem of Creation*; Richard England, “Natural Selection, Teleology, and the Logos,” *Osiris* 16 (2001): 270-287, esp. 274-275; Dov Ospovat, “God and Natural Selection,” *Journal of the History of Biology* 13, no. 2 (Sept. 1980): 169-194; Dov Ospovat, “Darwin’s Theology,” review of Neal Gillespie’s *Charles Darwin and the Problem of Creation*,” *Science* 207, no. 4430 (Feb 1, 1980): 520; Dov Ospovat, *The Development of Darwin’s Theory* (Cambridge: Cambridge University Press, 1981), 223-224; Momme von Sydow, “Charles Darwin: A Christian Undermining Christianity?” in *Science and Beliefs: From Natural Philosophy to Natural Science, 1700-1900*, eds. D. M. Knight and M. D. Eddy (Burlington, VT: Ashgate, 2005), 141-156; John Cornell, “God’s Magnificent Law: The Bad Influence of Theistic Metaphysics on Darwin’s Estimation of Natural Selection,” *Journal of the History of Biology* vol. 20, no. 3 (Fall 1987): 381-412; Dilley, “Charles Darwin’s use of theology,” 29-58; John Cornell, “Newton of the Grassblade? Darwin and the Problem of Organic Teleology,” *Isis* 77, no. 3 (Sept. 1986): 405-421; James Moore, *The Post-Darwinian Controversies* (New York: Cambridge University Press, 1979), 318; Robert J. Richards, “Theological Foundations of Darwin’s Theory of Evolution,” in *Experiencing Nature*, eds. P.H. Theerman and K.H. Parshall (Dordrecht: Kluwer Academic Pub., 1997), 61-79.

¹⁰⁸Donald Prothero, *Evolution* (New York: Columbia University Press, 2007), 30–49, esp. 37–39; Theodosius Dobzhansky, “Nothing in Biology Makes Sense Except in the Light of Evolution,” *The American Biology Teacher* (March 1973): 125–129; Stephen Jay Gould, *Ever Since Darwin* (New York: W. W. Norton, 1977), 91–96; Gould, *The Panda’s Thumb* (New York: W. W. Norton, 1980), 20–21, 24, 28–29, 248; Gould, *Hen’s Teeth and Horse’s Toes* (New York: W. W. Norton, 1983), 258–259, 384; Gould, *The Structure of Evolutionary Theory* (Cambridge, MA: Harvard University Press, 2002), 104; Gould, “Evolution and the Triumph of Homology, Or Why History Matters,” *American Scientist* 74, no. 1 (1986): 60–69, esp. 63; Douglas Futuyma, *Science on Trial: The Case for Evolution* (Sunderland, MA: Sinauer Associates, 1995), 46–50, 121–131, 197–201, 205; Niles Eldredge, *The Triumph of Evolution . . . And the Failure of Creationism* (New York: W. H. Freeman, 2000), 99–100, 144–146; Francisco Ayala, *Darwin and Intelligent Design* (Minneapolis: Fortress, 2006), 25–42, 85–89, esp. 34–36; Francisco Ayala, *Darwin’s Gift to Science and Religion* (Washington, DC: Joseph Henry Press, 2007), x-xi, 1–6, 22–23, 76, 88–92, 154–160; Jerry A. Coyne, *Why Evolution Is True* (New York: Penguin, 2009), 12, 13, 18, 26–58, 64, 71–72, 81–85, 96, 101, 108, 121, 148, 161; Richard Dawkins, *The Blind Watchmaker* (New York: W. W. Norton, 1986), 93; Dawkins, *River out of Eden* (New York: Basic Books, 1995), 95–133, esp. 105; Dawkins, *The Greatest Show on Earth: The Evidence for Evolution* (New York: Free Press, 2009), 270, 296–297, 315, 321–322, 332, 341, 351, 354, 356, 362, 364, 369, 371, 375, 388–389, 390–396 (we thank Colin Zwirko and Caitlin Maples for their fine research on Coyne and Dawkins); Nathan H. Lents, *Human Errors* (New York: Houghton Mifflin Harcourt, 2018); R. Diogo and J. Molnar, “Links between Evolution, Development, Human Anatomy, Pathology, and Medicine, with a Proposition of a Re-Defined Anatomical Position and Notes on Constraints

arguments appear in major areas of biology, including genetics, embryology, biogeography, paleontology, physiology, genomics, and the like.

While we can only gesture toward this phenomenon here, we briefly note that several studies have brought to light notable features of these arguments.¹⁰⁹ First, these studies collectively show that the biologists who make these arguments overwhelmingly view them as scientific—no doubt because they draw on scientific data, inferences, patterns of reasoning, and peer-reviewed research. Second, these theological claims are typically indispensable to the arguments in which they appear.¹¹⁰ Without God-talk, the arguments in question do not support evolutionary theory. Third, these arguments are often central to a given thinker's overall scientific case for evolution. Indeed, some of these thinkers' self-reported *best* arguments for evolution depend upon God-talk.¹¹¹ If we adopt any of the three objections above, then this array of justifications for evolutionary theory counts for little. But this is a high price: apparently, textbooks must exclude some of the top biologists' arguments for evolution.¹¹²

This pressing question becomes even more difficult in light of recent philosophical analysis of scientific testing. Among philosophers of science, the current conventional view is

and Morphological 'Imperfections,'" *Journal of Experimental Zoology* 326, no. 4 (2016): 1–10, elliptically; Patrick Forterre and Daniele Gadelle, "Phylogenomics of DNA topoisomerases: their origin and putative roles in the emergence of modern organisms," *Nucleic Acids Research* 37, no. 3 (2009): 679–692, esp. 679, elliptically; Ulrich Kutschera, "Photosynthesis Research on Yellowtops: Macroevolution In Progress," *Theory in Biosciences* 125 (2007): 81–92, esp. 90–91; Émile Zuckerkandl, "Intelligent Design and Biological Complexity," *Gene* 315 (2006): 2–18, esp. 10; George C. Williams, *The Pony Fish's Glow* (New York: Basic Books, 1997), 2, 4, 6–10, 104, 132–160; John C. Avise, *Inside the Human Genome: A Case for Non-Intelligent Design* (New York: Oxford University Press, 2010); Neil Shubin, *Your Inner Fish* (New York: Pantheon, 2008), 173–198; Ian Barbour, *When Science Meets Religion* (New York: HarperCollins, 2000), 111–114; Denis Alexander, *Creation or Evolution*, 234–251; Francis Collins, *Language of God* (New York: The Free Press, 2006), 130, 134–137, 139, see also 176–177, 191, 193–194; Karl Giberson and Francis Collins, *The Language of Science and Faith* (London: SPCK, 2011), 34, 38, 55, 101–108, 161; Kenneth Miller, *Finding Darwin's God*, 80, 100–103, 267–269.

¹⁰⁹Dilley, "Nothing"; Dilley, "Charles Darwin's use of theology"; Nelson, "Role of Theology"; Lustig, "Natural Atheology"; Hunter, "Darwin's Principle"; Hunter, *Science's Blind Spot*; Hunter, "The Random Design Argument."

¹¹⁰See especially Nelson, "Role of Theology"; Dilley, "Nothing."

¹¹¹Among others, Coyne, *Why Evolution Is True*, 26–54, 79; Dawkins, *Greatest Show*, 296–297, 315, 321–322. Gould, *Structure*, 104; Dobzhansky, "Nothing," 126–128.

¹¹²It remains something of a puzzle just how biology textbooks can accurately represent their field while also ignoring the key arguments of some of their own notables. Aren't such omissions somewhat contrary to the very purpose of textbooks in the first place? (Our thanks to a reviewer for bringing this point to our attention.)

that scientific testing is contrastive.¹¹³ With rare exception, current models of testing require the juxtaposition of one theory against one-or-another rival. This is true of the Big 3: likelihood, inference to the best explanation, and Bayesian models. Of course, it is possible for Darwinian evolution to be tested against a non-theology-laden view (say, neo-Lamarckian evolution). But the problem is that any such test only shows (at most) that Darwinian evolution is empirically superior to this other non-theological theory. It does nothing to show that Darwinian evolution is empirically superior to creationist rivals. Justifying this latter claim requires head-to-head comparison.¹¹⁴ In such a comparison, God-talk is unavoidable. Notably, the point here isn't just that a number of prominent biologists happen to invoke theology in their arguments for evolution; rather, it's that, according to recent analysis of scientific testing, *any* textbook author who wishes to defend evolution against all rivals cannot avoid theology. In this sense, if authors hold that Darwinian evolution is the best explanation of things below, they must also contend with things above.

4.5 Scientific Evidence Cast Aside

Yet perhaps the most striking problem with the 'no theology' approach is that it undermines the very heart of biology textbooks: scientific evidence.¹¹⁵ If theology-laden claims are excluded, then scientific evidence is unavailable to critique creationism or to favor evolution over its supernatural rivals. Regarding the first point, if science cannot address religious matters, then scientific data and arguments are impotent to falsify special creation, young-Earth creationism, and the like. While some versions of creationism are not empirically testable, other versions surely are. Readers even vaguely familiar with the biology textbooks on our list know that an overwhelming number claim (or imply) that radiometric dating of ancient strata run counter

¹¹³See Sober, *Evidence and Evolution*, 109–88; Sober, *Did Darwin Write the Origin Backwards?*, 121–54.

¹¹⁴Of course, some versions of creationism are not empirically testable (such as versions that invoke a deceptive deity). Then again, other versions of creationism are empirically testable—at least that's what many textbook authors seem to believe. Why else would they critique creationism by reference to empirical data of, say, homologous structures, vestigial organs, pseudogenes, atavisms, the nested hierarchy, biogeographical distributions, and the like? For discussion about whether creationism, in its most defensible form, is really testable, see Sober *Evidence and Evolution*, 109–88 and *Did Darwin Write the Origin Backwards?*, 121–54. Replies to Sober include Lim, "A Critique of Elliott Sober's Goals and Abilities Objection to the Design Argument" and Dilley, "How to Lose a Battleship," 621–23.

¹¹⁵cf. Larry Laudan, "Science at the Bar—Causes for Concern," *Science, Technology & Human Values*, vol. 7, no. 41 (Fall 1982): 16–19; Dilley, "How to Lose a Battleship," 593–631.

to young-Earth creationism, for example.¹¹⁶

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Second, if theology is ‘absent,’ then textbooks’ scientific data and arguments are also impotent to show the empirical superiority of evolutionary theory over supernatural rivals. But isn’t this a key reason why so many textbook authors promote the former over the latter? Even a cursory read shows that they widely believe anatomical similarities, fossil sequences, suboptimal organs (and so on) count as empirical grounds to favor evolution over creationism. The evidence itself is supposed to have teeth.

Of course, a critic might counter that textbook authors can still retain all the evidence for evolution (and against creationism) without labeling this evidence as “scientific” per se. Perhaps arguments that invoke theology ought to be filed under a different heading, such as “philosophical arguments” or “natural theology” or “cultural perspectives” or similar. Textbooks can keep these arguments as long as they are careful to alert students to the differences between, say, scientific arguments and philosophical ones.

By way of reply: this objection attempts to solve the problem by superficial relabeling. Simply switching out titular headings (“philosophy” instead of “science”) hardly addresses the salient epistemological matter at hand. Does empirical evidence have implications for the truth of evolutionary theory vis-à-vis creationism? Do the data impinge upon creationism at all? Mere labels change nothing. Moreover, the arguments in question rely on scientific data, methods, inferences, articles, and patterns of thinking. They bear all the hallmarks of scientific analysis. To claim that they are not really scientific after all amounts to hollow word play.

So, the point stands. The absence of theology is deeply problematic. Moreover, this point transcends the analyses we have given of particular theologies in this article (presumptive theology, indeterminate theology, and so on). That is, a critic can completely disagree with our analyses of concrete cases of theology and yet still must face this problem. Any scientific argument against creationism, of whatever form, requires theology (for example, ‘If God created human beings, we would expect...’). And any scientific argument that claims that the data favor evolution over creationism also requires theology (for example, ‘On evolution, we’d expect similar bone structures, but if God was at work, we would not’). If theology is absent in the case for evolution, then scientific evidence is unavailable to critique creationism or to favor evolution over its supernatural rivals. The empirical evidence becomes effete. If God is gone, then so is the power of the data.

¹¹⁶See note 94.

We may now step back from our argument in Section 4. We have contended that textbook authors must be prepared to pay the price if they wish to exclude theological considerations from their arguments for evolution. But this is not so easy, especially in the light of the failure of halfway measures, the broader influence of American culture and the Western intellectual tradition, the mind-world affinity between the cognitive hardwiring of human beings and the striking appearance of design in nature, the theology-laden elements of the *Origin*, a host of theology-laden arguments for contemporary evolutionary theory by prominent biologists, the role of comparative evaluation in scientific testing, and the centrality of empirical evidence. Collectively, these factors encourage the inclusion, rather than exclusion, of God-talk in biology textbooks.

5 A Difficult Dilemma

Let us pause once again to recount our overall argument to this point. In Sections 2 and 3, we contended that the presence of theology in evidence-for-evolution sections raises a whole range of problems for biology textbooks. In Section 4, we argued the opposite. If our two arguments are correct, then biology textbook authors face a crippling dilemma. They are damned if they include God-talk and damned if they don’t.

The difficulty of this dilemma can be further reinforced by a brief examination of a common solution offered by textbooks.¹¹⁷ We argue below, however, that this solution is both incoherent and self-serving. The failure of this approach underscores just how pressing the dilemma is.

In a nutshell, the pressing difficulty with the ‘common solution’ is that some textbooks attempt both to incorporate theology into their scientific arguments for evolution and, at the same time, to bar theology from science itself. These texts wish to have their cake and eat it too. Seventy-two percent of textbooks on our list do so.¹¹⁸

The problem usually begins with a demarcational claim. Although these textbooks are often not as precise as they could be, in one way or another, a number of them ac-

¹¹⁷Just to be clear, in our view, it’s not entirely clear that textbook authors are, in general, aware of this dilemma. So, we are careful not to say that authors are self-consciously giving a “solution” per se. Rather, we will examine a typical approach among the textbooks on our list that, charitably interpreted, counts as a possible way to handle the dilemma.

¹¹⁸See the “Separation/HM” column in Figure 1.

cept some version of the 'separation' thesis: science cannot address religious matters, or religious claims are not appropriate within a scientific context.¹¹⁹ This thesis is sometimes articulated in the form of NOMA, complementarity, or methodological naturalism. For example, in their textbook *Evolution*, Carl Bergstrom and Lee Alan Dugatkin write:

The strategy of trying to explain the world based solely on natural phenomena is fundamental to the scientific method and is at the heart of modern evolutionary biology. It is sometimes called **methodological naturalism**. We call it *naturalism* because of the focus on the natural rather than the supernatural. We use the adjective *methodological* because this strategy provides a method or procedure for seeking scientific explanations of the world. . . . If we propose an explanation of a phenomenon based on natural processes, that is, if we develop a hypothesis, we can then test this hypothesis because we can observe and often manipulate these processes. By contrast, we have no way to observe, let alone manipulate, the supernatural, and thus we cannot test supernatural explanations.¹²⁰

Similarly, textbook authors Colleen Belk and Virginia Bor-

¹¹⁹For example, Freeman et al., *Biological Science*, p. 9; Urry et al., *Campbell Biology*, p. 16-26, esp. 18, 26; Singh-Cundy et al., *Discover Biology*, p. 13, 402; Brooker et al., *Biology*, p. 460, elliptically; Belk and Maier, *Biology*, p. 4; Solomon et al., *Biology*, p. 16. As noted, a full list of textbooks that accept the separation thesis (or a halfway measure) can be found in Figure 1. It's worth pointing out that some textbooks accept partial versions of the separation thesis. For example, some claim that certain religious beliefs are testable by scientific methods (and so fall within the purview of science) while other religious beliefs are not testable by scientific methods (and so are isolated from science). For example, some textbooks state that scientists can test whether God created life only 6,000 years ago, but cannot test whether God exists per se. Yet these textbooks virtually never provide any principled and defensible justification why "testability" applies to some religious beliefs but not others. (The oft-cited appeal to the necessity of "predictions" does not, in itself, resolve the matter; it only repackages the problem with slightly more focus.) Moreover, in principle it seems possible that some scientific data, now or in the future, are relevant to the question of God's existence. For example, depending on one's background beliefs, a version of the problem of evil that turns on a scientific analysis of predation and animal suffering arguably has implications for the implausibility of theistic belief. Or, on the other side of the coin, the existence of a fine-tuned universe may provide support for theistic belief to one degree or another—again, depending on one's background beliefs. Whatever the case, our own speculation is that textbook authors who endorse a partial version of the separation thesis either are unaware of the considerations explored here or, perhaps, are trying to placate religious students by assuring them that they are allowed a handful of generic religious beliefs (such as "God exists"), which, they are told, remain safe from the power of science. See also note 95.

¹²⁰Bergstrom and Dugatkin, *Evolution*, p. 32, original emphases.

den Maier state:

For a hypothesis to be testable by science, we must be able to evaluate it through observations or measurements made within the material universe (Chapter 1). Because a supernatural creator is not observable or measurable, there is no way to determine the existence or predict the actions of such an entity through the scientific method. Therefore, as it is stated, special creation is not a scientific hypothesis. In fact, any statement that supposes a supernatural cause—including intelligent design, which argues that while evolution is possible, some specific features of organisms must have been designed by a creator—cannot be considered science.¹²¹

As one text simply puts it: "Scientists cannot evaluate a claim about the actions of a supernatural agent, since scientific theories explain phenomena that follow natural, repeatable patterns."¹²² In sum, in one way or another, many of our textbooks endorse the separation thesis.¹²³

Two concerns arise. First, if religious explanations cannot be evaluated (or are 'not testable'), then what of the empirical tests in biology textbooks that aim to show the superiority of evolutionary theory over special creation or young-Earth creationism?¹²⁴ The strong majority of textbooks we examined held that, across a wide range of sub-disciplines of biology, creationist hypotheses in one form or another have been vetted against the empirical data and found wanting. Indeed, the whole point of comparative arguments between evolutionary theory and creationism, from the *Origin* to the present, is to show that the data vindicate the former over the latter. Unfortunately, when taken as a whole, over 70% of our textbooks offer an incoherent model of the relationship between science and religion: in the 'nature of science' chapters (typically), these textbooks assert that religious claims cannot be evaluated by the methods of science, for example, but in the 'evidence for evolution' chapters, they draw on scientific evidence to deem particular religious claims false.¹²⁵ This is plainly in-

¹²¹Belk and Maier, *Biology*, p. 207.

¹²²Zimmer and Emlen, *Evolution*, first edition, p. 320. Interestingly, this quote was removed in the second edition of the text.

¹²³In total, 21 out of 32.

¹²⁴cf. Laudan, "Science at the Bar—Causes for Concern," 16-19.

¹²⁵See the "Incoherence" category in Figure 1. Examples include Freeman et al., *Biological Science*, p. 9, 441-43; Urry et al., *Campbell Biology*, p. 18, 26, 466-83, esp. 467-68, 477-78; Mader, *Biology*, p. 11 (elliptically), 266-79, esp. 267; Singh-Cundy et al., *Discover Biology*, p. 13, 386-89, 402; Phelan, *What Is Life?*, p. 4-5, 24, 332-33, 336-37; Audesirk et al., *Biology*, p. 10-11, 263-66, 270-71; Belk and Maier, *Biology*, p. 4, 207, 213, see also 230; Bergstrom and Dugatkin,

coherent, like saying that a student failed an exam she was never eligible to take.

A second concern surfaces as well. Even if we concede that religious claims are not testable, we are still left with a problem: if the separation thesis is correct, why are theology-laden arguments present in biology textbooks in the first place? In particular, why are theological claims part of the *scientific* case for evolution? As we have noted, theological assertions appear in chapters (or sections) that self-consciously present the scientific evidence for evolutionary theory. In fact, theological claims play a key role in some of these arguments. Yet if God-talk remains in a separate realm from science-talk, then theological propositions have no legitimate place in this context. Once again, in their opening chapters, many textbook authors prohibit the incursion of religious claims into science, then, in their ‘evidence for evolution’ chapters, they permit religious claims back into science for the purpose of bolstering evolutionary theory. Theological claims are barred—except when they are not. This, too, is incoherent. Even worse, it is self-serving. God-talk is *only* allowed when it strengthens evolution. J.B.S. Haldane once quipped that “[t]heology is like a mistress to the biologist; he dare not be seen with her in public but cannot live without her.” Perhaps something similar can be said of theology: her existence is never officially acknowledged, yet her diverting benefits come in handy when desired.

This underscores the difficulty that biology textbook authors face. Do they include theology or do they dispense with it? The ‘solution’ so common among textbooks on our list only exacerbates the dilemma.

Evolution, p. 31-32, 53, 55, 115; Herron and Freeman, *Evolutionary Analysis*, p. 38, 43, 56, 103; Hall and Hallgrímsson, *Strickberger’s Evolution*, p. 56, 208, 574-75; Mader and Windelspecht, *Essentials of Biology*, p. 11-12 (elliptically), 237-51, esp. 248; Taylor et al., *Campbell Biology: Concepts and Connections*, p. 6, 260-61, 264, 278. Less clear, but still notable, examples include: Krogh, *Biology*, p. 8, 286-87, 293-95; Simon et al., *Campbell Essential Biology*, p. 4, 250; Barton et al., *Evolution*, p. 75, 81-82; Sadava et al., *Life*, p. 15, 420, 443; Solomon et al., *Biology*, p. 16, 391-405, esp. 391-95; Shuster et al., *Biology for a Changing World*, p. 2-6, esp. 3, 322-24, 352-69 (in our view, the text lacks nuance about the testability of supernatural hypotheses); Miller and Levine, *Miller & Levine Biology*, p. 5, 466 (see our discussion of Miller & Levine); Hoefnagels, *Biology: Concepts and Investigations*, p. 13, 238-43, 260-79, esp. 264; Sadava et al., *Life*, p. 15, 420, 443; Zimmer and Emlen’s first edition of *Evolution*, is incoherent on this score (see p. 42, 44, 318, 320). Their second edition assiduously erases any mention of the supernatural in later chapters, thus giving the appearance of avoiding the problem. But see our comments about ‘halfway measures.’ On a related note, if one is skeptical of Ridley’s own halfway measure, then Ridley, *Evolution*, p. 43-70. See also Futuyma and Kirkpatrick, *Evolution*, p. 44-45, 573-83, esp. 578 on testing whether “an omnipotent God...created anything.”

6 Final Thoughts

In this essay, we have argued that biology textbook authors face an unwelcome predicament: there are pressing reasons both to include and to exclude theological claims in arguments for evolution. We attempted to establish this thesis in four parts. In Section 2, we examined concrete examples of straw god theology, presumptive theology, and indeterminate theology. We argued that each type played an important role in some arguments for evolution and yet all three types face significant difficulties, including mischaracterizations of opponents, unsupported certitude about what God would do, and trivial expressions about what God might do.

In Section 3, we stepped back from concrete cases and instead explored broader problems created by generally having theology in biology textbooks’ arguments for evolution. These problems include:

- The worry that direct engagement with contemporary versions of creationism (or intelligent design) may give students the mistaken impression that these hypotheses are legitimate contenders to evolutionary theory.
- The practical lack of time and interest of authors to learn and nuance various versions of creationism (and ID), and to tease out in their textbooks *which* particular arguments support evolution over *which* versions of creationism.
- In public high schools, the legal precedents in *Epperson*, *McLean*, *Edwards*, *Kitzmiller*, which may ban arguments for evolution that draw on (or critique) certain propositions involving a supernatural Creator.
- The epistemological problem that, given unguided evolution, it likely inscrutable or improbable that human beings can legitimately justify certain theological claims, including those used in arguments for evolution.
- The ‘science and religion’ demarcation problem, in which the truth of either NOMA or complementarity renders scientific evidence powerless to critique creationism.
- Similarly, the truth of either NOMA or complementarity leaves scientific evidence impotent to favor evolution over creationism.
- The ‘methodological’ problem, in which, if methodological naturalism is proper to science, then theology-laden arguments for evolution run counter to the scientific method itself.

- Similarly, if methodological naturalism is canonical, then, within the context of science, empirical evidence cannot refute any theology-laden hypothesis or theory.
- And, finally, if methodological naturalism is correct, then, within the context of science, empirical evidence can never favor evolution over creationism.

Thus, the general presence of theology—of whatever kind—creates unwelcome problems for biology textbooks. While the saliency of these problems depends in part on the commitments of a given textbook (or author), nonetheless, as a collection, they pose a formidable obstacle.

In Section 4, we switched gears and tackled the question, “Why not get rid of theology?” We argued that this is easier said than done. Problems abound, including:

- The broader influence of the Western intellectual tradition and of American culture on the background beliefs of millions of people in the United States
- The failure of halfway measures
- The ‘design-oriented’ cognitive hardwiring of human beings
- The striking appearance of design in nature
- The mind-world affinity between this hardwiring and the appearance of design in nature
- The loss of the central argument in the *Origin*
- The loss of a host of theology-laden arguments for contemporary evolutionary theory by prominent biologists
- The need for comparative evaluation in scientific testing
- The loss of scientific evidence to critique creationism
- The loss of scientific evidence to favor evolutionary theory over creationism

Collectively, these factors encourage the inclusion, rather than exclusion, of God-talk.

Finally, in Section 5, we articulated the dilemma that is now obvious. Moreover, we underscored the power of this dilemma by examining a frequent ‘solution’ found in many texts. We argue that this solution is thoroughly incoherent and self-serving. The poor performance of textbooks on this point shows just how deep the difficulty is. In the end, the overall dilemma remains.

It would be a mistake, of course, to say that our analysis constitutes a critique of evolutionary theory or of the comprehensive justification for it. Our argument is fully compatible with the truth and justification of evolution. While we acknowledge that our worries about textbooks are not entirely disconnected from these broader topics, even so our study does not attempt an expansive analysis of the theory itself or its general grounding.

We return at last to Thomas Kuhn’s meditation on textbooks in *Structure*. He contends that science textbooks play a regulative ideal. They articulate to both laymen and scientists the contours, boundaries, and content of a given paradigm. They tell us what a field is, how it operates, and the way scientists are supposed to reason within that discipline. In this article, we have analyzed 32 textbooks, including the top four in each of the key undergraduate categories: biology majors, non-majors, and evolution courses. Surprisingly, the paradigm that emerges from these texts includes a deep theological muddle. If our argument is correct—and if Kuhn’s analysis of the role of textbooks is right—then the problems we’ve described affect more than just current undergraduates. Instead, as students graduate and join the work force, they may well carry this conflicted paradigm with them to broader domains of society, from professional to lay, public to private. If so, then the problem will only deepen. Darwin once said in his later years that he was in a theological muddle.¹²⁶ On this point, as with so many others, Darwin’s legacy will likely survive and reproduce for some time to come.

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About the Authors

Stephen Dille, Ph.D., is an associate professor of philosophy at St. Edward’s University. He can be reached at stephend@stedwards.edu. Nicholas Tafacory, MLA, is an independent scholar. He can be reached at nicholas.tafacory@gmail.com.

¹²⁶Charles Darwin, letter to J.D. Hooker. 12 July 1870. Darwin Correspondence Project, “Letter no. 7273,” accessed on 7 May 2019, <http://www.darwinproject.ac.uk/DCP-LETT-7273>.

Figure 1: God-talk Table

Notes: (a) An asterisk designates an elliptical statement that, in our view, can be plausibly interpreted as presumptive theology, indeterminate theology, or the like (as appropriate) when considered in the larger context of the passage. (b) “Separation/HM” indicates a version of the separation thesis (e.g., NOMA, methodological naturalism) or a halfway measure.

Title	Straw God	Presumptive	Indeterminate	Separation/HM	Incoherence
Audesirk 11 th	p. 263	p. 265-66, 270-71		p. 10-11	p. 10-11, 263-66, 270-71
Barton 1 st	75	75, 81		81-82*	75, 81-82
Belk 5 th	205-207			4, 207	207, 213, 230*
Bergstrom 2 nd	33	115		31-32	31-32, 53, 55, 115
Brooker 3 rd	460				460*
Freeman 6 th	435-38	442-43			9, 441-43
Futuyma 4 th	9, 575-76	45	44-45	578	44-45, 573-83, esp. 578
Gunstream 12 th					
Hall 5 th	572, 575	208*		561-62, 575*	56, 208*, 561-62, 574-75*
Herron 5 th	38, 62, 66	56, 98			38, 43, 56, 103
Hillis 2 nd			291*		
Hoefnagels 4 th	238	239-40		13*, 264	13*, 238-43, 260-79
Krogh 5 th	285	293-95	8*	8	8, 286-87, 293-95
Mader 10 th	266-67	277*		11*	11*, 266-79, esp. 267
Mader & W 4 th	238	248*		11-12*	11-12*, 237-51, esp. 248
Mason 1 st	9	9-11	442*		
Miller 1 st				5	5, 450-66, esp. 453-54
Morris 3 rd	427*		393		
Phelan 4 th	300-304, 336-37	332-33		24	4-5, 24, 332-33, 336-37
Raven 10 th	11	9, 432-433*	428-29		
Ridley 3 rd	67, 263-64		281	43-70, esp. 44, 67-68	44, 67-68, 263-64, 281
Russell 3 rd	440	440			
Sadava 11 th			420*, 433*	15	15, 420*, 433*
Simon 2 nd	152	161		4	
Simon et al. 7 th	244-48, esp. 245, 247	250		4, 6	4, 6, 245, 247, 250
Singh-Cundy 5 th	386*			13, 402	13, 402, 386-89
Shuster 2 nd	322-24			3	3, 322-24, 352-69
Solomon 11 th				16	16, 391-405, esp. 391-95
Stearns 2 nd					
Taylor 9 th	260-61	264*		6	6, 260-68
Urry 11 th	467-68	477-78*		16-19, esp. 18; 26	18, 26, 466-83, esp. 467-68, 477-78
Zimmer 2 nd	29-34, 52	40			

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