

# PERSPECTIVES on Science and Christian Faith

JOURNAL OF THE AMERICAN SCIENTIFIC AFFILIATION

## *In This Issue ...*

The English Bible and the Days of Creation:  
When Tradition Conflicts with Text

Genetic Insights for Human Origins in Africa  
and for Later Neanderthal Contact

Understanding the Beginning in Light of the End:  
Eschatological Reflections on Making Theological  
Sense of Evolution

Christian Commitment and the Scientist

Logical Pitfalls and Communication Gaps:  
Frequent Lines of Argument That  
Dead-End the Origins Conversation

*"The fear of the Lord  
is the beginning of Wisdom."  
Psalm 111:10*

VOLUME 66, NUMBER 3

SEPTEMBER 2014

### Editor

JAMES C. PETERSON (Roanoke College and  
Virginia Tech Carilion School of Medicine)  
221 College Lane  
Salem, VA 24153  
jpeterson@roanoke.edu

### Book Review Editors

PATRICK FRANKLIN (Providence University College  
and Seminary), Coordinating Editor  
10 College Crescent  
Otterburne, MB R0A 1G0  
patrick.franklin@prov.ca

ARIE LEEGWATER (Calvin College)  
1726 Knollcrest Circle SE  
Grand Rapids, MI 49546  
leeg@calvin.edu

SARA SYBESMA TOLSMA (Northwestern College)  
101 7th St SW  
Orange City, IA 51041  
stolsma@nwciova.edu

HEATHER LOOY (The King's University)  
9125 - 50th Street  
Edmonton, AB T6B 2H3  
heather.looy@kingsu.ca

DEREK SCHUURMAN (Redeemer University College)  
777 Garner Rd E  
Ancaster, ON L9K 1J4  
dschuurman@cs.redeemer.ca

### Editorial Board

ROBERT BISHOP, *Wheaton College*  
HESSEL BOUMA III, *Calvin College*  
WALTER L. BRADLEY, *Baylor University*  
WARREN S. BROWN, *Fuller Graduate School of  
Psychology*  
JEANNE BUNDENS, *Eastern University*  
HARRY COOK, *The King's University*  
JANEL M. CURRY, *Gordon College*  
EDWARD B. DAVIS, *Messiah College*  
OWEN GINGERICH, *Harvard-Smithsonian Center  
for Astrophysics*  
ALLAN HARVEY, *Boulder, CO*  
D. GARETH JONES, *University of Otago*  
ROBERT KAITA, *Princeton University*  
TREMPER LONGMAN III, *Westmont College*  
HEATHER LOOY, *The King's University*  
SARA MILES, *Eastern University*  
KEITH B. MILLER, *Kansas State University*  
GEORGE L. MURPHY, *Trinity Lutheran Seminary,  
Columbus, OH*  
ALAN PADGETT, *Luther Seminary*  
JACK C. SWEARENGEN, *Santa Rosa, CA*  
JUDITH A. TORONCHUK, *Trinity Western University*  
DAVIS A. YOUNG, *Calvin College*

### Managing Editor

LYN BERG (American Scientific Affiliation)  
PO Box 668  
Ipswich, MA 01938-0668  
lyn@asa3.org

ESTHER MARTIN, Manuscript Editor

### *Perspectives on Science and Christian Faith*

(ISSN 0892-2675) is published quarterly for \$50 per year by the American Scientific Affiliation, 55 Market Street, Ste. 202, PO Box 668, Ipswich, MA 01938-0668. Phone: 978-356-5656; Fax: 978-356-4375; asa@asa3.org; www.asa3.org.

Periodicals postage paid at Ipswich, MA and at additional mailing offices. POSTMASTER: Send address changes to: *Perspectives on Science and Christian Faith*, American Scientific Affiliation, PO Box 668, Ipswich, MA 01938-0668.

## Manuscript Guidelines

The pages of *Perspectives on Science and Christian Faith (PSCF)* are open to original, unpublished contributions that interact with science and Christian faith in a manner consistent with scientific and theological integrity. A brief description of standards for publication in *PSCF* can be found in the lead editorial of the December 2013 issue. This is available at [www.asa3.org](http://www.asa3.org) under publications → PSCF → index. Published papers do not reflect any official position of the American Scientific Affiliation.

1. Submit all manuscripts to: **James C. Peterson, Editor, Roanoke College, 221 College Lane, Salem, VA 24153.** E-mail: [jpeterson@roanoke.edu](mailto:jpeterson@roanoke.edu). Submissions are typically acknowledged within 10 days of their receipt.
2. Authors must submit **an electronic copy of the manuscript formatted in Word** as an email attachment. Typically 2–3 anonymous reviewers critique each manuscript considered for publication.
3. Use endnotes for all references. Each note must have a unique number. Follow *The Chicago Manual of Style* (16th ed., sections 14.1 to 14.317).
4. While figures and diagrams may be embedded within the Word text file of the manuscript, authors are required to also send them as individual electronic files (JPEG or TIFF format). Figure captions should be provided as a list at the end of the manuscript text. Authors are encouraged also to submit a sample of graphic art that can be used to illustrate their manuscript.

**ARTICLES** are major treatments of a particular subject relating science to a Christian position. Such papers should be at least 2,000 words but **not more than 8,000 words in length**, excluding endnotes. An abstract of 50–150 words is required. Publication for such papers normally takes 9–12 months from the time of acceptance.

**COMMUNICATIONS** are brief treatments of a wide range of subjects of interest to *PSCF* readers. Communications **must not be longer than 2700 words**, excluding endnotes. Communications are normally published 6–9 months from the time of acceptance.

**BOOK REVIEWS** serve both to alert readers to new books that appear significant and to engage these books in critical interaction. When a subject area editor selects a book for review, the book is then offered to a scholar with the best match in expertise. ASA/CSCA members who would like to be considered as potential reviewers are welcome to express interest to the book review coordinating editor for inclusion in the reviewer database. Publishers may also contact the book review coordinating editor if they are not sure which subject area reviewer would best consider a particular book.

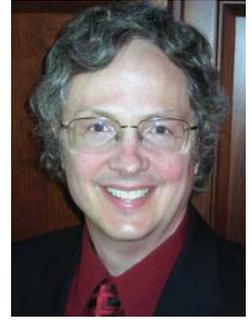
- **Patrick Franklin** ([patrick.franklin@prov.ca](mailto:patrick.franklin@prov.ca)): book review coordinating editor; subject areas: ethics, philosophy, and theology.
- **Arie Leegwater** ([leeg@calvin.edu](mailto:leeg@calvin.edu)): cosmology, history of science, mathematics, and physical sciences.
- **Sara Sybesma Tolsma** ([stolsma@nwciova.edu](mailto:stolsma@nwciova.edu)): biology, environment, genetics, and origins.
- **Heather Looy** ([heather.looy@kingsu.ca](mailto:heather.looy@kingsu.ca)): anthropology, neurology, psychology, and sociology.
- **Derek Schuurman** ([dschuurman@cs.redeemer.ca](mailto:dschuurman@cs.redeemer.ca)): computers, engineering, and technology.

The viewpoints expressed in the books reviewed, and in the reviews themselves, are those of the authors and reviewers respectively, and do not reflect an official position of the ASA.

**LETTERS** to the Editor concerning *PSCF* content may be published unless marked not for publication. Letters submitted for publication **must not be longer than 700 words** and will be subject to editorial review. Letters are to be submitted as electronic copies. Letters accepted for publication will be published within 6 months.

**ADVERTISING** is accepted in *PSCF*, subject to editorial approval. Please address inquiries for rates or further information to the Managing Editor. The ASA cannot take responsibility for any orders placed with advertisers in *PSCF*.

**AUTHORIZATION TO PHOTOCOPY MATERIAL** for internal, personal, or educational classroom use, or the internal or personal use of specific clients, is granted by ASA, ISSN: 0892-2675, provided that the appropriate fee is paid directly to Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923 USA for conventional use, or check CCC online at the following address: [www.copyright.com/](http://www.copyright.com/). No registration with CCC is needed: simply identify the article being copied, the number of copies, and the journal title (*Perspectives on Science and Christian Faith*). For those who wish to request permission for other kinds of copying or reprinting, kindly write to the Managing Editor.



James C. Peterson

# What Is Not Said

**R**ecognizing what is not said is often as important as hearing what is said. In our lead article of this issue, Harry Lee Poe argues that the first chapter of Genesis describes five days of creation, with each day as a particular starting point. The specific grammar used does not imply that the days are in immediate succession. Each described day is a day, not the very next day. According to Poe, many attempts at harmonizing scripture with science are actually trying to match science with something scripture has never said.

There is a key principle here for Christian faith (and the sciences). If one is taking scripture seriously, it is as important to hear what it is not saying as to hear what it is saying. Otherwise, one is attributing revelation and authority to one's own additions to the text. That is eisegesis, rather than exegesis: reading into scripture rather than reading out from scripture. The final chapter of the New Testament is explicit in warning against such (Rev. 22:18-19).

Our second article carries on this theme of carefully reporting as accurately as possible what is said without claiming what is not said. David Wilcox describes how genetics reveals much about human origins, but there is much that genetics cannot say. Scientific study includes theorizing interest, context, and potential explanations for observed data. But it is not within the ability of science to settle theological implications. Science is very good at what it does, but only at what it does. It is as important to realize the limits of how far it can go as to recognize how far it has come. Science describes as best it can patterns of material causation. It cannot address whether that material causation is all that exists. When science is claimed as the sole arbiter of what is real, that is an expression of a philosophy or worldview of scientism, no longer science itself.

In the third article in this issue, the theologian Patrick Franklin proposes a way of approaching Christianly some of what science thinks it has observed. He sees an evident evolutionary process as part of what God as the Trinity is doing through the Son and the ongoing work of the Holy Spirit toward a new creation.

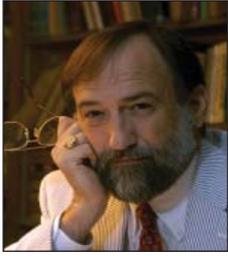
Then, in the first communication, we find a piece written exactly fifty years ago. Elving Anderson again guides us in thinking about fruitful dialogue between established commitments and the fair assessment of what appears to be new and reliable data.

In the second communication, Stephen Contakes reflects on the dialogue at a recent conference on the sciences and Christian faith. He suggests various methods of better sorting out what we can claim in such discussions.

Finally, our review section alerts us to ten new books that think through the extent and implications of what we do and do not know in our ongoing investigations.

It has been said that people who are absolutely sure, probably do not understand the breadth and depth of whatever it is that they are addressing. The person who is not absolutely sure, probably understands more. Or at least so it seems. It is an essential part and characteristic of truly growing in understanding, to recognize how finite we and our understandings are. We can learn, but that very progress triggers a greater realization of the extent of our limitations. Whether listening to Christian scriptures or to scientific observations and theory, recognizing what is not said is part of understanding what is said. Being aware of what we do not know is an important part of knowing what we do. *✍*

**James C. Peterson**, *editor*



Harry Lee Poe

## Article

# The English Bible and the Days of Creation: When Tradition Conflicts with Text

Harry Lee Poe

*The English Bible translation of Genesis 1 has framed the discussions and disagreements over science and religion in the West throughout the modern period. Regardless of the players' attitude toward God and the Bible, many assume that the Bible says that the universe was made in six consecutive solar days within one week. The problem with such an approach is that this idea cannot be found in the Hebrew text of Genesis. The Hebrew text does not have the definite article with the first five days of the week. Creation did not begin "the first day" but "one day." It did not continue on "the second day" but on "a second day," and so on until humans appear. In Genesis, the aspects of creation have six definite beginning points, but creation occurs over an indeterminate period of time. The Hebrew, Greek, and Latin texts do not introduce the definite article before day six, yet most English translations since the time of Wycliffe have added the definite article to the first five days.*

Of all the controversies that arise between science and religion in the West, the pivotal issue for many of them involves how to read the first chapter of Genesis. Some people prefer a literal reading, whereas others prefer a symbolic reading. Both of these approaches, however, depend upon establishing how best to translate the Hebrew into modern English.

Enormous energy has gone into the debate over whether the Hebrew word *yom* should be translated *day* or *period of time*. For centuries, the debate has ignored the grammar of the first chapter and the other words in the first chapter. Ironically, *yom* probably was intended to mean a solar day in the first chapter of Genesis

while also allowing for an indeterminate time span between days that could be the approximate fourteen billion years that current cosmology suggests. In other words, while allowing that *yom* should be understood as a twenty-four-hour day, a literal reading of the text allows for a vast period of time that makes the option of a week of seven twenty-four-hour days highly problematic.

Each of the seven days of Genesis 1 clearly presents new things happening that had never happened before. This linear unfolding of the world would have contrasted starkly against the understanding of the ancient Near Eastern nature religions or even the sophisticated philosophy of Aristotle centuries later. Aristotle's basic understanding of an eternal, infinite universe persisted in scientific circles into the latter twentieth century. Even the philosophy of science that attaches to string theory and multiverses yearns for the days of Aristotle and the rhythm of the nature religions.

---

**Hal Poe** serves as Charles Colson Professor of Faith and Culture at Union University in Jackson, TN. Poe has published over fifteen books on the intersection of the gospel and culture, including four books on science and faith co-authored with Jimmy Davis, the most recent of which is *God and the Cosmos: Divine Activity in Space, Time and History* (IVP, 2012). He was elected to the Executive Council of the ASA in 2010.

In Genesis, creation has a necessary sequence from simplicity to complexity that we do not find in the other sacred texts of antiquity where “creation myths” involve a refashioning of what already existed from previous epochs. When he returned to God from his pagan apostasy, King Solomon described in Ecclesiastes the meaninglessness of “no new thing” before contrasting this pagan view of endless cycles with the idea of “a time for every purpose under heaven” (Ecclesiastes 1–3). In the universe in which we live, there was a time before which life did not exist, but then one day it did. The universe has a sequence of development, as does human culture.

## The Challenge of Tradition

The Protestant Reformation arose in the sixteenth century with a commitment to scripture over tradition as the final authority in matters of faith. Ironically, in some cases, the Protestants who translated the Bible into English were governed by tradition rather than the actual words of the biblical text in deciding how they translated the scriptures. The cases vary in their significance.

One of the most obvious examples of the choice of tradition over text concerns how the King James Bible treats the name of God. When God revealed himself to Moses and commissioned him to lead the children of Israel out of Egypt, he told Moses that his name is *Yahweh*, and he instructed Moses to call him by name. Over the centuries, the descendants of the Hebrews grew superstitious about the covenant name of God and resolved that it was too holy to speak; therefore, when they came to the holy name in the scriptures, they said *Adonai* (Lord) instead of *Yahweh*. The translators of the King James Bible carried on this tradition of not speaking the name of God by replacing the holy name with the title LORD spelled with all capital letters whenever the name *Yahweh* occurs.

Another example concerns how the translators dealt with the Greek word *baptizo*, which means to dip or immerse. By the time of the King James Bible, the English church had not practiced the immersion of new Christians in centuries. To translate the word would have conflicted with the tradition of initiation into the church. Instead of translating the word, therefore, the translators transliterated the word as *baptize*.

The case of the seven days of creation in the first chapter of Genesis, however, has probably had the most significant impact on how modern people view the Bible and its authority. The King James Bible presents creation within the context of six consecutive days within a single week that culminate with God’s rest on the seventh day. Coming at the dawn of the scientific age in 1611, the King James Bible was the Bible used in the English-speaking world as scientific knowledge propelled Western culture dramatically beyond all other cultures of the world in terms of technological sophistication and understanding of how the physical world works. With the remarkable success of the scientific method in physics and chemistry, scientific knowledge came to be regarded as the real knowledge, and for something to be true, it should be scientific. This attitude created a crisis for faith in the nineteenth century with the development of the sciences of geology and paleontology.

As geologists discovered layers of sediment and rock and developed theories to account for interruptions of strata, a new view developed regarding the age of the earth. The geology of the earth suggested great antiquity and that the earth had undergone tremendous stress, cataclysm, and upheaval over millions of years. This view appeared to contradict the clear meaning of the biblical text with which everyone was familiar. As paleontologists discovered bones of gigantic creatures that no longer roam the earth, and as these bones appeared in layers of the earth from the distant past, another contradiction with the biblical account of creation appeared to arise.

By the mid-nineteenth century, several theories had arisen to account for the discrepancy between the clear meaning of the biblical account and what the new sciences had proposed. The Scofield Reference Bible follows the view of the Reverend William Buckland, Oxford’s first professor of geology, who believed that a great “gap” of millions of years existed between the creation in the first verse of Genesis and the first day. During this gap, all the catastrophes of the geological record occurred. Scottish geologist Robert Jameson proposed the Age-Day Theory in 1813 which argued that each day of Genesis 1 represents a vast period of time. Another approach to the contradiction comes from the Scientific Creationism movement which argues that the science is wrong and that the clear meaning of the text should be accepted. All of these views, and many other perspectives in the science and religion area, have one thing

# Article

## *The English Bible and the Days of Creation: When Tradition Conflicts with Text*

in common. They all agree that the Bible appears to teach that creation occurred in six consecutive days within a single week. In translating the first chapter of Genesis, however, the King James translators followed the tradition rather than the text.

### The Text as Written

In the Hebrew text of Genesis, the days of creation occur sequentially, but not necessarily as consecutive days. January 1 and February 1 come sequentially, but not consecutively because other days intervene between the two days. It is even possible that the fourth day is intentionally placed out of order chronologically.<sup>1</sup> Instead of describing the first act of creation as happening on “the first day,” Genesis states that it happened “one day.”<sup>2</sup> The action does not occur on the first day. It happens one day. A cardinal rather than an ordinal numeral is used. Instead of the second act of creation happening on “the second day,” the original text of Genesis actually states that it happened on “a second day.” On and on the description of creation goes in the original Hebrew text with “a third day,” “a fourth day,” and “a fifth day.” Finally, the pattern changes at the end of the sequence when the Hebrew text explains that humans were made on “the sixth day” and that God rested on “the seventh day” (emphasis added):

- 1:5    **דְּחַם הַיּוֹם** (adjective numeral masculine singular)  
          one day
- 1:8    **יּוֹם שֵׁנִי** (adjective masculine numeral ordinal)  
          a second day
- 1:13    **יּוֹם שְׁלִישִׁי** (adjective masculine numeral ordinal)  
          a third day
- 1:19    **יּוֹם רְבִיעִי** (adjective masculine numeral ordinal)  
          a fourth day
- 1:23    **יּוֹם חֲמִישִׁי** (adjective masculine numeral ordinal)  
          a fifth day
- 1:31    **יּוֹם שֵׁשֶׁת** (definite article—adjective masculine  
          singular numeral ordinal)  
          the sixth day
- 2:2    **יּוֹם שִׁבְעִי** (definite article—adjective  
          masculine singular numeral ordinal)  
          the seventh day

The days do not necessarily come one after another without intervening time. Instead of the next day, the events unfold on some other day.

The grammar of the Hebrew language and the way words are formed in Hebrew based on the verb makes Hebrew one of the most regular languages on Earth. It follows strict patterns. Even its irregular verbs follow regular patterns. Students of Hebrew learn the language by learning the patterns. An interruption in the normal pattern comes as a striking emphasis. As in English and many European languages, Hebrew has a definite article that is normally used when referring to one of the seven consecutive days within a week, namely, the second day, the third day, the fourth day, and so forth. This pattern continues for the first ten consecutive days within a month. This pattern may be seen clearly in the first books of the Bible:

Genesis 22:4; 31:22; 34:25; 40:20; 42:18

Exodus 2:13; 12:3, 16, 18; 13:6; 16:5, 22, 26, 27, 29, 30; 19:11, 15, 16; 20:10, 11; 22:29; 23:12; 24:16; 31:17; 34:21; 35:2; 40:2

Leviticus 7:17, 18; 9:1; 12:3; 13:5, 6, 27, 32, 34, 51; 14:9, 10, 23, 39; 15:14, 29

Numbers 7:12, 18, 24, 30, 36, 42, 48, 54, 60, 66; 29:17, 20, 23, 26, 29, 32, 35.

Deuteronomy 1:3; 5:14; 16:4, 8

Genesis forms the introductory section of a group of books known as the Pentateuch (the first five books of the Bible also known as the Books of Moses and as the Torah). In every example of the enumeration of a full sequence of consecutive days within a week or a month in the Pentateuch, the pattern of using the definite article with the ordinal numeral is always followed. Beyond the tenth day, however, the Hebrew text never uses the definite article, probably because numbers above ten are formed by the combination of more than one word instead of by a single word.<sup>3</sup> In Exodus 19:16, the frightening presence of God happened on “the third day.” In Exodus 16:5, the Israelites are instructed to gather twice as much manna on “the sixth day.” In Genesis 22:4, Abraham arrived at the place of sacrifice on “the third day” after setting out. At the battle of Jericho, God gives instruction about what the people are to do on consecutive days until “the seventh day” when they were to take the city (Joshua 6:3–4, 12–15). These well-known examples illustrate the normal Hebrew pattern of using the definite article to indicate consecutive days within a week. The seven days of creation in Genesis 1 do not follow this pattern. The text

says something quite different, which means something quite different.<sup>4</sup>

The definite article is frequently omitted in Hebrew poetry, especially in the oldest poetry such as the psalms.<sup>5</sup> While the first chapter of Genesis has a liturgical quality to it, that quality does not make it poetry. One might argue that the passage is highly poetic. On the other hand, all of Hebrew prose is highly poetic. One would expect to find the definite article in a discussion of successive days in a single week. The definite article is normally found in other Hebrew narratives in which events take place within the time frame of a week, but it does not occur here. Its absence is conspicuous and significant for what its absence conveys.

The presence or absence of the definite article with the ordinal numeral and the noun “day” makes an enormous difference in meaning. If I relate my life and how I came to Union University, I might say,

- One day I was born.
- A second day I started preaching.
- A third day I started being married to Mary Anne Whitten.
- A fourth day I started being a father to Rebecca and then to Mary Ellen.
- A fifth day I started living in Minnesota.
- The sixth day I started working at Union.
- The seventh day I die.

This narrative is true, and it captures the significant moments that began on particular days. The activity or state that begins on a particular day had not occurred previously, and it continues on into the future. So why does this narrative of my life use a definite article for day six? The sixth day is the focus of activity in which I am now engaged. We may also speculate on why day six of creation has a definite article. It appears that the rest of the Bible focuses its attention on God’s creation of people and his ongoing relationship with them. We could speculate further that we still live in the age inaugurated by the sixth day. We have not yet entered into the Sabbath rest of God (Heb. 4:1-10). This brief speculation demonstrates the difference between revelation and theology. The text is revelation from God. Theology is speculation about the text.

A more controversial issue that affects the interpretation of the text relates to the verb forms in Genesis 1.

The verbs that describe the creative acts of God on the days of creation are all imperfect verbs. Ancient Hebrew had no past, present, or future tense verbs as English does. Its verbs focus on the quality of action. The perfect verb indicates completed action, whether the action is completed in the past, the present, or the future. The imperfect verb indicates incomplete action, whether the action was begun in the past, the present, or the future. On the surface, this concept of verbs may sound strange to us today with our worldview, but we have a way of thinking that corresponds to this approach which we use every day. We call it the historical present, and even seasoned writers are known to lapse into it. Consider this example:

Charles Dickens tells us of the contradictory nature of French society in the opening of *A Tale of Two Cities*. He writes about the contrast between English and French approaches to the challenges of the eighteenth century, and he says that love is more powerful than a revolution.

Though the verbs are all in the present tense, we know that the paragraph refers to the writing of Charles Dickens one hundred and fifty years ago. It is not necessary to have a past tense verb in order to understand that events have taken place in the past.

The imperfect verb indicates incomplete or continuing action. The activity of God during the seven days of creation employs the imperfect verb, indicating continuing action or action which has begun but which does not stop. By contrast, the first sentence of the Bible uses the perfect tense of the verb “create” to indicate that God has completed the creation of the heavens and the earth. The perfect verb form of create is rendered as a past tense verb in English (created), for to say that God completes something is to give it a quality of certainty as though it has already happened, but the text then goes on to describe the continuing creation by God.<sup>6</sup>

In contrast to the completed action of the perfect tense, the imperfect tense indicates that action has begun, but that it continues. The action unfolds sequentially, with each new act of creation introduced by the construction known as the *waw* consecutive (the *waw* conjunction plus an imperfect verb), so named because the simple Hebrew letter *waw* serves as the conjunction. A literal translation of Genesis 1:3 might be, “And then God begins to say, let there begin to be and continue to keep on

# Article

## *The English Bible and the Days of Creation: When Tradition Conflicts with Text*

being light. And then there begins to be and continues to keep on being light." The activity that begins "one day" continues beyond the day on which it begins. The light continues to be called forth on the day when the firmament begins to be established, along with the dry land and the oceans. The first day comes to an end, but the activity of the first day does not. The light, the firmament, the dry land, and the oceans continue to be called forth and shaped even on the day when God begins to call the earth to begin to put forth plant life. This Hebrew thought pattern of continuing action is reflected in Peter's discussion of the last judgment when he observes,

First of all, you must understand that in the last days scoffers will come, scoffing and following their own evil desires. They will say, "Where is this 'coming' he promised? Ever since our fathers died, everything goes on as it has since the beginning of creation." (2 Pet. 3:3-4)

Notice the Hebrew pattern of thought that piles up the continuing action. Notice the emphasis on the "beginning of creation." It is not a modern Western worldview that nurtured Peter, but the ancient Hebrew thought pattern of his culture.

Thus, the calling forth of light was not an activity of God on one particular day only, but an activity of God, once begun, that continues on. This idea of the continuing activity of God over his creation is reflected in the words of Jesus: "He causes his sun to rise on the evil and the good, and sends rain on the righteous and unrighteous" (Matt. 5:45). We might make the theological judgment that God is still calling forth the light. The modern translations make no attempt to capture the force of the Hebrew as they attempt to place the verbs into English tenses, but we see a reflection of this idea of the continuing calling forth by God in Hebrews 1:3: "upholding all things by the word of his power." As a result of neglecting the force of the verbs, however, the possible interpretation of the Bible has been skewed.<sup>7</sup>

On a fourth day of creation (which was not, grammatically speaking, *the* fourth day of the universe), something intriguing happens. Up until this point, the action happens sequentially, as indicated by the *waw* consecutive construction, normally translated "and then." With the creation of the sun and the moon we have one of the great problems in science and religion. Some will ask how plants can exist before the sun. The timing for the creation of the sun

and moon falls out of sequence for a modern understanding of the solar system.<sup>8</sup> While the sentence about the creation of the sun and moon comes after the sentences about the creation of plants, the grammar allows the possibility for their creation at the same time or prior to the preceding action. Instead of relying on the *waw* consecutive conjunction ("and then") with a piling up of imperfect verbs to relate the narrative, the text introduces the perfect of relation construction (the *waw* conjunction with the perfect verb) in Genesis 1:14-15 which can thrust the action backward.<sup>9</sup> The grammatical point is that the verbs suggest that what happened on "a fourth day" could have taken place at an earlier time.<sup>10</sup> The change in verbs on this day is the more striking because of the regular pattern of using the imperfect verb throughout the rest of the creation narrative. Patterns are important in the Hebrew language and the interruption of the pattern at the one point in which it would make a difference to the modern world is noteworthy. It is possible that the text makes a change at this point with no other purpose than to offer variety, but the coincidence is remarkable if that is the case.

This placing of the activity of point number four at an earlier period is reflected in the Hebrew thought pattern of Jesus. In describing the end times, he spoke of wars, revolutions, earthquakes, famines, and pestilence. Then he said, "But before all this, they will lay hands on you and persecute you" (Luke 21:12). Then he goes back to a chronological sequence of events leading up to the coming of the Son of Man in glory. Though the creation of sun and moon fall fourth in the list of aspects of creation, the construction of the *waw* conjunction with a perfect verb suggests that it may have occurred earlier.

## The Translation Tradition

Several hundred years before the birth of Christ, the Hellenistic Jewish community in Alexandria translated the Hebrew Scriptures into Greek. This translation, known as the Septuagint and signified by the Roman numerals LXX, became the standard biblical text of the Jews in the time of Christ throughout the Roman Empire. Hebrew had ceased to be a spoken language, so much so that when Jesus quoted Psalm 22 in Hebrew from the cross, the Jerusalem mob did not know what he was saying (Matt. 27:46-47; Mark 15:34-35). The Koine Greek of

the New Testament does not have the same regularity as Hebrew, for as the commercial language of the Roman Empire, it resembles modern pigeon English compared with Classical Greek. The Greek of the Septuagint Pentateuch (ca. 250 BC) represents an early form of the transition from Classical Greek to Koine Greek and probably falls only a few generations after Alexander the Great.

In the Septuagint, the rabbis followed the Hebrew text and did not use the definite article with the ordinal numerals and days of creation. The omission of the definite article in a Greek text would not be absolutely determinative in itself, but as the rabbinic understanding of the original Hebrew text in ancient times, it serves to explain why the ancient rabbis understood the days of creation to represent a vast period of time.<sup>11</sup> As in the Hebrew text, the Septuagint adds the definite article when it comes to the sixth and seventh days:

- 1:5 ἡμέρα μία (noun, feminine nominative singular adjective)  
day one
- 1:8 ἡμέρα δευτέρα (noun, feminine nominative singular adjective)  
day second
- 1:13 ἡμέρα τρίτη (noun, feminine nominative singular adjective)  
day third
- 1:19 ἡμέρα τετάρτη (noun, feminine nominative singular adjective)  
day fourth
- 1:23 ἡμέρα πέμπτη (noun, feminine nominative singular adjective)  
day fifth
- 1:31 ἡμέρα ἕκτη (noun, feminine nominative singular adjective)  
day sixth
- 2:2 τῇ ἡμέρᾳ τῇ ἕκτῃ (definite article, noun, definite article, feminine dative singular adjective)  
the day the sixth
- 2:2 τῇ ἡμέρᾳ τῇ ἑβδόμῃ (definite article, noun, definite article, feminine dative singular adjective)  
the day the seventh

With the Septuagint, however, the rabbis do make an intriguing alteration or interpretation of the activity of God at the end of creation. At the end of verse 31, the Septuagint does not follow the

Hebrew text. Instead, it continues the earlier pattern and describes the making of people as occurring on “a sixth day” instead of “the sixth day.” What the Hebrew text places in verse 31, the Septuagint then moves to chapter two, verse two. The Septuagint begins Genesis 2:2 by adding that God finished his work “on the sixth day” before stating that God rested “on the seventh day.”

In the last days of the Western Roman Empire, about a decade before Alaric sacked Rome in 410, Jerome translated the Bible into Latin. His translation, known as the Vulgate, was the text of the Bible used by the Roman Catholic Church until the 1960s. Latin, like modern Russian, has no definite article. It has no way to say “the book.” It can only say “book.” As a result, the Vulgate does not carry forward the same emphasis as the Hebrew text of the Bible.

- 1:5 *dies unus* (noun, adjective nominative masculine singular cardinal)  
day one
- 1:8 *dies secundus* (noun, adjective nominative masculine singular ordinal)  
day second
- 1:13 *dies tertius* (noun, adjective nominative masculine singular ordinal)  
day third
- 1:19 *dies quartus* (noun, adjective nominative masculine singular ordinal)  
day fourth
- 1:23 *dies quintus* (noun, adjective nominative masculine singular ordinal)  
day fifth
- 1:31 *dies sextus* (noun, adjective nominative masculine singular ordinal)  
day sixth
- 2:2 *die septimo* (noun, adjective dative masculine singular ordinal)  
day seventh

Whereas the Hebrew and Septuagint scriptures indicate indefinite days of creation in terms of their relationship to each other in time, the Vulgate has no necessary meaning one way or the other. Augustine, a contemporary of Jerome who knew neither Greek nor Hebrew, assumed that the days of creation involved vast periods of time. Moreover, he believed that the days of Genesis 1 refer to the creation of the angels and their light, rather than to solar days.<sup>12</sup>

# Article

## *The English Bible and the Days of Creation: When Tradition Conflicts with Text*

### A New Tradition Begins

For a thousand years, the Vulgate was the Bible of the West. Then, in England during the late 1300s, John Wycliffe initiated a translation of the Bible into English. Known as “The Morningstar of the Reformation,” Wycliffe argued that the Bible, as God’s law, represented the highest authority on Earth. During the crisis of authority at the end of the medieval period when schism in the Roman Catholic Church had resulted in multiple popes and when tradition had so overshadowed the faith that corruption crept in at every side, Wycliffe argued for reform of the practices, government, and theology of the church along biblical lines.

Ironically, it was the Wycliffe Bible translation of Genesis, which sought to combat human tradition, that first introduced the definite article into the text. The effect of this introduction changes the meaning of the text from seven sequential days of creation that are not immediately consecutive, to a single week of seven successive, consecutive days:

- 1:5 o daie
- 1:8 the seconde dai
- 1:13 the thridde dai
- 1:19 the fourthe dai
- 1:23 the fyueþ dai
- 1:31 the sixte day
- 2:2 the seuenthe dai

Wycliffe was in the vanguard of the new thinking that ushered in not only the Reformation, but also the scientific revolution, for both were the products of the same reforming intellectual spirit within the Roman Catholic Church. Though Wycliffe led in the translation of the Wycliffe Bible, it was not completed until ten years after his 1384 death. Wycliffe appears not to have done the translation work of the Old Testament himself, but to have left it to Nicholas Hereford and John Purvey who translated from the Latin Vulgate rather than from the original Hebrew text. This article will not attempt to explain what influences in the late medieval period might have led to this new tradition. This article merely indicates that a new tradition developed concerning the creation account, just as the doctrines of transubstantiation, papal infallibility, purgatory, and many more arose during this period.

All of the English language Bibles of the English Reformation period followed the tradition established by the Wycliffe Bible of treating the days of creation as consecutive days within a single week, including Tyndale, Coverdale, the Geneva Bible, and the Bishops’ Bible. By the time the translators began their work on the King James Bible, the mindset within the culture of conceiving of creation as having taken place within the framework of a single week of seven consecutive days formed part of the cultural worldview of the translators. Tradition overruled text. This tradition continued into the late twentieth century when a flurry of activity produced an avalanche of new translations. The notable exceptions to this tradition are the American Standard Version (1901) and its revision, the New American Standard Version (1971), and the Jewish Publication Society’s Tanakh (1917 and 1985), which relied upon the American Standard Version. These translations follow the Hebrew text in not including the definite article.

The tradition has become so entrenched that even Hebrew scholars in the English Bible tradition fail to explore the significance of the glaring absence of a definite article with the days of creation. It is not a theological issue, because conservative and liberal scholars alike simply overlook the matter until it is called to their attention. Commentators as diverse as Gerhard von Rad, Ralph Elliott, E. A. Speiser, Walter Brueggemann, James Montgomery Boice, and John Skinner make no mention of the absence of the definite article in their commentaries.<sup>13</sup>

On the other hand, Kenneth Mathews notes the absence of the definite article but does not discuss its implications.<sup>14</sup> G. Henton Davies, Gordon J. Wenham, and Victor P. Hamilton give literal translations of the Hebrew as “one day,” “a second day,” and so forth, yet in their commentaries on the text, they fail to explain why they gave this translation and what difference it makes.<sup>15</sup> Bruce Waltke notes that the absence of “the definite article on each of the first five days suggests they may be dis-chronologized,” but he does not expound on what the suggestion means.<sup>16</sup> C. F. Keil and Franz Delitzsch took note of the problem of the absence of the article with “day one” and proposed a theory to account for the absence of the article: “Like the numbers of the days which follow, it is without the article, to show that the different days arose from the constant recurrence

of evening and morning.”<sup>17</sup> Claus Westermann took note of the use of “one day” and suggested that it should be understood as an ordinal number, but he took no notice of the absence of the article with the other days.<sup>18</sup> Thus, the power of tradition veils what would otherwise be obvious.

## Conclusion

The perceived conflict between science and religion in the West occurs in large part because of a perceived contradiction between the biblical account of creation and the scientific account of cosmogony. Time is the issue. The science and religion debate has tended to be the arena of philosophers of religion rather than of theologians, and certainly not of biblical scholars. The neglect of such an important topic by merely acquiescing to a tradition, whose origin is vague at best, represents a strange abdication of responsibility. The King James Bible firmly entrenched a view of creation as having taken place within the span of seven chronologically successive, consecutive days within a calendar week. The text cannot sustain this understanding, but with people, tradition too often trumps text.

From this brief survey of a rather esoteric discussion of Hebrew grammar, we may draw several conclusions that range in degree of certainty. The grammar of one situation may dictate the meaning, while the grammar in another situation may only allow for a range of understandings. Of the issues raised in this discussion, the following conclusions may be drawn.

The absence of the definite article with the days of creation almost certainly means that the days are intended to be understood as not occurring in immediate succession to one another without any intervening time. The absence of the definite article precludes the option that the days compose what a modern person regards as a single week of seven days, each day comprising twenty-four hours. What does this mean for the other passages in the Bible that refer to creation as having occurred within a week? There are no such places. Instead, we find several references to God creating the world in six days (Exod. 20:11; 31:17). Whether the six days of creation occur in immediate sequence or with time intervals between, the idea of six days in which God commences new facets of creation is maintained.

Of less certainty from the grammatical constructions, but still of high probability, is the idea that God has continued to be active in creation since he began creating. The deist position would be that God executed an act of creation at the beginning, but that God has been removed from creation since the initial decree. The force of the piling up of imperfect verbs would argue that God begins a good work and continues until he brings it to completion on the last day, an idea reflected in Philippians 1:6. Note that the last day of creation, the seventh day, does not have evening and morning. We might speculate that the seventh day, the last day, is the Day of the LORD.

From high probability, we move to mere possibility that the making of the sun and the moon in day four precedes the previous action. Grammarians continue to argue the point of whether the verb form of the perfect is changed by the *waw* conjunction into an imperfect. If so, then the creation of the sun and moon are intended by the text to have occurred after the previous action. If not, and the force of the perfect verb continues as a perfect verb, then John Joseph Owens’s understanding of the perfect of relation would suggest that the creation of sun and moon occurred at the same time or previous to the preceding action in the narrative.

Neither of the extreme positions on the meaning of Genesis 1 seems tenable. One position argues for a literal understanding of creation as occurring within a week of seven solar days. For the reasons mentioned in this article, it seems highly improbable that the text will allow that understanding. Tradition insists upon such an understanding, but the text does not. The other extreme position argues that the first chapter of Genesis should be understood simply as a poetic affirmation of faith in a creator God. This view regards Genesis as a record of the beliefs of people of faith from an ancient culture. The issue with this view is that it ignores the anthropological problem, that the people of the ancient world had no experiential reason rooted in the world in which they lived that would have given them a reason to believe in a single God, who created the world in a sequential pattern, beginning with the creation of the basic elements and proceeding toward the complexity of life. All the great cultures of the world that had made significant advances in astronomical observation had concluded that the world continues in an endless stream of cycles. The most primitive cultures found

# Article

## *The English Bible and the Days of Creation: When Tradition Conflicts with Text*

this same cyclical understanding in the perpetual cycles of the seasons. It remains for some theory to propose an alternative understanding of how the Hebrews would have conceived such a linear understanding of the world apart from revelation.<sup>19</sup>

This article has proposed that both extreme positions are mistaken because of the assumptions they have accepted from the English Bible tradition of translating Genesis. This article did not explore the powerful force of popular religion in creating religious traditions that may be contrary to the teaching of the Bible, but popular religion has always played an important role in shaping theology that eventually becomes dogma. The sequential account of creation written in antiquity presents a powerful argument for the Genesis creation account as more than a mere cultural artifact of an ancient people. The linear understanding of cosmology that matches the modern scientific breakthroughs of the twentieth century provides evidence of revelation. On the other hand, a literal reading of the text allows for creation that took place over a vast period of time with new things occurring in chronological sequence throughout that vast period. The text is silent about the length of time over which the six days of creation began, except that they did not take place within an Earth reckoning of a solar week. ~

### Notes

<sup>1</sup>For a technical discussion of the chronological ordering of the days in Genesis 1, see David A. Sterchi, "Does Genesis 1 Provide a Chronological Sequence?," *Journal of the Evangelical Theological Society* 39, no. 4 (1966): 529–36. See also M. Throntveit, "Are the Events in the Genesis Account Set Forth in Chronological Order? No," in *The Genesis Debate*, ed. R. F. Youngblood (Nashville, TN: Thomas Nelson, 1986), 53.

<sup>2</sup>I began dealing with this issue in print several years ago when I began to realize that few seminary-trained theologians grasped the significance of the grammar of the Hebrew text, while at the same time lacking even a rudimentary understanding of modern science since Einstein, Bohr, and Lemaître. See Harry L. Poe and Jimmy H. Davis, *Science and Faith: An Evangelical Dialogue* (Nashville, TN: Broadman & Holman, 2000), 79–81, 125–33; Harry Lee Poe and J. Stanley Mattson, *What God Knows: Time and the Question of Divine Knowledge* (Waco, TX: Baylor University Press, 2005), 5–25.

<sup>3</sup>This pattern may be seen clearly in the first books of the Bible: Genesis 8:4, 14; Exodus 12:6, 14; 16:1; Numbers 7:72, 78.

<sup>4</sup>C. John Collins has written an article that illustrates how Hebrew scholars can acknowledge the absence of the definite article and yet adhere to the English Bible tradition.

See C. John Collins, "The Refrain of Genesis 1: A Critical Review of Its Rendering in the English Bible," *The Bible Translator* 60, no. 3 (2009): 121–31.

<sup>5</sup>C. L. Seow, *A Grammar for Biblical Hebrew* (Nashville, TN: Abingdon, 1995), 157.

<sup>6</sup>In ancient Hebrew narratives, the story often begins with a perfect verb followed by imperfect verbs as in Genesis 1. The normal narrative pattern involves the introduction of each new element of the story with the construction "and then" (the conjunction plus an imperfect verb). In some cases such as in the book of Jonah, the narrative actually begins with the conjunction and an imperfect verb. Gesenius reminds us, however, that

the *perfect* and *imperfect consecutive* cannot possibly be used in a way which contradicts their fundamental character as described in §§ 106 and 107. In other words, even the *perfect consecutive* originally represents a finally completed action, &c., just as the *imperfect consecutive* represents an action which is only beginning, becoming or still continuing, and hence in any case incomplete. (*Gesenius' Hebrew Grammar*, ed. and enlarged by E. Kautzsch, 2nd English ed. (Oxford: Clarendon Press, 1920), 330, n. 2)

See also Seow, *A Grammar for Biblical Hebrew*, 147, 207.

<sup>7</sup>This long-held understanding of Hebrew verbs has recently come into dispute in some quarters. In recent years, a fierce debate has grown among Hebrew grammarians over the possibility that the *waw* added to a perfect verb actually changes the perfect into what the English language would consider a past tense. Bruce Waltke argues for a conversion of the tense based on long and short prefix conjugations. See Bruce Waltke and M. O'Connor, *An Introduction to Biblical Hebrew Syntax* (Winona Lake, IN: Eisenbrauns, 1990), 455–78, 543–63. In English, the addition of the suffix *-ed* changes a present tense to a past tense. An example in English of a kind of prefix added to a verb to change its force would be *shall* or *will* prior to a verb. This view that the imperfect verb plus the *waw* prefix forms a past tense has arisen through the study of the limited number of Ugaritic texts available. Among the many problems with this new view is the problem that if the *waw* is the mark of a past tense, it can no longer serve as the conjunction linking the verb to the narrative. In other words, if the *waw* is the mark of a past tense, then it cannot be a conjunction and it would be impossible to have imperfect verbs in a sequence. Even if the imperfect with a *waw* becomes a true past tense, it is still an imperfect denoting incomplete action commenced in the past.

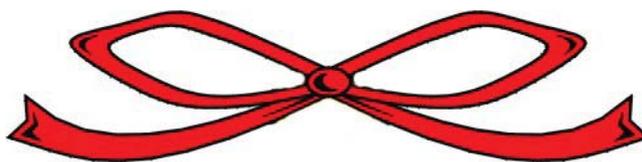
<sup>8</sup>Ralph Elliott raised this question in *The Message of Genesis* (Nashville, TN: Broadman, 1961), 32. James Montgomery Boice also notes the problem in *Genesis: An Expository Commentary*, vol. 1 (Grand Rapids, MI: Baker, 2002), 76.

<sup>9</sup>John Joseph Owens used the term *perfect of relation* of a "simple act completed in relation to another act," and described it as "a simple act completed at a time previous to another act or state, thus resulting in a state of completion." See Kyle M. Yates, *The Essentials of Biblical Hebrew*, rev. ed. by John Joseph Owens (New York: Harper & Row, 1954), 132–3.

<sup>10</sup>At one time, grammarians believed that the *waw* joined to a verb converted it into the same form as the verb that preceded it. Owens reminds us that "there is no particle which has the power of changing a verbal state to another state." See Yates, *The Essentials of Biblical Hebrew*,

104. See also Seow, *A Grammar for Biblical Hebrew*, 226; Page H. Kelley, *Biblical Hebrew: An Introductory Grammar* (Grand Rapids, MI: Eerdmans, 1992), 145. Some modern grammarians cling to the old idea that the *waw* conjunction converts a verb from one form to another, sometimes called a preterite. See Allen P. Ross, *Introducing Biblical Hebrew* (Grand Rapids, MI: Baker, 2001), 136.
- <sup>11</sup>As E. C. Colwell observed of the Greek of the Septuagint that “the Semitic original was a sacred language to be changed as little as possible in translation.” See E. C. Colwell, “The Greek Language,” in *The Interpreter’s Dictionary of the Bible*, vol. 2 (Nashville, TN: Abingdon Press, 1962), 484.
- <sup>12</sup>Augustine, *City of God*, 11.5–9, in which Augustine also discusses the idea of infinite time, God’s experience of time, and his idea that there is no time before the creation of the world; *On the Literal Interpretation of Genesis*, 6.27–7.28, 12.36, 13.43. These citations come from the modern translation *St. Augustine on Genesis*, trans. Roland J. Teske (Washington, DC: Catholic University of America Press, 1990).
- <sup>13</sup>Gerhard von Rad, *Genesis*, The Old Testament Library, rev. ed. (Philadelphia, PA: Westminster, 1976), 52–67; Ralph Elliott, *The Message of Genesis* (Nashville, TN: Broadman, 1961), 34–5; E. A. Speiser, *Genesis*, The Anchor Bible, 2nd ed. (Garden City, NY: Doubleday, 1964), 3–13; Walter Brueggemann, *Genesis. Interpretation: A Bible Commentary for Teaching and Theology* (Atlanta, GA: John Knox, 1982), 22–39; Boice, *Genesis: An Expositional Commentary*, vol. 1, 72–86; John Skinner, *A Critical and Exegetical Commentary on Genesis* (Edinburgh: T&T Clark, 1910), 8–10, 20–38.
- <sup>14</sup>Kenneth A. Mathews, *Genesis 1–11:26*, The New American Commentary (Nashville, TN: Broadman & Holman, 1996), 148.
- <sup>15</sup>G. Henton Davies, “Genesis,” *The Broadman Bible Commentary*, vol. 1 (Nashville, TN: Broadman, 1969), 125–33; Gordon J. Wenham, *Genesis 1–15*, Word Biblical Commentary (Waco, TX: Word, 1987), 2–3, 19; Gordon J. Wenham, *The Book of Genesis: Chapters 1–17*, The New International Commentary on the Old Testament (Grand Rapids, MI: Eerdmans, 1990), 118–43.
- <sup>16</sup>Bruce Waltke, *Genesis: A Commentary* (Grand Rapids, MI: Zondervan, 2001), 62.
- <sup>17</sup>C. F. Keil and F. Delitzsch, *Biblical Commentary on the Old Testament*, vol. 1, trans. James Martin (Grand Rapids, MI: Eerdmans, 1959), 50.
- <sup>18</sup>Claus Westermann, *Genesis 1–11*, trans. John J. Scullion (Minneapolis, MN: Fortress, 1994), 115.
- <sup>19</sup>For a more developed discussion of the anthropological problem of a linear universe prior to the acceptance of Big Bang cosmology in the latter part of the twentieth century, see Harry Lee Poe and Jimmy H. Davis, *God and the Cosmos: Divine Activity in Space, Time and History* (Downers Grove, IL: InterVarsity Press, 2012), 249–83.

**ASA Members:** Submit comments and questions on this article at [www.asa3.org](http://www.asa3.org)→FORUMS→PSCF DISCUSSION.

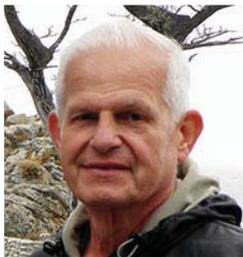


### Looking for a Meaningful Christmas Present?

Gift ASA memberships and PSCF subscriptions are a great way to introduce someone to ASA and our journal. Giving a gift is easy: Go to our online store on our website, <http://network.asa3.org/store>, and click on our gift section.

Select and purchase the gift you wish to give. You will receive a downloadable page with a code that you can give to someone so that he or she can activate the gift membership or subscription.





David L. Wilcox

## Article

# Genetic Insights for Human Origins in Africa and for Later Neanderthal Contact

David L. Wilcox

*It has become obvious that the scientific evidence for where and when the human race appeared is radically different from the traditional assumptions drawn from the narratives in Genesis. The evidence – skeletal, archeological, and genetic – clearly points to Africa, not to the Middle East. The genetic evidence for an ancient African root for humanity is particularly convincing, as is the evidence that human origins occurred to a small population, not to a single pair of humans. Further, some human beings who left Africa to settle the rest of the earth mated with the local Neanderthals. Neanderthal DNA has spread to all non-Africans. This article surveys and explains recent genetic data bearing on these topics.*

## Presuppositions: Setting the Stage—Integrating Scientific Data and the Scriptures

The earth and its fullness belong to the Lord—it is God’s creation. Therefore, expectations (predictions) about the earth that humans draw from the biblical narratives are verifiable or falsifiable by valid data from that creation. This includes theological statements that imply real world predictions. Creation’s data cannot be simply rejected, but require theological reconciliation. Traditional understandings of the scriptures predict (expect or state) patterns of data far different than those reported by modern investigation, producing a serious dilemma. And, in fact, the data supporting alternate views grows stronger year by year. It is true that all theories (scientific or theological) are human formulations, but the data they explain are not human creations; they are discoveries of God’s truth. Theology may reject the theories of science, but it cannot

reject the data of the creation and remain honest before its Creator. And that means giving the data a rational explanation rather than simply rejecting it.

My intent in this article is to survey the recent genetic discoveries related to the origin, nature, and early prehistory of the human species. These are indeed difficult issues, but difficult issues which must be faced and worked out by theologians and scientists in open discussion.<sup>1</sup>

## African Genealogies

Genealogies are constructed from genetic data by looking for slight differences in existing people, specifically changes in their DNA (mutations) caused at various times in the past. Since the most likely reason for two people to share one of these DNA differences is that the change happened in a common ancestor, computer algorithms can be designed to calculate the likely trees of descent. Likewise, the number of DNA differences which have accumulated between any two people can be used to estimate how long ago their common ancestor lived. Such comparisons can be carried out on mitochondrial

**David L. Wilcox** is a population geneticist with a long-term interest in evolutionary mechanisms and faith/science issues. He is an Emeritus Professor of Biology at Eastern University, where he has taught since 1976.

DNA (female parent's line), the Y chromosome (male parent's line), and the autosome chromosomes (both parents' lines). These are the familiar tests done by commercial DNA genealogy sites such as "Family-TreeDNA" or "23andMe." By extending exactly the same techniques, one can construct "paleo-genealogy" lineages.

The traditional reading of Genesis would place the origin of the human race with two people living in the Middle East a few thousand years ago. This traditional reading generates a clear prediction for the genetic genealogy of the human race as a whole. It should be rather short (not too many accumulated changes), and the longest separate branches from the common root should be Middle Eastern. If other regions were settled from that center, they should all have equally shorter local genealogies. That is not what the data show. The basic message—an African origin for humanity—has remained the same since Cann, Stoneking, and Wilson's seminal paper in 1987.<sup>2</sup> In contrast, Wayne Frair's Separate Creation paradigm assumes (predicts) four genetically equidistant continental populations.<sup>3</sup>

Of course, since this is an area of very active research, the complexity and clarity of the data are constantly changing. And yes, there are some slight but significant differences between the specific point of origin within Africa indicated by Y chromosome genealogies, mtDNA, and autosomal DNA, not to speak of languages and archaeology.<sup>4</sup> However, every study which has been done over the last twenty-five years—and there have been hundreds—has confirmed the conclusions of that first paper. Here are a few results of the latest research.

First, the female line: a recalculation of the base of the human mtDNA genealogy ("mitochondrial Eve") places her date at around 185,000 years ago. This paper places her location in South Africa among the hunting and gathering Khoisan people. All the other people groups on Earth are on one main branch of the human genetic tree, and the Khoisan are on the other branch.<sup>5</sup> (Neanderthal mtDNA sequences form a similar tree with a 200,000-year root. The total mutational distance between the two trees is best explained as 500,000 years of separate descent.<sup>6</sup>) These ancient data are confirmed by other recent studies which have calculated a root of 99,000 to 148,000 years<sup>7</sup> based on when the New World was settled, or an estimate of 134,000 to 188,000 years

using ten ancient "modern human" samples (e.g., the "Iceman" and CroMagnon 1) for calibration.<sup>8</sup> That study also confirmed African origins—the "ancient moderns" are all non-African, part of the two unique non-African mtDNA haplogroups termed M and N (a haplogroup is a genetic sequence identified by a unique set of genetic markers). Using that data, the "out of Africa" branch of humanity originated between 62,000 and 95,000 years ago.<sup>9</sup> Another mtDNA study, focusing specifically on the Khoisan people, shows that the amount of genetic divergence (between the L0K and L0D haplogroups) found between their tribes required the tribes to have been isolated for most of the last 100,000 years.<sup>10</sup> The most recent analysis, looking at the Khoisan branch of the tree (the L0 haplotype), confirms mitochondrial Eve's date at 180,000 years ago, but places her in central Africa, showing that the Khoisan ancestors arrived in the south about 120,000 years ago.<sup>11</sup>

This is confirmed by the autosomal data. A whole genome (autosome) study places the divergence of the Khoisan from the rest of the human race at 108,000 to 157,000 years ago.<sup>12</sup> These data support the consensus view that the Khoisan are the most anciently divergent human group, and have been significantly structured by long-term tribal separations since that ancient period. Another autosomal study confirms the centrality of the Khoisan in the origin of modern humans (*Homo sapiens*), showing their high internal genetic diversity, and their genetic separation from other African (and non-African) genomes.<sup>13</sup> Other studies show that autosomal SNPs (single nucleotide polymorphisms) are most diverse in the Khoisan, consistent with their divergence from the rest of our species around 100,000 years ago.<sup>14</sup> Another analysis of nuclear SNPs looked at Khoisan chromosomal components found in other South African tribes. The only non-Khoisan groups with a bit of Khoisan admixture were the Hadza and Sandawe, ancient Tanzanian click-speakers.<sup>15</sup>

There has been a fairly hot debate over the mutational rate used to calculate these ages, a debate with significant implications for when and where people left Africa.<sup>16</sup> The issue has been whether to use mutation rates as measured in current populations (which gives older dates) or to use the difference between the DNA of living people and ancient samples. This decision has implications for the emigrant population size and for their exit route—through the Sinai at 100,000 years ago or through Yemen around

# Article

## *Genetic Insights for Human Origins in Africa and for Later Neanderthal Contact*

60,000 years ago.<sup>17</sup> Several different studies indicate that the later date is correct. One is the previously mentioned mtDNA study using ancient genomes.<sup>18</sup> Another used whole genomes to calculate an exit date of 38,000 to 64,000 years ago.<sup>19</sup> A third evaluated worldwide linkage disequilibrium (haplogroup size),<sup>20</sup> and a fourth looked at origin and expansion of the L3 African “parent haplotype” of the non-African M and N haplogroups.<sup>21</sup> Finally, the comprehensive and careful evaluation of Mellars et al. dates the origin of L3 (in Africa) to 70,200, N (in Arabia) to 65,000, and M (in south Asia) to 47,970 years ago.<sup>22</sup> The later dates and the southern route best fit the data.

The only consistent conclusion to the genetic data—and the fossil data—is that the modern human race appeared in Africa.<sup>23</sup> It is not just that the deepest roots of the human genealogy are in Africa. Every one of the thousands of human genomes from outside Africa which has been sequenced belongs to just two haplogroups—the M and N branches of the African L3 haplogroup—and those haplogroups were formed around 60,000 years ago. Every haplogroup branch formed during the 120,000 years before that date is found only in Africa. So if one is looking for an “Eden” at the “headwaters of the human race,” it will have to be in Africa. For example, if Adam was created directly from soil, macro-mutated from the prehuman, or was the first full human given a soul, the event must have occurred more than 200,000 years ago somewhere in Africa. If Adam was the leader or representative of a unique band of humans given the opportunity by God to lead the race into spiritual maturity, it could have occurred at a population bottleneck 150,000 years ago in Africa.

How well does the Y chromosome data match? Recent changes in the estimate have caused some confusion. In a series of jumps, the date for “Y Chromosome Adam” has gone from 59,000 years ago in 2000 to 209,000 years ago (or possibly 338,000 years ago) in 2013. Does this sound suspicious? It is perfectly reasonable. The date of the root is calculated from all of the available data. The changes were due to newly discovered, highly divergent Y sequences (in the A haplogroup) from a series of northwestern African men (the Mbo tribe). Their sequences pushed back the date, and confirmed the male origin in north central Africa.<sup>24</sup> Other recent papers also have calculated older Y chromosome convergence points—a Sardinian sample put it at 180,000 to 200,000 years.<sup>25</sup> A second paper dated it at 120,000 to 156,000 years

ago and further showed Y chromosome diversity among the Khoisan which was almost that deep.<sup>26</sup> So, the new data which moved the Y chromosome coalescence back to 200,000 years confirm African origins. Fifteen years ago, the oldest lineages outside Africa were almost as old as the oldest known African ones at 59,000 years ago. But the deeper branches since discovered are entirely African, the same pattern which the mtDNA and autosomes show. The first three-quarters of the Y chromosome branches are all African branches.

## Tracing Population History from Genetic Patterns

Keep in mind that “mitochondrial Eve and Y chromosome Adam” should not be identified with the two biblical individuals, nor do they prove the existence of Adam and Eve. They are simply constructs, deduced from the most distant common genetic sequences we can calculate. One would expect both sexes to have the same population history and have coalescence points at the same time and location. However, the true origin of our species could easily be earlier than these coalescence points, obscured by later history of population movements and changing population sizes. To a certain extent, this history can be derived from the amount of diversity retained in the genealogy at different points in the past (due to different rates of genetic drift).

Population logic provides multiple independent ways to estimate changes in past human effective population size ( $N_e$ ). As well as having higher levels of linkage disequilibrium, small populations lose diversity more rapidly (in insertion/deletion mutants, single nuclear polymorphisms, microsatellites, alleles, transposable elements, etc.). The smaller the population, the exponentially faster will be the loss. If a population is very small or decreasing, it will retain very little genetic diversity; if it is large or increasing, it will retain a lot. A level in a genealogy with many retained branch points indicates that it was increasing at that time; a level with few retained branch points indicates that it was declining. Why? A new mutation generates a potential branch point if both forms of the gene are retained. The larger the population, the better the chances for the preservation of both branches.  $N_e$  can therefore be independently calculated for mtDNA, Y chromosomes, X chromosomes, and sections of the

autosomes—sometimes with differing results. Note that Y chromosomes and mtDNA will show smaller  $N_e$  than autosomes because they are haploid (one copy per individual).

One important technique for extracting historical information from genes is linkage disequilibrium (LD). The logic is as follows: We receive matching (homologous) chromosomes from each parent. Homologous chromosomes exchange matching sections during meiosis (gamete formation), with “crossing over” occurring at random intervals along the chromosome. On the average, each human sperm or ova experiences thirty cross-over events—that is, one or two per chromosome, one crossover every 100 million bases or so. As the chromosomes continue to be recopied generation after generation, their sequences are being very gradually “homogenized” by such crossover events. Since this is a slow process, significant lengths of DNA sequences can remain unmixed for very long times. The average length of shared haplogroups (matching lengths of DNA found in many individuals) decreases with time, a fact which can be used to deduce a number of interesting historical measures.

One use of LD is to evaluate when a particularly favorable gene was first introduced by either mutation or interbreeding. If rapid selection for a “new” form (allele) of a gene has occurred (termed a selective sweep), the haplogroups flanking that gene will be unusually long. Due to their proximity to the selected gene, they will have “hitch-hiked” to high frequency in the population, being “selected” with the new gene too rapidly to have been “mixed in.”<sup>27</sup> How much “too long” they are is inversely proportional to the time since the beneficial allele was introduced. This sort of data shows that the sickle cell allele has been independently produced by mutation a half dozen times. (The sickle cell hemoglobin allele is positively selected and maintained in malarial areas.)

Another use of LD is to provide an effective evaluation of population mixture. When populations mix or exchange migrants, the cross-bred offspring have chromosomes from both populations. LD can measure how much admixture occurred, and how long ago it happened. As generations pass, the long “foreign” haplogroups are slowly homogenized. Their average length is inversely proportional to the time since the admixture event.<sup>28</sup> The percent-

age of the genome which is composed of such longer haplotypes (which show high LD) indicates how much admixture occurred. This sort of analysis, for instance, can show when interbreeding may have occurred between modern humans and Neanderthals.<sup>29</sup>

A third use of LD is to measure the length of time a population has lived in its present location. The average length of the haplogroups in the entire genome decreases with time, and is therefore inversely proportional to the long-term  $N_e$ . Multiple studies have confirmed that African populations have far shorter linkage groups than non-African populations, thus indicating a larger African  $N_e$  and a longer African history.<sup>30</sup> This supports the conclusion that Africa is the original source of the world’s other local populations.

## Implications of the Genetic Evidence for a Bottleneck

Obviously the question of the size of the human population at its origin is important to theology. The idea of a bottleneck can be attractive for certain integrative proposals. The evidence for such an event begins with significant differences in the patterns of genetic diversity in humans and apes. Chimpanzees and humans have about the same amount of diversity in their autosomal chromosomes. However, human mtDNA and Y chromosomes have only about one-tenth of the diversity expected from the equivalent chimp values and the autosomes.<sup>31</sup> For instance, the “mitochondrial Eve” of the pigmy chimpanzee is calculated to have lived 540,000 years ago, three-fold older than the human value.<sup>32</sup>

Blum and Jakobsson evaluate this discrepancy using calculations for the TMRCA (time to most recent common ancestor) for different parts of the human genome.<sup>33</sup> Autosomal and X-linked segments on average have TMRCA of, respectively, 1,500,000 and 1,000,000 years. Y chromosome and mtDNA TMRCA (“Adam” and “Eve”) are (as we have seen) around 200,000 years. They calculate that the depth of the autosomal TMRCA are consistent with an Out-of-Africa scenario—if the ancestral  $N_e$  was around 14,000. However, that  $N_e$  value is not consistent with the far more recent TMRCA of the mtDNA and the Y chromosomes. To explain this discrepancy, they propose a bottleneck in the Middle Pleistocene

# Article

## *Genetic Insights for Human Origins in Africa and for Later Neanderthal Contact*

at around 150,000 years ago (long before the migration out of Africa). They calculate that this bottleneck could either be due to drastic population reduction or due to the survival of a single group from a larger ancestral structured population (“multiple archaic populations”). Either model could account for the eight-fold discrepancy, but they demonstrate that neither “recent admixture” (from Neanderthals) nor “long-standing admixture” (a long-term structured population) can explain the discrepancy.

There is supporting physical evidence. The middle of the previous glacial maximum, a time of maximum dryness in Africa, was 150,000 years ago. Modern humans are thought to have been forced into refugia along the eastern coast and lake regions in Africa, tied to coastal resources for the long-chained polyunsaturated fatty acids required for constructing our large brains.<sup>34</sup> Modern humans would be particularly vulnerable because of our unique, very rapid, brain growth in early infancy.<sup>35</sup>

Such a refuge-based bottleneck would have increased local density, cross-cultural contact, and environmental challenges—all of which are elements thought to speed up cultural development.<sup>36</sup> Although cultural changes do not necessarily produce human genetic signatures, they can alter the environment of our commensals and parasites, and thus, the selection pressures which can be reflected in their genomes. One intriguing bit of data is that lice apparently started to live in our clothes sometime between 170,000 and 80,000 years ago. At least, that is when clothing (body) lice became a separate genetic lineage,<sup>37</sup> indicating that the wearing of clothing had become common and continuous, a behavior with both adaptive and symbolic significance.

Climate change may also explain a good deal of the subsequent movement of populations. During glacial maxima and minima (we are now in a glacial minimum), North Africa is extreme desert (the Sahara). But during many of the intermediate periods, patterns of rainfall shift, and for tens of thousands of years, the Sahara becomes habitable savannah and/or grassland.<sup>38</sup> So, after glacial maxima or minima, human populations spread northward across the Sahara. The Saharan climate worsened dramatically around 73,000 years ago when the eruption of the Indonesian super volcano at Toba accelerated the cooling of the earth. This would have forced the Saharan population to abruptly flee southward,

invading the territories of local tribes. To some extent, northern males (with their Y chromosomes) would replace local males (and their Y chromosomes), but the local autosomes and mtDNAs would have been spared due to interbreeding, producing a somewhat divergent estimate of the location of the oldest sequences.

So, how and when was the earth settled? Both mtDNA and Y chromosome data show that the emigrants left Africa about 65,000 years ago, crossing the southern end of the Red Sea into Yemen. The first wave moved eastward along the coast of the Indian Ocean settling East and South Asia, and arrived in Australia around 50,000 years ago. The population which remained in refuges along the Arabian coast and the area of the Persian Gulf produced a second wave, which left the Middle East around 45,000 years ago—moving eastward through Asia and north-westward across Europe. The migrations have been traced via the progressive divisions of M and N mtDNA haplogroups (females) and the F, C, and D haplogroups of the Y chromosomes (males), as illustrated on numerous websites such as the National Geographic Project.<sup>39</sup> The timing (pre- and post-Toba) is debated due to disagreements over mutation rate and archeological evidences, as previously discussed.<sup>40</sup> I think the later date best fits the data.

### How Many “First Humans” Were There?

Another critical question for theological issues is the population size of the first true human population. Different models for how to (or how not to) integrate the story of Eden with the scientific data depend on that value. Genetic data indeed limit the possibilities. There is a general consensus that our over-all (African) ancestral  $N_e$  was about 10,000. Recent published estimates have been based variously on nucleotide diversity, LD, SNPs located near ALUs, whole genomes, allelic diversity, admixture calculations, and the comparative diversities of mtDNA, Y chromosomes, X chromosomes, and autosomes. Estimated  $N_e$  values in nine studies over the last five years range from 4,000 to 15,000.<sup>41</sup>

Huff has compared this value to other living and extinct species. His estimate of  $N_e$  for the human lineage was 9,300, but only for the last 1.2 million years.

Before that (which would be prior to *Homo heidelbergensis*), the value was 18,500 and 26,000, comparable to the ancestral  $N_e$ s of gorillas (25,000) and common chimpanzees (21,000), and greater than that of the pigmy chimpanzees (12,300).<sup>42</sup> Despite our present worldwide distribution, at some point the human lineage must have been significantly reduced, comparable to the pigmy chimp. That species has always had a very limited range south of the Zambezi River, utilizing swampy rainforest—a habitat which practically disappears during glacial maxima, producing its own “bottleneck effect.” Low human values only make sense if our lineage was also a very “localized” phenomenon. Again, a very low  $N_e$  can either be due to a long stretch of time with a small population or to a relatively brief bottleneck episode.

What did Blum and Jakobsson’s proposal give us?<sup>43</sup> A bottleneck at 150,000 years does not mean that *Homo sapiens* was formed at that time—it simply reduces the amount of past genetic diversity retained. If an “Eden” event happened at that time, it might have involved a fairly small (tribal) population, but they had ancestors who certainly looked like modern humans. An “integrative” scenario involving changes in the functional nature of humanity could fit at that point in time, and it does mean that we are all descended from that single stock. The data are problematic for the idea of locating Eden at the “headwaters” of the human race at an earlier date, at the time when the modern physical form appears. Although the TMRCA of the mtDNA and Y chromosomes are around the same date as the earliest fossils with modern morphology, the much higher levels of retained diversity in the autosomal chromosomes are only compatible with an earlier bottleneck, not with two people.

There is an additional reason why the ancestral human population cannot be reduced to just two people—previous ancestors or not. The problem is that two people can have a total of only four alleles (alternate forms) at any specific locus. If our species were ever just two people, all the alleles presently found at each locus in the entire species would have to be produced by mutations from those four ancestral alleles. But there are far too many divergent alleles in humans to be produced by that process, particularly in the histocompatibility loci central to immunity (in which high diversity is maintained by selection). Also, the existing arrays of very different

human alleles are frequently homologs to matching sets of alleles found in other primate species, implying that the alleles originated before the lineages became separate species.<sup>44</sup>

It has been argued that this immune diversity could have been generated independently in apes and humans, but this is problematic. The usual argument is that since the introns (noncoding sections) of the HLA-DRB loci are more alike within the species, whereas the exons (coding sections) are more alike between species, the exons must also have separately diverged within each species.<sup>45</sup> However, specific HLA alleles are under strong specific selection, and changes in the introns are mostly neutral. Thus, most mutations and cross-overs will be tolerated in introns. Over millions of years, crossing over will allow introns to become homogenized within lineages. But at the same time, strong stabilizing selection is able to retain an adaptive array of different exon sequences.

Supporting this analysis, the initial report on the chimpanzee genome evaluated the coding (exon) and noncoding (intron) differences between the human and chimp genomes for 13,355 out of 21,000 protein-coding loci.<sup>46</sup> Retained substitutions in the introns were 5.5 times more frequent than retained substitution in the exons. Further, synonymous exon substitutions were 33% more frequently retained, and substitutions in intron splicing junctions were three times *less* frequently retained. This distribution precisely follows the impact of these various changes on working protein production, and demonstrates the ability of purifying selection to retain functional protein-coding sequences (including those found in immune alleles) over millions of years, while allowing significant change to accumulate in introns.

Further, the last few years have given us data which indicate that the population which left Africa to settle the world interbred to a small extent with the Neanderthals and another archaic lineage, the Denisovans.<sup>47</sup> We non-Africans apparently picked up some “archaic” alleles involved with immunity (due to selection for non-African immune alleles). Parham’s team reported that 50% of the HLA-A alleles found in Europeans, up to 80% in Asians, and up to 95% in Papua New Guineans have an archaic origin.<sup>48</sup> If so, selection in the HLA antigen series is not simply based on diversity, but on specific

# Article

## *Genetic Insights for Human Origins in Africa and for Later Neanderthal Contact*

diversity—on specific functional alleles, the sort of selective pressure which could indeed carry an array of specific alleles through a lineage split.

But, if some human beings did mate with Neanderthals, it clearly raises questions about what it means to be human, as well as further confusing the issue of “finding Adam.” This is the topic of the next section of this paper.

### So, Did Grandma Marry a Neanderthal?

First, were Neanderthals really fully “human” or not? If they were, interbreeding raises no problems except pushing our common ancestors back to half a million years. The Neanderthals were a lot like us. Their bodies were as upright as ours, although far more powerful. Their brains were as large as ours, although their skulls were long and low rather than globular like ours. Their faces were visually different—they lacked pointed chins, had tall faces with pushed out cheeks, and foreheads which sloped back from heavy brow-ridges. But surely humanity is not to be measured by facial appearance. How can we measure the shape of their souls?

Looking for cultural differences is equivocal. Neanderthals made much the same sorts of stone tools as did the first physically modern humans. Possibly they buried their dead, and they may have started using a bit of symbolism (shell beads) around the time modern humans arrived in Europe. But there is little data, and a lot of passionate disagreement about the meaning of shell bead finds.<sup>49</sup> For instance, the few “evidences” for Neanderthal symbolism date from around 40,000 years ago, and only one site has Neanderthal remains.<sup>50</sup> Also, improved radiocarbon dating places the first modern people in Europe by that era, so those artifacts could possibly be “modern” or due to modern acculturation.<sup>51</sup> Further, European Neanderthals may have been decimated around 40,000 years ago by a major volcanic event in Italy. If so, there may have only been a depleted remnant to oppose the entrance of modern humans into Europe.<sup>52</sup> Invoking the culture of tool or bead making does not solve the puzzle—it only increases the heat of the debate.

Anatomy may be less ambiguous. There are significant differences in cerebral development driven by

significant genetic differences. Modern craniums are high and domed, positioned above the face. Neanderthals’ craniums were low and long, positioned behind the face. These differences are due to alterations in sphenoid bone and cribriform plate which change the cranial base angle and enlarge the middle cranial fossa (temporal lobe).<sup>53</sup> And temporal lobe changes are significant. The human temporal lobe is 25% larger than expected from scaling up a chimpanzee brain. It has far denser neuropil (white matter—meaning increased synaptic complexity) and specialized new areas related to recursive language, high-level integration (the default system, involved with long-term planning), and possibly responses to spiritual experiences.<sup>54</sup>

Modern human brains also have larger olfactory bulbs, which, it has been suggested, indicate more neural commitment to the “higher olfactory functions” of memory and emotion, located in enlarged limbic systems.<sup>55</sup> Complementing that, the neural commitment of the Neanderthals to the control of their heavy musculature and to enlarged visual systems (shown by larger orbits and parietal lobe spreading), may have cost them usable cerebral cortex. It is estimated that they had only three-quarters of the amount of cerebral cortex available to modern humans for social intelligence, a central aspect of human adaptation. Thus, it is suggested, modern humans were able to manage larger social groups and needed more complex language.<sup>56</sup> Stringer estimates the Neanderthal encephalization quotient at 4.3 to 4.8 versus an early modern value of 5.3 to 5.4.<sup>57</sup>

There were significant differences in developmental timing. Comparisons in tooth enamel growth rings indicate significantly slower general and neural development in modern humans.<sup>58</sup> Brain growth and neuronal maturation were two-thirds faster in Neanderthals than in even the earliest modern humans. Chimpanzees reach 75% of their adult brain size by nine months; Neanderthals, by fifteen months; but modern humans, by thirty months.<sup>59</sup> This gives modern humans an extended period of neural plasticity, allowing the “nurture” of individual experience to shape the hard-wiring of neural circuits. This developmental difference is also reflected by a unique modern trajectory of cranial growth. The globular shape of the modern cranium is produced during an unusual growth phase during the first year of life. This globularization event is absent in

chimpanzees—and in the Neanderthals.<sup>60</sup> Such cranial changes reflect functional changes to the brain and to the mind, thus indicating real differences in important human characteristics.

What of genetic differences? The altered patterns of brain growth are tied to altered gene activation. In living humans, compared to the chimpanzee, there are specific differences in the expression of genes in particular cerebral areas. There is a significant slowing in the expression of genes for synaptic functions in the human cerebral cortex, but not in the cerebellum. Human neocortical myelination is also developmentally protracted. Chimpanzees' myelination density is completed at approximately the time of sexual maturity (age seven). In modern humans, myelination continues throughout childhood, and neural maturation extends beyond late adolescence.<sup>61</sup> The extensive cortical rewiring during adolescence interconnects specialized cortical areas into higher networks of complexity.<sup>62</sup> Coupling delayed synaptic maturation with increased brain volume allows the modern prefrontal regions to be rapidly reformatted with reciprocal connections to posterior cortical centers during development.<sup>63</sup> These processes transform the human brain, and they are key to understanding the flexible nature of human intelligence, language, and culture. Human social complexity literally reshapes neural connectivity of the growing brain.<sup>64</sup> All of this suggests that the differences between modern humans and Neanderthals were more than superficial.

## Genetic Differences

In light of such developmental differences, should we view these two archaic populations as human in the same sense that we are? If they are truly different, we can expect some significant genetic differences. Important clues concerning our genetic uniqueness have come from recent advances in the processing of ancient DNA which have produced complete high quality genome sequences for archaic humans—both the Neanderthals and the Denisovans.<sup>65</sup> (The Denisovans were a group of archaic humans in Asia with genomes close to the Neanderthals and evidence for significant interbreeding.) Comparative genomics indicates that both archaic populations diverged around 500,000 years ago from the African lineage leading to modern humans. The Denisovians were

apparently a more widespread, genetically diverse population, whereas the Neanderthals were inbred and genetically reduced.<sup>66</sup>

Since the quality of sequencing of these archaic genomes is as good as those of living humans, very precise gene-on-gene comparisons can be made across the entire genome. This has already allowed the identification of thousands of genetic differences unique to *Homo sapiens*.<sup>67</sup> Most of the 113,000 SNPs and INDELs are probably meaningless, but 250 of these alter amino acids sites, 72 affect splice junctions, and thirty-five affect known regulatory sites.

So how much of that is functionally significant? Of the twenty-three most conserved loci with significant amino acid changes, eight affect genes active in nervous system function or development. SLITRK1 and KATNA1 control axonal and dendritic growth, ARHGAP32 and HTR2B are involved in synaptic transmission, and ADSL and CNTNAP2 are implicated in autism. CNTNAP2 is a target of FOX-P2—the mutants interfere with speech development. NOVA1 is a neuron specific RNA binding protein, and LUZP1 is a leucine zipper protein (transcription factor) active in neural tube development. The last two loci are subject to alternative splicing. They also located four unique modern human loci affecting the skin and six loci which affect the eye.<sup>68</sup>

Another altered modern gene with neural activity, MEF2A, delays synaptic development, thus allowing extended synaptic plasticity.<sup>69</sup> The expression of this locus peaks before one year in chimps; in modern humans, it peaks at around five years. Linkage data indicates that the selective sweep for the modern allele occurred after our lineage split from the two archaic lineages. This modern slow-down fits with the slower maturation of the modern brain.

But these are just coding sites. An unchanged control protein may still have significant altered function through altered regulation sites and target loci. Evidence of noncoding regulatory genetic changes can be harder to detect, but is probably far more widespread and important. An interesting example is FOX-P2, the well-known and highly evolved “speech gene.” It regulates mRNA production and slows synaptic maturation in genes involved with axonal and synaptic development.<sup>70</sup> Chimp and mouse alleles are identical, but the human allele has two altered sites. Mice genetically engineered

# Article

## *Genetic Insights for Human Origins in Africa and for Later Neanderthal Contact*

to express the human KE mutation show abnormal striatal activity in the basal ganglia when faced with learning a new task.<sup>71</sup> Since Neanderthals made the modern allele, does this mean that they could speak? There are not enough data to say. However, the FOX-P2 *locus* is not exactly the same. The eighth intron (introns are noncoding) of the FOX-P2 locus in modern humans has an altered recognition site for POU3F2, a protein which decreases the level of FOX-P2 production, and shows signs of a selective sweep (positive selection).<sup>72</sup> The Neanderthal control sequence is unchanged, the same as in the chimp (and the Zebra fish). So, there is an altered control site—and an altered target CNTNAP2 mentioned above is one of the targets of FOX-P2. But even if there are detectable differences in the modern and archaic genomes, were they really significant? The best test is interbreeding.

### Evidence of Interbreeding

And they did. A series of analyses, and further improvements in the quality of the data, have made it irrational to deny that. Two massive studies reported in early 2014 evaluated 1,000 modern genomes from Asia, Europe, and Africa for the presence of Neanderthal sequences.<sup>73</sup> Using completely different techniques, they came up with exactly the same results. All modern humans outside Africa have a few (2% on the average) “Neanderthal” haplogroups—whether Celtic European, Han Chinese, Native Australian, or Native American—but African populations do not. Both studies showed that approximately 20% of the Neanderthal genome can be retrieved from modern human genomes. And both studies showed the same genomic distribution of areas of significant positive and negative selection. But were these archaic northern hominines the same species as modern humans?

Comparison with several Neanderthal genomes indicates that the sequences of these “borrowed” Neanderthal genes best match the genomes of Neanderthals from the Caucasus, suggesting that local population is their source.<sup>74</sup> Supporting this, the complete genome sequencing of a modern human remains in Siberia dated at 46,000 years ago contains Neanderthal sequences, with a low level of linkage disequilibrium (not much cross-over mixing) which confirms a rather recent interbreeding period.<sup>75</sup>

However, the Tianyuan specimen from 40,000 years ago has no more Neanderthal DNA than modern genomes, showing the speed with which it was eliminated.<sup>76</sup> In addition to this broad Neanderthal contribution, many modern Melanesian populations have enough Denisovan haplotypes to make up an additional 5% of their genome.<sup>77</sup>

For perspective, keep in mind that 92% to 98% of the genes of all living non-African populations are of African origin, and the modern African genome diverged from the Neanderthal genome half a million years ago. That is 250,000 to 300,000 years before the earliest skeletal evidence of modern skeletal morphology (Omo Kibish)<sup>78</sup>—and for that matter, long before the specific Neanderthal characteristics developed in northern populations from *Homo heidelbergensis*.<sup>79</sup> Still, although long separated, the presence of archaic gene sequences in non-Africans is hard to explain without a significant amount of interbreeding.

Where and when did this admixture (interbreeding) occur? The necessary background is the pattern of human migration out of Africa. Recall the consensus view of the National Geographic Project.<sup>80</sup> A small group of East African emigrants arrived in southern Yemen about 60,000 years ago. Their descendants settled the rest of the earth. The first wave out of Yemen followed the coast of the Indian Ocean, arriving in Australia around 50,000 years ago. The second wave headed northward out of the Middle East about 45,000 years ago, spreading east and west into Europe and Asia (and on to the Americas). The evidence indicates that they met the Neanderthals in the Middle East, and the Denisovans further to the west.<sup>81</sup>

There has been a series of papers proposing alternate scenarios of interbreeding.<sup>82</sup> For instance, Currat and Excoffier proposed that a continuous but very unfruitful process of interbreeding occurred along the migration routes as they reached archaic hominine ranges.<sup>83</sup> Interbreeding would have to be low indeed—perhaps one fertile mating per generation worldwide over 6,000 years. Higher levels of successful interbreeding would have produced a “surfing” effect along the migration route (a serial founder effect). The moving emigrant wave would have accumulated archaic genes, becoming predominantly archaic. The large recent studies support this conclusion.<sup>84</sup>

The Denisovan admixture is a separate issue. Again, there is more than one model—possibly a single event along the coast, or a second smaller event inland.<sup>85</sup> Mainland populations are reported to have some specific archaic immune (HLA) alleles, whereas Melanesian populations have a larger and more diverse set of Denisovian genes.

## Effects of Interbreeding

So, did the interbreeding contribute anything useful? Some “Neanderthal” alleles do seem to have been subject to positive selection, to be “enriched” in modern genomes. Adaptive archaic alleles for immune system loci have been reported by Parham’s team. Perhaps 50% of the HLA-A alleles found in Europeans, up to 80% in Asians, and up to 95% in Papua New Guineans have an archaic origin, as well as other immune system loci such as STAT2 and OAS.<sup>86</sup> A selective sweep driven by strong immune benefits could have caused a significant amount of background selection/genetic hitchhiking. The recent large genome studies suggest that Neanderthal alleles are related to a variety of auto-immune diseases such as Crohn’s disease and Lupus.<sup>87</sup> They also report a significant tie to smoking behavior, diabetes, size of the optic disk, and levels of interleukin. The only other “enriched” loci they report are a few alleles for keratin alleles (the protein in our nails and hair). Another recent study also reports Neanderthal alleles for fat-processing genes in the brain.<sup>88</sup>

On the other hand, the large studies show widespread genomic areas with far lower levels of Neanderthal sequences than would be expected—areas in which the Neanderthal sequences were cleaned out by purifying selection. These areas of “enriched” modern sequences were quite significant: they involve a wide variety of loci active in nucleic acid processing and cell signaling—the base levels of genomic integration. This was especially true for the X chromosome. They conclude that modern and archaic humans were extremely infertile.<sup>89</sup>

It is not biologically unreasonable to propose some interbreeding between modern and archaic human populations—even if they are not the same species. As sister species go, half a million years is not much of a separation. In comparison, common and pygmy chimps, separated for two million years,

will cross-breed successfully.<sup>90</sup> Many living species do interbreed to varying extents in the wild, and can even absorb significant genetic changes. For example, coyotes found in New York are larger than those in Missouri due to a significant number of timber wolf genes absorbed in Canada on their ancestors’ eastward migration.<sup>91</sup> We too might have picked up a few useful genes, without meaning that we belong to the same species. In fact, the high level of purifying selection suggests that we did not.

The core to a species’ biological identity is a “differentiated” genetic blueprint, a “genetic program” which constrains the expression of genes.<sup>92</sup> When a new allele is added (by breeding or mutation), its first selective hurdle is the test of genetic compatibility. If it does not work well, its owner/organism does not produce many offspring, and it disappears. For two species to truly fuse, their genomes must differentiate a compromise genetic program. The red wolf of the American south, a coyote/gray wolf fusion species, is an example.<sup>93</sup> But this did not happen to the African emigrant populations that mated with the Neanderthals. Almost all significant Neanderthal loci were apparently filtered/selected out by the modern “program.” A few alleles were neutral, or perhaps increased the efficiency of the immune system for the north latitudes. But the genetics and the “human nature” of the emigrants remained essentially unchanged, a package for “being human” which was put together in Africa hundreds of thousands of years after our ancestors went their separate ways from the ancestors of the Neanderthals (and the Denisovans).<sup>94</sup>

In summary, the recent data on the presence of Neanderthal genes in all non-African populations do have implications for our humanity. I concede that the exact human status of the Neanderthals remains debatable. However, I am not a theologian, and I do not want to speculate on their status before God. Biologically speaking, however, they were apparently a functionally different species, probably showing a more limited rationality and social intelligence.<sup>95</sup> Whatever their human status, however, a very limited amount of Neanderthal interbreeding with modern humans did occur. All non-Africans are evidently part Neanderthal, but there is little evidence that this altered our species in any significant way. And if the interbreeding did not alter our humanity, it should not alter our understanding of what it

# Article

## Genetic Insights for Human Origins in Africa and for Later Neanderthal Contact

means to be human. I simply would point out that the Sovereign God knew what he was doing when he allowed it to occur.

In conclusion, recent data from genetics continue to confirm that *Homo sapiens*, modern humans, people with our cerebral morphology and our pattern of development, first appeared in Africa. And, that the probable date of that appearance was at least 200,000 years ago, and possibly significantly earlier. And, that the first members of our species were likely few in number, but nothing like the biblical two, Adam and Eve. And, that the rest of the world was settled by African emigration around 60,000 years ago, first to Asia. And, that a few of the people who migrated out of Africa mated with Neanderthals, spreading some advantageous genes, although the two populations were on the edge of genetic incompatibility. None of this was expected thirty years ago by either theology or anthropology.

Should we conclude that the scriptures are in error, or should we concede that we might have misunderstood them? In this article, I am not trying to harmonize the scientific data with a particular theological perspective. There is a large literature proposing alternative scenarios for Adam, but I am not advocating one.<sup>96</sup> My intent has simply been to lay out the above data as groundwork for a further honest, comprehensive discussion. Unexpected, but accurate, data come from the hand of God, whatever the motives of those who discover them. Of course, such data do not come with attached meaning. We have to figure it out. But we should have confidence that God already knows how it all rightly fits together. Our challenge is to solve the puzzle he has set us, without losing fellowship with each other. We must follow the Lion wherever he goes—and give him glory for the works of his hands. ☞

### Notes

- <sup>1</sup>A much more complete discussion of issues relevant to these prepositions can be found in J. van der Meer, "Background Beliefs, Ideology, and Science," *PSCF* 65, no. 2 (2013): 87–103.
- <sup>2</sup>R. L. Cann, M. Stoneking, and A. C. Wilson, "Mitochondrial DNA and Human Evolution," *Nature* 325 (1987): 31–6.
- <sup>3</sup>W. Frair, "Baraminology—Classification of Created Organisms," *Creation Research Society Quarterly Journal* 37, no. 2 (2000): 82–91.

- <sup>4</sup>C. Batini and M. Jobling, "The Jigsaw Puzzle of Our African Ancestry—Unsolved or Unsolvable?," *Genome Biology* 12, no. 6 (2011): 118.
- <sup>5</sup>D. Behar et al., "A 'Copernican' Reassessment of the Human Mitochondrial DNA Tree from Its Root," *The American Journal of Human Genetics* 90 (2012): 675–84.
- <sup>6</sup>*Ibid.*
- <sup>7</sup>M. Gonder et al., "Whole-mtDNA Genome Sequence Analysis of Ancient African Lineages," *Molecular Biology and Evolution* 24, no. 3 (2007): 757–68.
- <sup>8</sup>Q. Fu et al., "A Revised Timescale for Human Evolution Based on Ancient Mitochondrial Genomes," *Current Biology* 23, no. 7 (2013): 553–9.
- <sup>9</sup>*Ibid.*
- <sup>10</sup>C. Schlebusch et al., "MtDNA Control Region Variation Affirms Diversity and Deep Sub-structure in Populations from Southern Africa," *BMC Evolutionary Biology* 13 (2013): 56; C. Barbieri et al., "Ancient Substructure in Early mtDNA Lineages of Southern Africa," *American Journal of Human Genetics* 92 (2013): 285–93.
- <sup>11</sup>T. Rito et al., "The First Modern Human Dispersals across Africa," *PLOS One* 8 (2013): 11.
- <sup>12</sup>I. Gronau et al., "Bayesian Inference of Ancient Human Demography from Individual Genome Sequences," *Nature Genetics* 43, no. 10 (2011): 1031–4.
- <sup>13</sup>S. Schuster et al., "Complete Khoisan and Bantu Genomes from Southern Africa," *Nature* 463, no. 7283 (2012): 943–7.
- <sup>14</sup>C. Schlebusch et al., "Genomic Variation in Seven Khoisan Groups Reveals Adaptation and Complex African History," *Science* 338 (2012): 374; D. Petersen et al., "Complex Patterns of Genomic Admixture within Southern Africa," *PLOS Genetics* 9, no. 3 (2013): e1003309.
- <sup>15</sup>J. Pickrell et al., "The Genetic Prehistory of Southern Africa," *Nature Communications* 3 (2012): 1143.
- <sup>16</sup>Notably, M. Petraglia et al., "Paleolithic Assemblages from the Indian Sub-continent before and after the Toba Super-Eruption," *Science* 317 (2007): 5834 versus P. Mellars et al., "Genetic and Archaeological Perspectives on the Initial Modern Human Colonization of Southern Asia," *PNAS* 10 (2013): 1073.
- <sup>17</sup>A. Scally and R. Durbin, "Revising the Human Mutation Rate—Implications for Understanding Human Evolution," *Nature Reviews: Genetics* 13 (2012): 745–53.
- <sup>18</sup>Fu, "A Revised Timescale for Human Evolution Based on Ancient Mitochondrial Genomes."
- <sup>19</sup>Gronau, "Bayesian Inference of Ancient Human Demography from Individual Genome Sequences."
- <sup>20</sup>M. Melé et al., "Recombination Gives a New Insight in the Effective Population Size and the History of the Old World Human Populations," *Molecular Biology and Evolution* 29, no. 1 (2011): 25–30.
- <sup>21</sup>P. Soares et al., "The Expansion of mtDNA Haplogroup L3 within and out of Africa," *Molecular Biology and Evolution* 29, no. 3 (2012): 915–27.
- <sup>22</sup>Mellars, "Genetic and Archaeological Perspectives on the Initial Modern Human Colonization of Southern Asia."
- <sup>23</sup>I. McDougall, F. H. Brown, and J. G. Fleagle, "Sapropels and the Age of Hominins Omo I and II, Kibish, Ethiopia," *Journal of Human Evolution* 55, no. 3 (2008): 409–20.
- <sup>24</sup>R. Thomson et al., "Recent Common Ancestry of Human Y Chromosomes: Evidence from DNA Sequence Data," *PNAS* 97, no. 13 (2000): 7360–5; T. Karafet et al., "New Binary Polymorphisms Reshape and Increase Resolution of the Human Y Chromosomal Haplogroup Tree,"

- Genome Research* 18, no 5 (2008): 830–8; F. Cruciani et al., “A Revised Root for the Human Y Chromosome Phylogenetic Tree—The Origin of Patrilineal Diversity in Africa,” *The American Journal of Human Genetics* 88 (2011): 814–8; R. Scozzari et al., “Molecular Dissection of the Basal Clades in the Human Y Chromosomal Phylogenetic Tree,” *PLOS One* 7, no. 11 (2012): e49170; F. Mendez et al., “An African American Paternal Lineage Adds an Extremely Ancient Root to the Human Y Chromosome Phylogenetic Tree,” *The American Journal of Human Genetics* 92 (2013): 454–9.
- <sup>25</sup>P. Francalacci et al., “Low-Pass DNA Sequencing of 1200 Sardinians Reconstructs European Y Chromosome Phylogeny,” *Science* 341 (2013): 565–9.
- <sup>26</sup>D. Poznik et al., “Sequencing Y Chromosomes Resolves Discrepancy in Time to Common Ancestor of Males versus Females,” *Science* 341 (2013): 562–5.
- <sup>27</sup>I. Alves et al., “Genomic Data Reveal a Complex Making of Humans,” *PLOS Genetics* 8, no. 7 (2012): e1002837.
- <sup>28</sup>M. Campbell and S. Tishkoff, “The Evolution of Human Genetic and Phenotypic Variation in Africa,” *Current Biology* 20 (2010): R166–R173; Melé, “Recombination Gives a New Insight in the Effective Population Size and the History of the Old World Human Populations.”
- <sup>29</sup>Alves, “Genomic Data Reveal a Complex Making of Humans.”
- <sup>30</sup>A. Tenesa et al., “Recent Human Effective Population Size Estimated from Linkage Disequilibrium,” *Genome Research* 17 (2007): 520–6.
- <sup>31</sup>N. Yu et al., “Nucleotide Diversity in Gorillas,” *Genetics* 166 (2004): 1375–83; M. Blum and M. Jakobsson, “Deep Divergences of Human Gene Trees and Models of Human Origins,” *Molecular Biology and Evolution* 28, no. 2 (2011): 889–98.
- <sup>32</sup>G. Zsurka et al., “Distinct Patterns of Mitochondrial Genome Diversity in Bonobos (*Pan paniscus*) and Humans,” *BMC Evolutionary Biology* 10 (2010): 270; Yu, “Nucleotide Diversity in Gorillas.”
- <sup>33</sup>Blum and Jakobsson, “Deep Divergences of Human Gene Trees and Models of Human Origins.”
- <sup>34</sup>R. Mathias et al., “Adaptive Evolution of the *FADS* Gene Cluster within Africa,” *PLOS ONE* 7, no. 9 (2012): e44926.
- <sup>35</sup>P. Gunz et al., “A Uniquely Modern Human Pattern of Endocranial Development: Insights from a New Cranial Reconstruction of the Neandertal Newborn from Mezmaiskaya,” *Journal of Human Evolution* 62 (2012): 300–13.
- <sup>36</sup>C. Vegvari and R. Foley, “High Selection Pressure Promotes Increase in Cumulative Adaptive Culture,” *PLOS One* 9, no. 1 (2013): e86406.
- <sup>37</sup>M. Toups et al., “Origin of Clothing Lice Indicates Early Clothing Use by Anatomically Modern Humans in Africa,” *Molecular Biology and Evolution* 28, no. 1 (2011): 29–32.
- <sup>38</sup>R. Tjallingii et al., “Coherent High- and Low-Latitude Control of the Northwest African Hydrological Balance,” *Nature: Geoscience* 1 (2008): 670–5; M. Trauth et al., “Trends, Rhythms and Events in Plio-Pleistocene African Climate,” *Quaternary Science Reviews* 11 (2008): 399–411; T. Couillard et al., “Were Rivers Flowing across the Sahara during the Last Interglacial? Implications for Human Migration through Africa,” *PLOS One* 8, no. 9 (2013): e74834.
- <sup>39</sup>National Geographic Project, <https://genographic.nationalgeographic.com/>; Petraglia, “Paleolithic Assemblages from the Indian Sub-continent before and after the Toba Super-Eruption”; Mellars, “Genetic and Archaeological Perspectives on the Initial Modern Human Colonization of Southern Asia.”
- <sup>40</sup>G. McVicker et al., “Widespread Genomic Signatures of Natural Selection in Hominid Evolution,” *PLOS Genetics* 5, no. 5 (2009): e1000471.
- <sup>41</sup>Tenesa, “Recent Human Effective Population Size Estimated from Linkage Disequilibrium”; C. Huff et al., “Mobile Elements Reveal Small Population Size in the Ancient Ancestors of *Homo sapiens*,” *PNAS* 107, no. 5 (2010): 2147–52; Campbell and Tishkoff, “The Evolution of Human Genetic and Phenotypic Variation in Africa”; Melé, “Recombination Gives a New Insight in the Effective Population Size and the History of the Old World Human Populations”; Gronau, “Bayesian Inference of Ancient Human Demography from Individual Genome Sequences”; Blum and Jakobsson, “Deep Divergences of Human Gene Trees and Models of Human Origins”; J. Hawks, “From Genes to Numbers: Effective Population Sizes in Human Evolution,” in *Recent Advances in Palaeodemography*, ed. J.-P. Bocquet-Appel (New York: Springer, 2011), 9–30; H. Li and R. Durbin, “Inference of Human Population History from Individual Whole-Genome Sequences,” *Nature* 475, no. 7357 (2011): 493–6; M. Meyer, “A High-Coverage Genome Sequence from an Archaic Denisovan Individual,” *Science* 338 (2012): 222–6.
- <sup>42</sup>Blum and Jakobsson, “Deep Divergences of Human Gene Trees and Models of Human Origins.”
- <sup>43</sup>Ibid.
- <sup>44</sup>A. L. Hughes and M. Yeager, “Natural Selection and the Evolutionary History of Major Histocompatibility Complex Loci,” *Frontiers in Bioscience* 3 (1998): 509–16; C. Raymond et al., “Ancient Haplotypes of the HLA Class II Region,” *Genome Research* 15 (2005): 1250–7.
- <sup>45</sup>A. Gauger, “The Science of Adam and Eve,” in *Science and Human Origins*, A. Gauger, D. Axe, and C. Luskin (Seattle, WA: Discovery Institute Press, 2012), 105–22; G. Doxiadis et al., “Reshuffling of Ancient Peptide Binding Motifs between *HLA-DRB* Multigene Family Members: Old Wine Served in New Skins,” *Molecular Immunology* 41, no. 10 (2008): 2743; G. Doxiadis et al., “Evolution of *HLA-DRB* Genes,” *Molecular Biology and Evolution* 29, no. 12 (2012): 3843–53.
- <sup>46</sup>Chimpanzee Sequencing and Analysis Consortium, “Initial Sequence of the Chimpanzee Genome and Comparison with the Human Genome,” *Nature* 437 (2005): 69–87.
- <sup>47</sup>Meyer, “A High-Coverage Genome Sequence from an Archaic Denisovan Individual.”
- <sup>48</sup>L. Abi-Rached et al., “The Shaping of Modern Human Immune Systems by Multiregional Admixture with Archaic Humans,” *Science* 334 (2011): 89–94.
- <sup>49</sup>F. Caron et al., “The Reality of Neandertal Symbolic Behavior at the Grotte du Renne, Arcy-sur-Cure, France,” *PLOS One* 6, no. 6 (2011): e21545; Mellars, “Genetic and Archaeological Perspectives on the Initial Modern Human Colonization of Southern Asia”; P. Mellars, “Neandertal Symbolism and Ornament Manufacture,” *PNAS* 107, no. 47 (2010): 20147–8.
- <sup>50</sup>J. Hublin et al., “Radiocarbon Dates from the Grotte du Renne and Saint-Césaire Support a Neandertal Origin for the Châtelperronian,” *PNAS* 109, no. 46 (2012): 18743–8.
- <sup>51</sup>S. Benazzi et al., “Early Dispersal of Modern Humans in Europe and Implications for Neandertal Behavior,”

# Article

## Genetic Insights for Human Origins in Africa and for Later Neanderthal Contact

- Nature* 479 (2011): 525–8; T. Higham et al., “The Earliest Evidence for Anatomically Modern Humans in North-western Europe,” *Nature* 479, no. 7374 (2011): 521–4; M. Soressi et al., “Neandertals Made the First Specialized Bone Tools in Europe,” *PNAS* 110, no. 35 (2013): 14186–90.
- <sup>52</sup>K. Fitzsimmons et al., “The Campanian Ignimbrite Eruption: New Data on Volcanic Ash Dispersal and Its Potential Impact on Human Evolution,” *PLOS One* 8 (2013): 6; R. Pinhasi et al., “Revised Age of Late Neanderthal Occupation and the End of the Middle Paleolithic in the Northern Caucasus,” *PNAS* 108, no. 21 (2011): 8611–6; L. Dalen et al., “Partial Genetic Turnover in Neandertals: Continuity in the East and Population Replacement in the West,” *Molecular Biology and Evolution* 29, no. 8 (2012): 1893–7; L. Golovanova et al., “Significance of Ecological Factors in the Middle to Upper Paleolithic Transition,” *Current Anthropology* 51, no. 5 (2010): 655–91; R. Wood et al., “Radiocarbon Dating Casts Doubt on the Late Chronology of the Middle to Upper Palaeolithic Transition in Southern Iberia,” *PNAS* 110, no. 8 (2013): 2781–6.
- <sup>53</sup>M. Bastir et al., “Middle Cranial Fossa Anatomy and the Origin of Modern Humans,” *Anatomical Record* 291, no. 2 (2008): 130–40; M. Bastir et al., “Evolution of the Base of the Brain in Highly Encephalized Human Species,” *Nature Communications* 2 (2011): 588.
- <sup>54</sup>D. Lieberman, “Speculations about the Selective Basis of Modern Human Craniofacial Form,” *Evolutionary Anthropology* 17 (2008): 55–68; T. Wynn and F. Coolidge, “The Role of Episodic Memory and Autonoetic Thought in Upper Paleolithic Life,” *Paleoanthropology* (2008): 212–7; T. Wynn and F. Coolidge, “The Implications of the Working Memory Model for the Evolution of Modern Cognition,” *International Journal of Evolutionary Biology* (2011): article ID 741357; S. Meli and M. Persinger, “Red Light Facilitates the Sensed Presence Elicited by Application of Weak, Burst-Firing Magnetic Fields over the Temporal Lobes,” *International Journal of Neuroscience* 119, no. 1 (2009): 68–75.
- <sup>55</sup>Bastir, “Evolution of the Base of the Brain in Highly Encephalized Human Species.”
- <sup>56</sup>E. Pearce et al., “New Insights into Differences in Brain Organization between Neanderthals and Anatomically Modern Humans,” *Proceedings of the Royal Society B*. 280 (2013): 20130168.
- <sup>57</sup>C. Stringer, *Lone Survivors: How We Came to Be the Only Humans on Earth* (New York: St. Martin’s Press, 2013), 207–8.
- <sup>58</sup>T. Smith et al., “Earliest Evidence of Modern Human Life History in North African Early *Homo sapiens*,” *PNAS* 104, no. 15 (2007): 6128–33; T. Smith, “Teeth and Human Life-History Evolution,” *Annual Review of Anthropology* 42 (2013): 191–208; T. Smith and Z. Alemseged, “Reconstructing Hominin Life History,” *Nature Education Knowledge* 4, no. 4 (2013): 2.
- <sup>59</sup>M. Ponce de León et al., “Neanderthal Brain Size at Birth Provides Insights into the Evolution of Human Life History,” *PNAS* 105, no. 37 (2008): 13764–8; C. Sherwood et al., “A Natural History of the Human Mind: Tracing Evolutionary Changes in Brain and Cognition,” *Journal of Anatomy* 212 (2008): 426–54.
- <sup>60</sup>Gunz, “A Uniquely Modern Human Pattern of Endocranial Development: Insights from a New Cranial Reconstruction of the Neanderthal Newborn from Mezmaiskaya.”
- <sup>61</sup>D. Miller et al., “Prolonged Myelination in Human Neocortical Evolution,” *PNAS* 109, no. 41 (2012): 16480–5.
- <sup>62</sup>K. Supekar et al., “Development of Large-Scale Functional Brain Networks in Children,” *PLOS Biology* 7, no. 7 (2009): 1000157.
- <sup>63</sup>T. Sakai et al., “Differential Prefrontal White Matter Development in Chimpanzees and Humans,” *Current Biology* 22 (2011): 171–2.
- <sup>64</sup>X. Liu et al., “Extension of Cortical Synaptic Development Distinguishes Humans from Chimpanzees and Macaques,” *Genome Research* 22 (2012): 611–22; M. Somel et al., “MicroRNA-Driven Developmental Remodeling in the Brain Distinguishes Humans from Other Primates,” *PLOS Biology* 9, no. 12 (2011): e1001214.
- <sup>65</sup>Meyer, “A High-Coverage Genome Sequence from an Archaic Denisovan Individual”; K. Prüfer et al., “The Complete Genome Sequence of a Neanderthal from the Altai Mountains,” *Nature* 505, no. 7481 (2014): 43–9.
- <sup>66</sup>E. Pennisi, “More Genomes from Denisova Cave Show Mixing of Early Human Groups,” *Science* 340 (2013): 799.
- <sup>67</sup>Meyer, “A High-Coverage Genome Sequence from an Archaic Denisovan Individual.”
- <sup>68</sup>Ibid.
- <sup>69</sup>X. Liu et al., “Extension of Cortical Synaptic Development Distinguishes Humans from Chimpanzees and Macaques,” *Genome Research* 22 (2012): 611–22.
- <sup>70</sup>W. Enard, “FOXP2 and the Role of Cortico-Basal Ganglia Circuits in Speech and Language Evolution,” *Current Opinion in Neurobiology* 21, no. 3 (2011): 415–24; W. Enard, “A Humanized Version of Foxp2 Affects Cortico-Basal Ganglia Circuits in Mice,” *Cell* 137 (2009): 961–71.
- <sup>71</sup>S. Vernes et al., “Foxp2 Regulates Gene Networks Implicated in Neurite Outgrowth in the Developing Brain,” *PLOS Genetics* 7, no. 7 (2011): e1002145.
- <sup>72</sup>T. Maricic et al., “A Recent Evolutionary Change Affects a Regulatory Element in the Human FOXP2 Gene,” *Molecular Biology and Evolution* 30, no. 4 (2013): 844–52.
- <sup>73</sup>B. Vernot and J. M. Akey, “Resurrecting Surviving Neanderthal Lineages from Modern Human Genomes,” *Science* 343, no. 6174 (2014): 1017–21; S. Sankararaman et al., “The Genomic Landscape of Neanderthal Ancestry in Present-Day Humans,” *Nature* 507, no. 7492 (2014): 354–7.
- <sup>74</sup>Pennisi, “More Genomes from Denisova Cave Show Mixing of Early Human Groups.”
- <sup>75</sup>A. Gibbons, “Oldest *Homo sapiens* Genome Pinpoints Neanderthal Input,” *Science* 343, no. 6178 (2014): 1417.
- <sup>76</sup>Q. Fu et al., “DNA Analysis of an Early Modern Human from Tianyuan Cave, China,” *PNAS* 110, no. 6 (2013): 2223–7.
- <sup>77</sup>D. Reich et al., “Denisova Admixture and the First Modern Human Dispersals into Southeast Asia and Oceania,” *The American Journal of Human Genetics*, 89, no. 4 (2011): 516–28; Abi-Rached et al., “The Shaping of Modern Human Immune Systems by Multiregional Admixture with Archaic Humans”; A. Cooper and C. Stringer, “Did the Denisovans Cross Wallace’s Line?,” *Science* 342 (2013): 321–3.
- <sup>78</sup>I. McDougall, F. H. Brown, and J. G. Fleagle, “Sapropels and the Age of Hominins Omo I and II, Kibish, Ethiopia,” *Journal of Human Evolution* 55, no. 3 (2008): 409–20.
- <sup>79</sup>B. Wood, “Reconstructing Human Evolution: Achievements, Challenges, and Opportunities,” *PNAS* 107, Suppl. 2 (2010): 8902–9.

- <sup>80</sup>National Geographic Project, <https://genographic.nationalgeographic.com/>.
- <sup>81</sup>Vernot and Akey, "Resurrecting Surviving Neanderthal Lineages from Modern Human Genomes"; Sankararaman, "The Genomic Landscape of Neanderthal Ancestry in Present-Day Humans."
- <sup>82</sup>E. Durand et al., "Testing for Ancient Admixture between Closely Related Populations," *Molecular Biology and Evolution* 28, no. 8 (2011): 2239–52; A. Eriksson and A. Manica, "Effect of Ancient Population Structure on the Degree of Polymorphism Shared between Modern Human Populations and Ancient Hominids," *PNAS* 109, no. 35 (2012): 13956–60; P. Skoglund and M. Jakobsson, "Archaic Human Ancestry in East Asia," *PNAS* 108, no. 45 (2011): 18301–6; S. Sankararaman et al., "The Date of Interbreeding between Neanderthals and Modern Humans," *PLOS Genetics* 8, no. 10 (2012): e1002947; M. Yang et al., "Ancient Structure in Africa Unlikely to Explain Neanderthal and Non-African Genetic Similarity," *Molecular Biology and Evolution* 29, no. 10 (2012): 2987–95; Reich, "Denisova Admixture and the First Modern Human Dispersals into Southeast Asia and Oceania"; J. Wall et al., "Higher Levels of Neanderthal Ancestry in East Asians Than in Europeans," *Genetics* 194, no. 1 (2013): 199–209.
- <sup>83</sup>M. Currat and L. Excoffier, "Strong Reproductive Isolation between Human and Neanderthals Inferred from Observed Patterns of Introgression," *PNAS* 108, no. 37 (2011): 15129.
- <sup>84</sup>Vernot and Akey, "Resurrecting Surviving Neanderthal Lineages from Modern Human Genomes"; Sankararaman, "The Genomic Landscape of Neanderthal Ancestry in Present-Day Humans."
- <sup>85</sup>M. Rasmussen et al., "An Aboriginal Australian Genome Reveals Separate Human Dispersals into Asia," *Science* 334 (2011): 94–8; Cooper and Stringer, "Did the Denisovans Cross Wallace's Line?"; Skoglund and Jakobsson, "Archaic Human Ancestry in East Asia"; Alves et al., "Genomic Data Reveal a Complex Making of Humans."
- <sup>86</sup>Abi-Rached, "The Shaping of Modern Human Immune Systems by Multiregional Admixture with Archaic Humans"; F. Mendez et al., "Neanderthal Origin of Genetic Variation at the Cluster of OAS Immunity Genes," *Molecular Biology and Evolution* 30, no. 4 (2013): 798–801;
- F. Mendez et al., "A Haplotype at STAT2 Introgressed from Neanderthals and Serves as a Candidate of Positive Selection in Papua New Guinea," *The American Journal of Human Genetics* 91 (2012): 265–74.
- <sup>87</sup>Vernot and Akey, "Resurrecting Surviving Neanderthal Lineages from Modern Human Genomes"; Sankararaman, "The Genomic Landscape of Neanderthal Ancestry in Present-Day Humans."
- <sup>88</sup>E. Khrameeva et al., "Neanderthal Ancestry Drives Evolution of Lipid Catabolism in Contemporary Europeans," *Nature Communications* 5 (2014): 3584, doi: 10.1038/ncomms4584.
- <sup>89</sup>Vernot and Akey, "Resurrecting Surviving Neanderthal Lineages from Modern Human Genomes"; Sankararaman, "The Genomic Landscape of Neanderthal Ancestry in Present-Day Humans."
- <sup>90</sup>H. Vervaecke et al., "Pan Continuity: Bonobo-Chimpanzee Hybrids," *Folia Primatologica* 75, no. 1 (2004): 59; H. Vervaecke and L. van Elsacker, "Hybrids between Common Chimpanzees (*Pan troglodytes*) and Pygmy Chimpanzees (*Pan paniscus*) in Captivity," *Mammalia* 56 (1992): 667–9.
- <sup>91</sup>S. Levy, "Rise of the Coyote: The New Top Dog," *Nature* 485 (2012): 296–7.
- <sup>92</sup>B. Hausdorf, "Progress Toward a General Species Concept," *Evolution* 65, no. 4 (2011): 923–31.
- <sup>93</sup>D. Reich et al., "Genetic Evidence for a Recent Origin by Hybridization of Red Wolves," *Molecular Ecology* 8 (1999): 139–44.
- <sup>94</sup>M. Ben-Dor et al., "Man the Fat Hunter: The Demise of *Homo erectus* and the Emergence of a New Hominin Lineage in the Middle Pleistocene (ca. 400 kyr) Levant," *PLOS One* 6, no. 12 (2011): e28689.
- <sup>95</sup>Wynn and Coolidge, "The Implications of the Working Memory Model for the Evolution of Modern Cognition."
- <sup>96</sup>I would recommend a careful reading of the following books, keeping in mind the data reported in this article: M. Barrett and A. B. Caneday, eds., *Four Views on the Historical Adam* (Grand Rapids, MI: Zondervan, 2013); and J. D. Charles, ed., *Reading Genesis 1–2: An Evangelical Conversation* (Peabody, MA: Hendrickson Publishers, 2013).

**ASA Members:** Submit comments and questions on this article at [www.asa3.org](http://www.asa3.org)→FORUMS→PSCF DISCUSSION.



## God and Nature Magazine

a source for those who are searching

GODANDNATURE.ASA3.ORG

essays \* poetry \* fiction \* opinion \* humor \* & more



Patrick Franklin

## Article

# Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution

Patrick Franklin

*This article proposes that a trinitarian eschatological hermeneutic, applied to the doctrine of creation, helps us to make sense of evolution theologically. From this perspective, the Holy Spirit incessantly draws creation to the Father's intended destination for it (new creation) through the cosmic, creative-redemptive work of the Son. This article first develops the proposed hermeneutic in dialogue with scripture and trinitarian theology. It then commends the hermeneutic as a way forward in resolving theologically three important issues in the science-faith dialogue concerning evolution: (1) it avoids both a deistic naturalism/materialism and a crude supernaturalist interventionism with respect to God's interaction with creation; (2) it provides a rich theology of nature while avoiding the pitfalls of pantheism; and (3) it helps us to account theologically for the existence of death as a naturally occurring phenomenon intrinsic to creation.*

Currently, the scholarly scientific consensus is that evolutionary theory best explains the biological origins of human beings.<sup>1</sup> Indeed, in terms of comprehensive coherence and explanatory power, evolution as a scientific model really has no serious rival.<sup>2</sup> This article explores the controversial topic of human evolution from a theological perspective. My thesis is that a trinitarian, eschatological hermeneutic, applied to the doctrine of creation, helps us to make theological sense of evolution. From the vantage point of this hermeneutic, when God initially created the universe, God did not create a "finished" product (i.e., in the sense of its being static and complete). Rather, God always intended an eschatological consummation for creation and so

initiated a dynamic, progressive process. In creating, God endowed creation with the intrinsic potentiality to develop, to mature, and to evolve over time. God's creating is also an ongoing work of continuous, active creation, in which the Holy Spirit incessantly draws creation to the Father's intended destination for it (new creation) through the cosmic, creative-redemptive work of the Son.

Let me make two points of clarification. First, the purpose of this article is not to argue the scientific case for evolution but to reflect theologically on its meaning and implications.<sup>3</sup> Second, I do not claim that scripture or the early Christian tradition *teaches* evolution. I reject concordist approaches to interpreting scripture that claim to observe the findings of modern science within the Bible. Instead, my view is that scripture teaches an unfolding, developing creation, in which the Holy Spirit is drawing all that the Father has created toward eschatological fulfillment.

**Patrick S. Franklin, PhD**, is assistant professor of theology and ethics at Providence University College and Seminary in Manitoba, Canada. He has an ongoing interest in theological anthropology (including how science informs it) and how it relates to other Christian doctrines, such as salvation and the church. Patrick currently serves as the Coordinating Book Review Editor for PSCF.

My proposal, while developed differently, is compatible with the “proleptic” theology of Ted Peters, in which God is “constantly engaged in drawing the world out of nonbeing and into existence with the aim of consummating this creative work in the future. God’s present work in and for the world anticipates the final work.”<sup>4</sup> Similar to Peters, I argue that there is an eschatological dimension to all of God’s creative activity. I wish to offer a complementary perspective that highlights the significance of pneumatology within a trinitarian framework for thinking theologically about God’s interaction with the physical world.<sup>5</sup> Moreover, I offer my own eschatological reading with the aim of helping evangelical readers navigate their way through some apparent difficulties that evolution poses for traditional beliefs about creation, human beings, sin and death, and Adam and Eve.

## Creation in Eschatological Perspective

### *Creation as the Continuous Work of the Triune God*

Creation is the continuous work of the Triune God.<sup>6</sup> Two trinitarian doctrines are relevant for the present discussion, namely the doctrine of the unity of operations and the doctrine of appropriation. The former states that all three persons of the Trinity are involved in everything God does outwardly, while the latter specifies that each divine person is involved in every divine activity in a particular, characteristic way. Moreover, the patterns of divine activity that we observe in the economy of God’s dealings with creation in salvation history (economic Trinity) mirror but do not exhaustively disclose the patterns of relation inherent within God’s own inner life (immanent Trinity). With respect to creation, we can express God’s activity of creating with the following trinitarian formulation: the Father creates *through* the Son and *in* the Spirit.<sup>7</sup> God’s creative activity originates with the Father, is given concrete expression through the Son, and is accomplished in the dynamic, creative power of the Spirit.<sup>8</sup> In Genesis chapters one and two, we observe this formula implicitly at work in the narratives as the Father speaks creation into being with his Word and his Breath (cf. John 1:1-3; Col. 1:15-17; John 3:5-8; 4:10; 6:63; Rom. 8:2, 11; Rev. 22:17).<sup>9</sup>

In terms of appropriation, of the three divine persons, the Holy Spirit is most closely associated with animating and preserving life and then drawing all of creation toward its eschatological goal.<sup>10</sup> As Thomas Oden puts it,

Wherever the one God, Father, Son, and Spirit, works to realize, accomplish, and consummate what God has *begun* and *continued*, that action is more properly ascribed in Scripture as the movement of the Holy Spirit.<sup>11</sup>

Thus, the eschatological hermeneutic proposed in this article focuses particularly on the person and work of the Holy Spirit.<sup>12</sup>

Early Christian creeds refer to the Holy Spirit as “the Lord and Giver of Life.”<sup>13</sup> This title for the Spirit is closely related to scripture’s portrayal of the Spirit as the breath of God who gives breath to all living things.<sup>14</sup> The Spirit offers, supports, nurtures, strengthens, and guides all of life, whether plant, animal, or human, according to their own specific natures.<sup>15</sup> Paul alludes to the Spirit as the breath of life in 1 Corinthians 15:45 when, quoting Genesis 2:7, he refers to the first man as a “living soul.”<sup>16</sup> Genesis 6:17 (the beginning of the flood account) refers to God’s plan to destroy “all flesh in which is the breath of life.” Job 32:8 refers to the “spirit in a mortal” as “the breath of the Almighty.”<sup>17</sup> Further, if God “should take back his spirit to himself, and gather to himself his breath, all flesh would perish” (Job 34:14-15). The Psalmist draws out the parallel between the breath of life and the Spirit of God: “When you take away their breath, they die and return to their dust. When you send forth your Spirit, they are created” (Ps. 104:29,30). Ecclesiastes 12:7 states that upon death “the breath returns to God who gave it.”

In the New Testament, the Spirit is likewise closely associated with breath and life, as applied to both regeneration and consummation (the latter through resurrection and glorification). John 3:5-8 connects the Spirit to the spiritual rebirth of the person who enters the kingdom of God. In John 4, Jesus refers to the Spirit as a spring of living water gushing up to eternal life (vv. 10, 13-14). In John 6:63, Jesus says, “It is the Spirit that gives life; the flesh is useless.” In Romans 8:11, Paul says that the same Spirit that raised Christ from the dead “will give life to your mortal bodies also through his Spirit that dwells in you.” And in Revelation 22:17, the Spirit and the

# Article

## *Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

Bride say “come,” and all are invited to drink the water of life.

The Spirit’s work in drawing human beings to their eschatological consummation includes transforming what is perishable into what is imperishable. For, as Paul writes in 1 Corinthians 15: “What is sown is perishable, what is raised is imperishable ... It is sown a physical body, it is raised a spiritual body” and “flesh and blood cannot inherit the kingdom of God, nor does the perishable inherit the imperishable” (vv. 43, 44, 50).<sup>18</sup> For much of Protestant and evangelical theology, the problem Paul is here addressing is the sinfulness of human beings, which he connects with their being perishable and incapable in themselves of possessing eternal life in God’s kingdom. Much of the Protestant tradition has also assumed that without the problem of human sinfulness, human beings would possess inherent immortality, a view which often depends on interpreting Genesis 1–2 as recording an idyllic state of original innocence and perfection. I wish to affirm the first assumption but challenge the second.

Certainly, Paul does connect the current impoverished state of the human condition with the problem of sin.<sup>19</sup> It is clear from Paul that sinful human beings cannot receive eternal life in the kingdom of God without having been saved by the death and resurrection of Christ in the power of the Spirit. To affirm this, however, is not of logical necessity to affirm that without sin human beings would possess intrinsic immortality. On the contrary, if we follow the symbolism of Genesis 2 closely, we see that human beings do not possess intrinsic immortality,<sup>20</sup> but are radically dependent for their continuing existence upon God, the source of all life (as represented by the tree of life in Genesis 2).<sup>21</sup> Even without sin, they still require “salvation,” in a sense, in order to be transformed from perishable to imperishable bodies. From this perspective, “Genesis 3 can best be read as one not of lost immortality but of a lost *chance* for immortality.”<sup>22</sup> Thus, human salvation is primarily about deliverance from sin (and sin does pervade human existence), but it is secondarily about deliverance from perishability and corruptibility.

To be clear: it is not that being perishable is sinful; rather, as perishable beings we are in need of eschatological consummation and completion. God created us perishable and corruptible, but predestined us in Christ to be imperishable and incorruptible.

Joel Green clarifies, “This transformation is not the release from the human body of a nonperishable soul, but the resurrection of the human person as ‘a body for the realm of the Spirit.’”<sup>23</sup> The writings of the early church fathers support this position.<sup>24</sup> For example, Athanasius writes that human beings were created “by nature corruptible, but destined, by grace following from partaking in the Word, to have escaped their natural state, had they remained good.”<sup>25</sup> It is also supported by many modern biblical scholars and theologians, who argue in various ways that the notion of the intrinsic immortality of the soul derives not from the Bible but from Greek philosophy (i.e., Platonism).<sup>26</sup>

### *The Creation of Human Beings*

When we explore and reflect on the biblical account of the creation of the world and of human beings, we discover that God creates a dynamic creation, one that God intends to grow and develop over time. Moreover, God intends human beings to play a crucial role within this developing creation.<sup>27</sup> Amazingly, scripture regards human activity as being essential to the full flourishing of God’s creation.<sup>28</sup> God creates human beings to share in his work of continuous creating.<sup>29</sup> Of course, humans do not participate in God’s unique work of creating *ex nihilo*; rather, their role is to participate in the ongoing development of creation by managing, directing, shaping, and cultivating what God has made, in ways befitting God’s own purposes and character—and this includes participating in shaping their own destiny as human beings.<sup>30</sup> To see this, we will briefly consider the portrayal of human beings as stewards, priests, and gardeners in the early chapters of Genesis.

First, many biblical commentators and theologians have pointed out that the declaration in Genesis 1 that human beings are made in God’s image occurs together with the mandate to have dominion over the earth (Gen. 1:26).<sup>31</sup> Moreover, Psalm 8:3–8 indicates that God made human beings to be rulers over God’s created works. In light of such texts, Middleton asserts that “the fundamental human task is conceived as the responsible exercise of power on God’s behalf over the non-human world.”<sup>32</sup> Middleton explains that in the ancient Near Eastern culture, ruling over the earth had to do primarily with the development of agriculture and animal husbandry (the basis of human societal organization), but it also

included by extension the advancement of culture, technology, and civilization.<sup>33</sup> Such ruling does not merely serve human plans and ambitions (certainly not exploitative ones) but must faithfully represent God's goals and purposes for creation. Human rule over the earth is not sovereign kingship but faithful stewardship. Human beings were created to be God's stewards or vice-regents, God's counterparts here on Earth.<sup>34</sup>

Second, Genesis 1 portrays the created universe as God's temple and human beings as priests of creation.<sup>35</sup> Rikki Watts suggests that the depiction of creation as a temple is unsurprising when one considers the contextual realities of the ancient world as well as the ancient belief that the actions of kings paralleled the cosmic activity of the gods. In such ancient societies, it was the king who defeated enemies and provided protection, who upheld the law, and who supervised the construction of barriers to restrain the floods. Moreover, upon establishing his kingdom and entering into victorious rest, the king would build a palace for himself and a temple for his nation's deity.<sup>36</sup> This pattern resembles the Genesis account of God differentiating, restraining, and ordering creation to function as God's temple-palace, in which God comes to dwell and to rule on the day of Sabbath rest.<sup>37</sup> Watts finds additional support for the temple-palace depiction of creation in the forming of humanity in the image of God. In the Ancient Near East, the last thing placed within a temple was the image of the deity, who was then invoked to indwell the temple.<sup>38</sup> Similarly, in Genesis 1, God forms the human being in God's own image as the culminating act of creation; in Genesis 2, God breathes the divine Spirit into the human creature to impart life and to call it into blessing (Sabbath rest) and dominion.<sup>39</sup>

In his recent books, *The Lost World of Genesis One* and the more detailed *Genesis One as Ancient Cosmology*, John Walton lends further support to the idea that scripture depicts creation as God's temple-palace and human beings as God's priests and stewards.<sup>40</sup> Walton argues that Genesis 1 should be interpreted not as an account of the material origins of creation, but as an account of God establishing creation's proper functioning and purpose.<sup>41</sup> Walton's crucial insight is that Genesis 1, being representative of ancient cosmology, operates with a functional ontology and is thus function-oriented.<sup>42</sup> Similarly, Middleton observes, "The underlying picture is of God as a cosmic ruler of a harmonious, well-functioning realm."<sup>43</sup>

Walton and Middleton view Genesis 1 as a temple text, in which the six days of creation culminate on the seventh when God "rests" from his creative activity and thereby takes up residence in God's cosmic temple.<sup>44</sup> The function of human beings in this context is to be priests of God's temple (creation).<sup>45</sup>

While the image of steward or vice-regent highlights the human vocation of ruling creation on God's behalf, the image of priest suggests that authentic governance requires worship of the one and only Creator God.<sup>46</sup> Thus oriented and motivated, authentic human governance of creation is worship. Moreover, as priests, human beings act as "worship leaders" within creation, coming alongside all of creation to shape and direct it to further glorify and to worship the Creator. Conversely, an autonomous and idolatrous orientation (wherein humanity has attempted to usurp God's rightful place) leads inevitably to the corruption of governance, the desecration of God's temple (creation), and disorder in creaturely relationships. Accordingly, in the context of "fallen" creation, human beings as priests of creation (fallen yet redeemed in Christ) are called to resist the destructive undoing of creation in both nature and human culture, and to call and direct creation toward redemption in the new creation (note that this calling, in the case of humans, requires repentance and regeneration).<sup>47</sup>

Third, Genesis 2 portrays human beings as gardeners who are needed to "work the earth" in order for things to grow.<sup>48</sup> According to Paul Evans, this necessity for cultivation recalls God's commission in Genesis 1:28 for humans to "subdue" the earth, which suggests that "creation from the beginning was 'wild,'" that "some coercion on the part of humans was necessary," and that "this subduing would change and develop creation over time."<sup>49</sup> This image of taming and shaping the wild fits with the portrayal of human beings as gardeners. As James Peterson suggests,

A garden is more ecologically complex than a wilderness. As with a wilderness there is an intricate interrelationship of life-forms and energy, but a garden has the added dimension of the gardener's intent. Human beings are placed in a unique position of being part of the earth. We are from the dust and to dust we shall return. Yet human beings are uniquely created in God's image (Gen. 1:27-31).<sup>50</sup>

# Article

## *Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

Beautiful and fruitful gardens do not simply come into existence by themselves without intervention. They require the hard work of gardeners to plant and cultivate them. Thus, the garden imagery in Genesis suggests that God intends human beings to develop what God has made, not to leave it alone in some supposed pristine natural state. This mandate does not grant human beings license to treat the natural world any way that they wish. “The earth, like the garden, is God’s gift to us ... ‘Stewardship’ in an environmental context must mean that humans act as caretakers of the earth, not as lords over it.”<sup>51</sup>

Extending the gardener metaphor, human advancement in art, culture, architecture, medicine, technology, the human and physical sciences, and the general pursuit of knowledge are seen in a positive light. As Middleton argues,

The Bible itself portrays the move from creation to eschaton as movement from a garden (in Genesis 2) to a city (in Revelation 21–22). Redemption does not reverse, but rather embraces, historical development. The transformation of the initial state of the earth into complex human societies is not part of the fall, but rather the legitimate creational mandate of humanity. Creation was never meant to be static, but was intended by God from the beginning to be developmental, moving toward a goal.<sup>52</sup>

As with the rest of creation, God created human beings to advance and develop over time. In addition to the three metaphors for human beings found in Genesis 1–2 (steward, priest, and gardener), early church fathers such as Athanasius and Irenaeus provide a fourth metaphor. They believed that God created human beings, not in a state of full maturity and perfection, but in a developmental stage of infancy or childhood. Irenaeus argued that the creation of human beings in the image of God points not to a static quality or possession but to a dynamic reality toward which they are moving.<sup>53</sup> Osborn explains, “While Adam is in one sense perfect, the possibility of further perfection is set before him.”<sup>54</sup> This image was present in human beings at creation in embryonic form as a promise of what would later be realized more fully through their union with Christ in the Spirit.<sup>55</sup> It would reach full maturity only at the final resurrection and is therefore ultimately an eschatological reality.<sup>56</sup>

Irenaeus links the re-creation of sinful human beings in the image of Christ to Christ’s redemptive work of

recapitulation, whereby Christ assimilated or “took up [humanity] into himself” and thereby restored human beings by means of his incarnation, life, death, resurrection, and ascension.<sup>57</sup> Jesus Christ came to “recapitulate” human existence—being born as an infant, growing into adulthood, and then dying a human death—in order to live the truly genuine and faithful human life that sinful men and women had failed to live and thereby to “accustom” humanity to God and God to humanity.<sup>58</sup> He incorporated fallen humanity into his own life of faithfulness before the Father, demonstrated how we ought now to live as creatures renewed in his image, and pointed the way forward to our eschatological future as mature image bearers.<sup>59</sup> Consequently, God’s original intention that humans be stewards, priests, and gardeners of creation is reaffirmed, but with renewed gratitude, focus, hope, and power, because of their union with Christ by the Spirit and their glorious eschatological destiny.<sup>60</sup>

## Making Theological Sense of Evolution in Light of an Eschatological Hermeneutic

Now it is time to ask how this trinitarian, eschatological hermeneutic helps us to make theological sense of human evolution. I will suggest three ways in which it does this.

### *1. It avoids deistic naturalism/materialism and crude supernaturalist interventionism.*

The debate over creation and evolution in recent history, especially but not exclusively at the popular level, has all too often been tainted by the use of aggressive and combative rhetoric to promote extreme positions (i.e., young-earth six-day creationism versus atheistic evolution).<sup>61</sup> This has given rise to the unfortunate (and mythical) popular impression that science and the Christian faith are inherently incompatible.<sup>62</sup> Both of these extreme positions are prone to reductionism. The evolutionary atheist focuses almost exclusively on physical reality and downplays or ignores the significance of nonphysical or spiritual reality (material reductionism) whereas the creationist focuses almost exclusively on spiritual reality and downplays the significance of physical reality along with the insights and discoveries of the sciences that carefully and methodically study it (supernatural reductionism).<sup>63</sup>

In contrast, the trinitarian eschatological hermeneutic promoted in this article pushes back against both of these extremes. It suggests that the Spirit of God pervades all of reality, giving breath to all created life and acting with sovereign love and freedom to shape and direct the unfolding of creation and human destiny. The Spirit's activity should not be understood in crude interventionist terms, in which a god of the gaps intervenes from "the beyond" to create every living organism by means of a special, unique act of divine intervention. Rather, the Spirit *is continually present and active* within the created order in sustaining the world and drawing it toward fulfillment.<sup>64</sup> Much of the time, the Spirit's work in this regard goes unnoticed and may well be scientifically undetectable.<sup>65</sup> Sometimes, however, the Spirit's presence and power *intensifies* in order to actualize and/or to make manifest specific intentions or communications of the divine will (e.g., prophecy, miracles, the conception, incarnation, and resurrection of Christ).

In a recent article in *Pneuma*, Canadian Pentecostal theologian Andrew Gabriel employs the metaphor of intensification to provide a more coherent theological account of how Spirit baptism, as found in the New Testament book of Acts, relates to the Spirit's presence generally in the rest of the Bible and especially in the Old Testament.<sup>66</sup> His thesis is that Spirit baptism is a particular experience of the intensification of the presence and power of the Spirit of God, which already pervades and upholds all of reality and animates all life (e.g., Jer. 23:24; 1 Cor. 2:10; Eph. 1:23; 4:6).<sup>67</sup> Gabriel demonstrates that in the Old Testament, God's Spirit (*ruach*) animates not just human life, but all of life. The Spirit's animating presence intensifies among human beings in a unique way, and further intensifies with respect to particular human beings for special purposes (e.g., fills, comes to rest upon, empowers, and brings visions, prophetic utterances, and acts). So, already within the Old Testament, we observe sequential, subsequent fillings—or better, *intensifications*—of the Spirit's presence and power.

In the New Testament, we observe further intensifications in fulfillment of Old Testament prophecies proclaiming the Spirit's future coming in power (e.g., Joel 2; cf. Acts 2). We see it in the ministry of Jesus, in the conversion of people to Christianity (e.g., 1 Cor. 12:3; John 3:5-6), in the life and ministry of the church and individual Christians whom Paul exhorts to be *continually* filled with the Spirit

(Eph. 5:18), and finally, in the experience of Spirit baptism in Acts.<sup>68</sup>

We can employ Gabriel's intensification model constructively to discuss the Spirit's activity in guiding creation in a manner that is active and intimate without being crudely interventionist.<sup>69</sup> In the intensification view, the Spirit is the one who undergirds and supports all life and reality, including the physical laws of nature. Thus, the "miraculous" does not introduce a radical disruption into nature, as in the special arrival of a God who is usually elsewhere (the "beyond") and inactive (such that natural laws are "broken" and the structure of the physical realm is violated by God "breaking in"). Rather, the miraculous, the charismatic, and the mystical are instances of the intensification of the presence and power of the Spirit, who already pervades and upholds the universe.<sup>70</sup> Thus, the concept of intensification allows for a more nuanced and holistic understanding of God's interaction with physical and spiritual reality.<sup>71</sup>

## 2. *It provides a rich theology of nature while avoiding the pitfalls of pantheism.*

One of the things that many Christians find threatening about evolution is that it gives an important place to chance (e.g., random genetic mutation, natural selection influenced by changing ecosystems and environments), which is difficult to explain from the perspective of much of traditional theology. For some, accepting the role of chance would threaten their understanding of God's sovereignty.

A trinitarian, eschatological hermeneutic helps us to account theologically for the chaos, randomness, and chance (perhaps the writer of Ecclesiastes would add "meaninglessness"! ) that we observe in the natural order—particularly in evolution. One of the fascinating things about evolution is that it involves a dynamic interplay between chaos and order, randomness and self-organization, chance and purpose.<sup>72</sup> Often popular or high-school-level literature places an undue, one-sided emphasis on the randomness of evolution. However, this is misleading, because the randomness within evolution works only because it is combined with nonrandom natural laws and processes. "Evolution happens within the given necessity of natural law," according to John Polkinghorne.<sup>73</sup>

# Article

## *Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

Arthur Peacocke similarly writes, "One might say that the potential of the 'being' of the world is made manifest in the 'becoming' that the operation of chance makes actual." Then, reflecting theologically on the significance of this, he writes, "Hence we infer *God is the ultimate ground and source of both law ('necessity') and 'chance.'*"<sup>74</sup> In addition, while randomness is crucial to evolution at the microbiological level of genetic mutation, it does not characterize the overarching direction of evolutionary history.<sup>75</sup> In fact, evolution has certain propensities that favor consistent, progressive outcomes.<sup>76</sup> The universe, it seems, is on a journey: its trajectory is not aimless but progresses toward increased complexity and the flourishing of life.<sup>77</sup>

Far from being a problem for Christian theology by threatening God's sovereignty, chaos and randomness, as intrinsic elements of creation, actually ensure it. From this perspective, "Chance is just a shuffling mechanism for exploring potentiality."<sup>78</sup> As an "open system" creation neither locks God out nor imprisons God within the bounds of the created order.<sup>79</sup> God remains sovereignly loving (thus immanent) and sovereignly free (thus transcendent). The Spirit's intimate presence within creation, to draw and guide it toward its eschatological consummation through creation's own natural processes, does not entail that the Spirit is enmeshed with creation, as in pantheism. The mainstream Christian tradition rightly stresses that divine being and created being cannot be conflated or mixed. Moreover, pantheism is also misleading, because the present created order is not wholly sacramental: to be sure, it is filled with the presence of God and declares God's glory (Psalm 19), but it is also entangled with the reality of evil and, as such, its mediation and revelation of God's presence and character remain distorted and ambiguous.<sup>80</sup>

To illustrate the way that God interacts with the order and openness of the world to direct it according to his purposes, Polkinghorne appeals to information systems theory. He writes, "God may be seen as interacting with creation by the input of information within its open history."<sup>81</sup> Such information exercises top-down control over the system without violating the processes inherent within the system. Similarly, we could employ a computer analogy in which hardware parallels the physical world; software, the natural laws, forces, and processes that govern the world; and input capacities, the openness

of the system to the direction of God (as the user or programmer). Notice that in this analogy the software not only depends on the physical hardware to run, but also exercises top-down control over it via its programs and information inputs.<sup>82</sup> Such analogies, while imperfect, help us to think about God's interaction with the world in a way that preserves both God's immanence and transcendence.

### *3. It helps us to account theologically for the existence of death as intrinsic to creation.*

On the basis of evidence obtained across a wide range of scientific fields, contemporary scientists infer that death is a naturally occurring event, intrinsic to all creaturely life. Moreover, death is not a relatively recent phenomenon in the history of creation, but existed long before the arrival of human beings and extends all the way back to the emergence of simple cell life some 3.5 billion years ago. Furthermore, the universe itself is inherently finite and has, in its future, a definite, foreseeable end. Polkinghorne observes that, ultimately, "the whole universe is condemned to a final futility, either as a result of the bang of collapse back into the Big Crunch or as a result of the whimper of decay into low-grade radiation, expanding and cooling forever." Thus, "if things continue as they have been, it is as sure as can be that all forms of carbon-based life will prove to have been no more than a transient episode in the history of the universe."<sup>83</sup> In addition, our own sun on which all life on Earth is dependent for existence has a limited life-span (about five billion more years).<sup>84</sup>

Thus, it seems that the world that God created is a finite, mortal one, in need of deliverance from decay, corruptibility, and perishability. As I argued earlier, part of the Spirit's work in drawing human beings to their eschatological consummation is to transform what is perishable into that which is imperishable. Moreover, creation itself awaits such deliverance. As Paul writes, "creation itself will be set free from its bondage to decay and will obtain the freedom of the glory of the children of God," whereas in the meantime "we know that the whole creation has been groaning in labor pains until now" (Rom. 8:21–22). Salvation includes transformation from mortality to immortality; and immortality is a gift and a goal, not an intrinsic endowment of human beings, possessed from the outset of their

existence.<sup>85</sup> This insight can alleviate some of the discomfort Christians feel when considering the universal pervasiveness of death throughout the history of creation. However, other problems remain, three of which I will address briefly now.

*First, some see the pervasiveness of death in the history of evolution as being wasteful, meaningless, disheartening, and perhaps even depressing.* But surely this is to see the glass half empty. For one thing, such a perspective overlooks the beauty and diversity of life that the evolutionary process has made possible. A flower is not wasted because it withers and dies; its withering and dying is a necessary part of the cycle of seed-bearing life. The incredible variety of creatures throughout the ages has been a source of delight and enjoyment to God, even if many species have long since vanished and are known to us now only through the fossil record. In addition, the “glass half empty” view of death in evolutionary history overlooks *the amazing persistence of life*, despite all odds stacked against the probability of its emergence.<sup>86</sup>

Scientists have observed that the emergence of life requires an extremely “fine-tuned” universe, one that is so statistically improbable that we rightly marvel with awe and wonder at the fact that we actually exist and indwell such a universe. So, in light of this remarkable fact, the truly interesting question crying out for explanation is not “why do living things die?” but “*why is the universe so biased toward life?*” As Moltmann declares, evolution does not narrate a “war of nature” but the triumph of life!<sup>87</sup> Theologically, what accounts for the triumph of life is the presence and activity of the eschatological Spirit of God.

*Second, for many people, the pervasiveness of death raises serious questions about the goodness of God and the moral integrity of creation.* The existence of suffering, death, and the natural extinction of so many living creatures just seems to be morally wrong. Scripture’s portrayal of the moral significance of death is complex. At times, particularly when it is linked with human sin, death is seen as a great tragedy, the judgment of God on human depravity (e.g., Rom. 1:32; 5:12; 6:16, 23; 7:5, 11; 8:2; James 1:15; Rev. 21:8) and the last enemy to be destroyed (1 Cor. 15:26; cf. 1 Tim. 2:10; Rev. 21:4). At other times, however, death is assumed to be a natural part of the created order.<sup>88</sup> Ecclesiastes expresses this well: “For everything there is a season, and a time for every matter under heaven: a time

to be born, and a time to die ...” (3:1ff.). The Psalmist writes, “As for mortals, their days are like grass; they flourish like a flower of the field; for the wind passes over it, and it is gone, and its place knows it no more” (Ps. 103:15). The writer of Ecclesiastes assumes that all people await a common destiny: the righteous and the wicked, the good and the evil, the clean and the unclean, those who sacrifice and those who do not sacrifice—all of them alike depart to “the realm of the dead” where “there is neither working nor planning nor knowledge nor wisdom” (Eccles. 9:2, 10, NIV).<sup>89</sup>

In such passages, death is portrayed in negative terms as a tragedy for human beings not because of its connection with sin and judgment but because it represents an existential crisis: it extinguishes human hopes and dreams and is the end of human subjectivity. The Psalmist protests to God, “In death there is no remembrance of you; in Sheol who can give you praise?” (Ps. 6:5). Ecclesiastes 9:4–6 laments,

whoever is joined with all the living has hope ... but the dead know nothing; they have no more reward, and even the memory of them is lost. Their love and their hate and their envy have already perished; never again will they have any share in all that happens under the sun.

Death is not tragic simply because it is the end of life in general; death is tragic because it is the end of *personhood*. The death of nonhuman creatures, including the prehuman ancestors of modern human beings, is not tragic in the same sense or degree that human death is tragic.<sup>90</sup> Death as a naturally occurring phenomenon becomes *morally relevant* only with the emergence of personhood, because it threatens *personal existence*, not merely creaturely existence. To be sure, human beings share much in common with other living beings. Like all other creatures, they are animated by the breath of life and are molded from the same biological material, the basic building blocks for life, and along with other creatures of the sixth day (Gen. 1:24–26), they are produced from the dust of the earth (Gen. 2:7). As Ray Anderson puts it, “creatureliness is an undifferentiated field on which the occasion of the human occurs.”<sup>91</sup> Theologically, however, humans are unique; by God’s design, calling, and covenant, they transcend mere creatureliness and exist as persons made in God’s own image and likeness. With the emergence of human persons, death gains existential and ethical significance. Life and death now pose ultimate questions to human

# Article

## *Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

beings about their nature, purpose, calling, and destiny.

To understand the moral and spiritual relevance of death that is unique to human beings, let us briefly consider an analogy: sexuality. Like death, sexuality becomes morally and spiritually relevant only with the emergence of personhood. For nonhuman creatures, sexuality is not a moral, ethical, or existential question; it is merely a biological function of creaturely existence. However, for human beings made in God's image, sexuality is not simply a biological function of creaturely existence but is now deeply integrated with personhood, and thus with subjectivity, personal dignity, individual and social identity, interpersonal relations and ethics, and spirituality (becoming "one flesh," as Gen. 2:24 puts it).

The good news of the gospel is that the Son of God became one of us, entering into our perishable human form and suffering our fate.<sup>92</sup> Thus, God deals with the problem of suffering and death *by entering into it* in the person of Jesus Christ, whose death on the cross in solidarity with humanity and resurrection from the grave gives us eschatological hope for everlasting life in the new creation. The Bible offers us not a rationalization for the existence of suffering and death, but the promise of resurrection through participation in Christ. Thus, it offers us eschatological hope.<sup>93</sup>

*Third, the Bible, in particular Paul, teaches a perspective about death that seems to contradict what science is telling us about evolutionary history.* According to Paul, in passages such as Roman 5 and 1 Corinthians 15, death entered the world through the sin of Adam, whom Paul depicts as being the first living man (along with his wife Eve, the first living woman). In traditional evangelical readings, Paul appeals to the creation and fall of Adam and Eve to explain the universality of sin based on the solidarity of all human beings with Adam and his sinful state, resulting in death. Modern science raises at least two problems with the traditional (more or less literalistic) evangelical understanding of this passage. First, as discussed earlier, modern science has demonstrated beyond reasonable doubt that death existed long before the emergence of human beings. Second, genomic evidence indicates that the original human population consisted of at least several thousand individuals; we do not all descend from one original human couple.<sup>94</sup>

A number of biblical scholars have wrestled with the implications of modern evolutionary science as it relates to the historicity and theological significance of Adam and Eve.<sup>95</sup> Denis Lamoureux argues that Genesis teaches theological truths in outmoded cultural forms (ancient science and cosmology). This allows Lamoureux to retain important theological commitments, such as the universality of human sin, while dispensing with the historical Adam and Eve. While Lamoureux's overall approach is very helpful, his rhetoric here unfortunately tends to suggest that what really matters is the "kernel" of theological truth within the text, not the "shell" of its cultural-textual form. Thus, Lamoureux (perhaps unintentionally) erects a false dichotomy between form and content.<sup>96</sup> I agree with John Collins that "the worldview is not an abstraction from the story; one cannot treat the story simply as the husk, which we then discard once we have discovered the (perhaps timeless) concepts." Such concepts only "gain their power from their place in the story."<sup>97</sup> Much better are Lamoureux's statements about divine accommodation, which explain that "the Bible is the Word of God delivered in the words of humans" (p. 69).<sup>98</sup> Both form and content are crucial to what God is doing in revelation, even if we must subsequently apply hermeneutical tools to grasp the text's present significance.

Collins defends the position that Adam and Eve were historical people whose sin constituted a historical "fall," which caused the universal condition of human sinfulness (often termed depravity). However, in order to account for the findings of contemporary science (namely common descent from prehuman forms, the emergence of modern human beings at least 40,000 years ago, and an original human population size of perhaps several thousand), he proposes that Adam and Eve were "at the headwaters of the human race" as the chieftain and queen of an original human tribe.<sup>99</sup> While Collins's view is helpful in that it aims to take science seriously, his proposal falls prey to two sets of weaknesses. On the one hand, biblical literalists will reject it for taking too many liberties with the text. They have a point; Collins is explicitly attempting to retain the historicity of the creation and fall of a literal Adam and Eve, but he clearly goes beyond the narrative with his original tribe solution. On the other hand, those holding to literary interpretation will criticize Collins

for not going far enough in recognizing the narratives as theological rather than historical literature.<sup>100</sup>

Peter Enns rejects a literal-historical interpretation of Adam and Eve in favor of a theological-literary one. For Enns, Adam is a literary, proto-Israel and proto-Christ figure.<sup>101</sup> He argues that Paul reads the Adam story (and the Old Testament generally) *theologically* in order to explain the significance of Christ's death and resurrection.<sup>102</sup> Thus, "Paul's understanding of Adam is shaped by Jesus, not the other way around." Similarly, with regard to sin and salvation, "the solution reveals the plight," not the other way around.<sup>103</sup> Tremper Longman III also advocates a literary view, which classifies Genesis 1-3 as "high-style prose narrative." Consequently, Longman believes that it is not necessary to regard Adam as historical in order to stay true to the text.<sup>104</sup> Concerning passages such as Romans 5 and 1 Corinthians 15, Longman suggests that Paul's interpretive strategy was to employ a literary-historical *analogy*. He approvingly cites Conor Cunningham's statement that "Paul was not interpreting the [Genesis] story in and for itself; he was really interpreting Christ through the use of images in the story."<sup>105</sup>

My own view is that Adam and Eve are theological-literary figures to whom Paul refers analogously (in agreement with Longman and Enns). How then do I explain the universality of sin? Collins asserts that only a historical reading of the creation and fall of Adam can preserve the Christian doctrines of original sin, the universality of sin (human depravity), and by extension certain aspects of Christian soteriology.<sup>106</sup> Collins's own proposal succeeds on one level, but it does so only by pushing the problem back to Adam. Thus, a nagging question persists: why did Adam sin?<sup>107</sup> This question is particularly troubling when one considers that Adam's circumstances were, in the traditional reading, much more ideal than ours. In the traditional view, Adam had a perfect parent (God himself!), a perfect spouse, a perfect physical and psychological constitution, and a perfect natural and social environment in which all of his needs were met in abundance. Considering this, I suggest that it is actually more difficult for the traditional view to explain *why Adam sinned* than for those endorsing a theological-literary Adam to explain why human beings universally sin. It is possible to observe that all human beings suffer the effects of a "sin of origin" (to which all are enslaved, unable to free themselves) without requiring the Augustinian

doctrine of "original sin" (a fall from original righteousness at the dawn of human history).<sup>108</sup>

In the theological-literary view, *Adam is sinful humanity*.<sup>109</sup> As F. F. Bruce explains,

It is not simply because Adam is the ancestor of mankind that all are said to have sinned in his sin (otherwise it must be argued that because Abraham believed God all his descendants were automatically involved in this belief); it is because Adam *is* mankind.<sup>110</sup>

The force of Paul's argument in its appeal to Adam is not to ground the universality of sin historically, but to *illustrate* it by depicting human solidarity in sin (in Adam). He employs the illustration in the service of his larger purpose, which is to *ground* the salvation of human beings in Jesus Christ, this salvation being universal in scope (thus the Adam-Christ typology), but particular in application (the "many" in Romans 5), as it is appropriated through faith. Thus, "The effect of the comparison between Adam and Christ is not so much to historicize the original Adam as to bring out the individual significance of the historic Christ," says James Dunn.<sup>111</sup>

### *Sin and Death in Eschatological Perspective*

In light of the eschatological view of becoming human as proposed in this article, sin is an existential possibility that arises only with the emergence of human personhood. Previously, as creatures who had not yet attained personhood, the prehuman ancestors of modern humans behaved in ways similar to other animals because such behavior had long promoted survival.<sup>112</sup> According to modern human standards, we would find much of this behavior reprehensible but not *sinful* in the proper theological sense (e.g., it is not sinful for a predatory animal to kill and eat its prey). With the emergence of the human, however, we now have beings with whom God relates personally, beings whom God uniquely equips and calls to reflect the divine image by emulating God's character and pursuing God's own purposes for creation as God's representatives. Creaturely patterns and behavior that were formerly morally neutral gain ethical significance because they must now be considered within the emergent domain of *human personhood*. Accordingly, along with the emergence of human beings comes also the existential possibility of sin (and the theologically

# Article

*Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

conceived possibility of spiritual death).<sup>113</sup> Sin results from the willful refusal to follow God's gracious call to transcend mere creaturely existence; it is a refusal to embrace our eschatological destiny as image bearers and partakers in the divine nature (2 Pet. 1:4).<sup>114</sup>

The call to be human is both a gift to be received in the present and an eschatological destiny to be pursued into the future by God's active, initiating, and enabling grace. While "being human as gift" is something that we simply receive from God, "being human as destiny" is something that we can resist, distort, and even finally reject. No one can become fully human in the ultimate sense without God's ongoing, consummating grace; and, in light of sin, no one can become fully human in the redemptive sense (i.e., new creation, new humanity) without God's active, redeeming, and saving grace. We all inevitably experience the reality of sin and are culpable in perpetuating it, but by God's justifying, sanctifying, and glorifying grace, we are forgiven, cleansed, and look forward to our final transformation into Christ's likeness. This transformative, saving work of the triune God thus both pervades and transcends our evolutionary development. As Ted Peters suggests, God's eschatological new creation is a pull from the future, not merely a push from the past.<sup>115</sup>

Our final transformation in Christ shares continuity with our evolutionary history but is not causally determined by it. God's "ultimate" act of saving grace with respect to the present creation is transcendent and contingent, rather than immanent and necessary, even as it enters, directs, and imparts coherent meaning to the present "penultimate" order.<sup>116</sup> Our prototype is Christ, not Adam; it is only by sharing in Christ's resurrection that we will finally and fully enter the new creation, even as our hope-filled anticipation of that resurrection reorients and redefines our present existence "in Christ."

## Conclusion

In this article, I have argued that a trinitarian eschatological hermeneutic, applied to the doctrine of creation, helps us to make theological sense of evolution. My intention has not been to attempt to settle all of the questions that evolution raises for theology, but to offer a theological framework within which we may discuss such questions fruitfully and propose provisional solutions that respect the integrity

of both science and theology as we seek to understand the complex and glorious world that God has created. 

## Notes

<sup>1</sup>Karl W. Giberson and Francis S. Collins, *The Language of Science and Faith: Straight Answers to Genuine Questions* (Downers Grove, IL: InterVarsity Press, 2011), 49.

<sup>2</sup>Kenneth R. Miller, *Only a Theory: Evolution and the Battle for America's Soul* (New York: Viking Penguin, 2008), 109; see also Dennis Venema, "Evolution as a Scientific Theory," *Evolution Basics: An Introductory Course on Evolutionary Biology*, <http://biologos.org/blog/evolution-basics-evolution-as-a-scientific-theory>.

<sup>3</sup>Many Christians in the sciences have mounted effective arguments in favor of evolution. For example, see: Denis Alexander, *Creation or Evolution: Do We Have to Choose?* (Oxford: Monarch, 2008); Francis S. Collins, *The Language of God: A Scientist Presents Evidence for Belief* (New York: Free Press, 2007); Karl W. Giberson, *How to Be a Christian and Believe in Evolution* (New York: HarperCollins, 2008); Denis O. Lamoureux, *Evolutionary Creation: A Christian Approach to Evolution* (Eugene, OR: Wipf & Stock, 2008) and *I Love Jesus & I Accept Evolution* (Eugene, OR: Wipf & Stock, 2009); and Dennis R. Venema, "Genesis and the Genome: Genomics Evidence for Human-Ape Common Ancestry and Ancestral Hominid Population Sizes," *Perspectives on Science and Christian Faith* 62, no. 3 (2010): 166-78. Others provide indirect support for evolution by employing it as the scientific model that best accounts for observations encountered in various scientific fields. For example, see Ian Tattersal, "Origin of the Human Sense of Self," and Ian Hodder, "An Archeology of the Self," in *In Search of Self: Interdisciplinary Perspectives on Personhood*, ed. J. Wentzel van Huyssteen and Erik P. Wiebe (Grand Rapids, MI: Eerdmans, 2011), 33-49, 50-69; Graeme Finlay, "The Emergence of Human Distinctiveness: The Genetic Story," and R. J. Berry, "Evolution of *Homo sapiens*" in *Rethinking Human Nature: A Multidisciplinary Approach*, ed. Malcolm A. Jeeves (Grand Rapids, MI: Eerdmans, 2011), 107-48, 149-75; R. J. Berry, "Nothing in Biology Makes Sense except in the Light of Evolution," *Science and Christian Belief* 18, no. 1 (2006): 23-9; and J. Wentzel van Huyssteen, *Alone in the World? Human Uniqueness in Science and Theology* (Grand Rapids, MI: Eerdmans, 2006).

<sup>4</sup>Ted Peters, *God – The World's Future: Systematic Theology for a New Era* (Minneapolis, MN: Fortress, 2000), 132.

<sup>5</sup>My position is also compatible with the pneumatological eschatology of Amos Yong, as set forth in *The Spirit of Creation: Modern Science and Divine Action* (Grand Rapids, MI: Eerdmans, 2011). Yong offers an excellent survey of past proposals and outlines his own unique view from a Pentecostal perspective.

<sup>6</sup>Jürgen Moltmann, *God in Creation: A New Theology of Creation and the Spirit of God*, trans. Margaret Kohl (Minneapolis, MN: Fortress, 1993), 196, 205-10.

<sup>7</sup>See Thomas C. Oden, *Classic Christianity: A Systematic Theology* (New York: HarperOne, 2009), 523. For this theme in Irenaeus, see Eric Osborn, *Irenaeus of Lyons* (Cambridge: Cambridge University Press, 2005), 91.

- <sup>8</sup>See David Kelsey, *Eccentric Existence: A Theological Anthropology*, vol. 1 (Louisville, KY: Westminster John Knox, 2009), 123. For a discussion of the Spirit of God in concert with God's vocalizing of creation into being in Genesis 1, see J. Richard Middleton, *The Liberating Image: The Imago Dei in Genesis 1* (Grand Rapids, MI: Brazos, 2005), 86–7.
- <sup>9</sup>Athanasius makes the same connection: "The Father creates all things through the Word, in the Spirit" (*Letters of St. Athanasius to Serapion, Concerning the Holy Spirit* 3.4, quoted in Oden, *Classic Christianity*, 523).
- <sup>10</sup>Kelsey writes, "It is appropriate ... to characterize 'the power of the Spirit,' in which the Father creates, as the divine triune love's vitalizing, enlivening, and empowering life-giving power" (Kelsey, *Eccentric Existence*, 124).
- <sup>11</sup>Oden, *Classic Christianity*, 523. Similarly, Kelsey states, "The Spirit, sent by the Father with the Son, draws creation to eschatological consummation" (Kelsey, *Eccentric Existence*, 125–26).
- <sup>12</sup>Pannenberg brings these themes together effectively when he writes,  
Pneumatology and eschatology belong together because the eschatological consummation itself is ascribed to the Spirit, who as an end-time gift already governs the historical present of believers ... Thus we are to view the presence of the eschatological future by the Spirit as an inner element of the eschatological consummation itself, namely, as a proleptic manifestation of the Spirit who in the eschatological future will transform believers, and with them all of creation, for participation in the glory of God. (Wolfhart Pannenberg, *Systematic Theology*, vol. 3 [Grand Rapids, MI: Eerdmans, 1998], 553)
- <sup>13</sup>See, for example, the Creed of Constantinople (381 AD), included in J. N. D. Kelly, *Early Christian Creeds* (London: Longman, 1972).
- <sup>14</sup>Oden, *Classic Christianity*, 516. Drawing on Basil, Oden writes,  
God's own Spirit is shared effortlessly with their spirits without ceasing to be entire, as a "sunbeam whose kindly light falls on him who enjoys it as though it showed for him alone, yet illumines land and sea and mingles with the air." (p. 517)
- <sup>15</sup>*Ibid.*, 530.
- <sup>16</sup>Wolfhart Pannenberg, *Toward a Theology of Nature: Essays on Science and Faith* (Louisville, KY: Westminster John Knox, 1993), 123. Genesis 2:7 says that the human being became a "living soul" after having received the breath of life from God.
- <sup>17</sup>Unless otherwise stated, all Scripture quotations are taken from the New Revised Standard Version of the Bible.
- <sup>18</sup>Paul's argument assumes a trinitarian inner logic. Through the Spirit's regenerating and glorifying work, human beings are drawn to participate in the resurrection of Jesus Christ (being made alive "in Christ"), who is "the first fruits of those who have died," and so enter the eternal kingdom of God the Father.
- <sup>19</sup>Paul frames his discussion of death and resurrection, perishable and imperishable, within the basic gospel narrative, beginning with, "For I handed on to you as of first importance what I in turn had received: that Christ died for our sins in accordance with the scriptures" (1 Cor. 15:3). He then goes on to argue for the importance of belief in bodily resurrection, because of the absolute centrality and sole efficacy of Christ's bodily resurrection for the Christian faith. For, "if Christ has not been raised, your faith is futile and you are still in your sins" (v. 17).
- <sup>20</sup>Genesis 2 indicates the inherent mortality of human beings through its depiction of humanity's creation from the dust. See John H. Walton, "Reading Genesis 1 as Ancient Cosmology," in *Reading Genesis 1–2: An Evangelical Conversation*, ed. J. Daryl Charles (Peabody, MA: Hendrickson, 2013), 166.
- <sup>21</sup>Dietrich Bonhoeffer, *Creation and Fall: A Theological Exposition of Genesis 1–3, Dietrich Bonhoeffer Works*, vol. 3, ed. John W. de Gruchy, trans. Douglas Stephen Bax (Minneapolis, MN: Fortress, 1997), 801–93, 111–20.
- <sup>22</sup>George L. Murphy, "Roads to Paradise and Perdition: Christ, Evolution, and Original Sin," *Perspectives on Science and Christian Faith* 58, no. 2 (2006): 117. Murphy's statement is indebted to James Barr, *The Garden of Eden and the Hope of Immortality* (Minneapolis, MN: Fortress, 1992).
- <sup>23</sup>Joel B. Green, "Humanity—Created, Restored, Transformed, Embodied," in *Rethinking Human Nature: A Multidisciplinary Approach*, ed. Malcolm A. Jeeves (Grand Rapids, MI: Eerdmans, 2011), 293. For his discussion of Paul's *sōma pneumatikon* in 1 Corinthians 15, see pp. 290–3.
- <sup>24</sup>Osborn, *Irenaeus*, 101–2, 107, 111, 113.
- <sup>25</sup>Athanasius, *On the Incarnation of the Word* 5.1, in NPNF2–04. *Athanasius: Select Works and Letters*, ed. Philip Schaff (New York: Christian Literature, 1892), 38. Pannenberg observes that several other early church fathers thought along similar lines, including Tatian, Theophilus of Antioch, and Clement of Alexandria. However, he also notes that Irenaeus and Tertullian believed in the intrinsic immortality of the soul (incorrectly, in the case of Irenaeus if we follow Osborn's reading of him). See Pannenberg, *Systematic Theology*, 571; and Osborn, *Irenaeus*, 101–2, 107, 111, 136, 222, 235.
- <sup>26</sup>Claus Westermann, *Genesis 1–11: A Commentary* (Minneapolis, MN: Augsburg, 1984), 277–8; Green, "Humanity," 293; Pannenberg, *Systematic Theology*, 571, and *Theology of Nature*, 125, 153.
- <sup>27</sup>Paul S. Evans, "Creation, Progress, and Calling: Genesis 1–11 as Social Commentary," *McMaster Journal of Theology and Ministry* (2011–2012): 77; cf. Middleton, *The Liberating Image*, 89–90, 204–12.
- <sup>28</sup>It should be noted that other parts of creation also contribute to the unfolding and development of the created order. For example, as Paul Evans notes, in Genesis 1:11 the earth is called to "bring forth" plants and is thus clearly "participating in bringing forth new creatures" (Evans, "Creation," 83, note 53). Similarly in Genesis 1:20, God commands, "Let the waters bring forth swarms of living creatures," and in verse 24, "Let the earth bring forth living creatures of every kind."
- <sup>29</sup>As Brueggemann puts it, "The role of the human person is to see to it that the creation becomes fully the creation willed by God." See Walter Brueggemann, *Genesis, Interpretation: A Biblical Commentary for Teaching and Preaching* (Atlanta, GA: John Knox, 1982), 33.
- <sup>30</sup>James C. Peterson, *Changing Human Nature: Ecology, Ethics, Genes, and God* (Grand Rapids, MI: Eerdmans, 2010); Evans, "Creation," 82.
- <sup>31</sup>Stanley J. Grenz, *The Social God and the Relational Self: A Trinitarian Theology of the Imago Dei* (Louisville, KY: Westminster John Knox, 2001), 196–7 and *Theology for the Community of God* (Grand Rapids, MI: Eerdmans, 1994), 174, 177–8; J. Richard Middleton, "A New Heaven and a New Earth: The Case for a Holistic Reading of

# Article

## *Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

the Biblical Story of Redemption," *Journal for Christian Theological Research* 11 (2006): 80–1.

<sup>32</sup>Middleton, "A New Heaven," 81. Similarly, Dallas Willard writes: "In creating human beings God made them to rule, to reign, to have dominion in a limited sphere. Only so can they be persons" (Dallas Willard, *The Divine Conspiracy: Rediscovering Our Hidden Life in God* [New York: HarperSanFrancisco, 1998], 21).

<sup>33</sup>Middleton, "A New Heaven," 81.

<sup>34</sup>Gordon J. Wenham, *Genesis 1–15, Word Biblical Commentary*, vol. 1 (Waco, TX: Word, 1987), 32; Westermann, *Genesis 1–11*, 157; Evans, "Creation," 80; Green, "Humanity," 274; Middleton, "A New Heaven," 81; Middleton, *The Liberating Image*, chapter 7.

<sup>35</sup>Another important representative text is Isaiah 66:1: "Heaven is my throne, and the earth is my footstool. Where is the house you will build for me? Where will my resting place be?" See Rikki E. Watts, "Making Sense of Genesis 1," paragraph 47, online article for the American Scientific Affiliation, <http://www.asa3.org/ASA/topics/Bible-Science/6-02Watts.html>.

<sup>36</sup>For a detailed discussion, see Middleton, *The Liberating Image*, chapter 3.

<sup>37</sup>See also Walton, *The Lost World*, 72–92, and Middleton, *The Liberating Image*, 212, about the meaning of the seventh-day Sabbath rest in relation to the cosmos as God's temple and human beings as God's representatives and emissaries.

<sup>38</sup>John Walton notes that the purpose of a temple in the ancient world was not primarily to be a place where people gathered for worship (like modern churches), but rather a "home" and "headquarters" or "control room" for the deity (Walton, *The Lost World*, 75).

<sup>39</sup>Of course, there are also important, well-known differences between the Genesis account and other Ancient Near Eastern myths. See Watts, "Making Sense," paragraphs 30, 36, 49, and 55; Evans, "Creation," 78–82; and Middleton, *The Liberating Image*, chapter 5.

<sup>40</sup>John H. Walton, *Genesis 1 as Ancient Cosmology* (Winona Lake, IL: Eisenbrauns, 2011). For Walton's most recent summary of his basic position, see his essay "Reading Genesis 1 as Ancient Cosmology," in *Reading Genesis 1–2*, ed. J. Daryl Charles, 141–69.

<sup>41</sup>The main thesis of *Genesis 1 as Ancient Cosmology* is that Genesis 1 never was an account of material origins but that, as the rest of the ancient world, the focus of the creation accounts was to order the cosmos by initiating functions ... Genesis 1 is founded on the premise that the cosmos should be understood in temple terms. (p. ix)

<sup>42</sup>Walton, *The Lost World*, 26–27; *Genesis 1 as Ancient Cosmology*, 43.

<sup>43</sup>Middleton, *The Liberating Image*, 70.

<sup>44</sup>Walton argues that the language of resting points unambiguously to a temple context. He writes, "Deity rests in a temple, and only in a temple;" consequently, "without hesitation the ancient reader would conclude that this is a temple text and that day seven is the most important of the seven days" (Walton, *The Lost World*, 72).

<sup>45</sup>In light of its context (the symbolic world of the ancient near east), Middleton interprets Genesis as depicting the cosmos as God's Kingdom, craftsmanship, and cosmic sanctuary or temple (*The Liberating Image*, 70–88).

<sup>46</sup>Genesis 1 mixes royal imagery (creation as God's palace, human beings as God's stewards or vice-regents) with priestly imagery (creation as God's temple, human beings

as God's priests). Walton connects these two themes when he explains that, in the ancient world, a temple was constructed so that a deity could have a center for its rule. The significance of day seven in the Genesis account, then, is that God comes to indwell creation and thus to fill and rule over it.

<sup>47</sup>In the eloquent words of T. F. Torrance, "It is now the role of man in union with Christ to serve the purpose of God's love in the ongoing actualization of that redemption, sanctification and renewal within the universe." Quoted in Eric G. Flett, "Priests of Creation, Mediators of Order: the Human Person as a Cultural Being in Thomas F. Torrance's Theological Anthropology," *Scottish Journal of Theology* 58, no. 2 (2005): 181.

<sup>48</sup>Evans, "Creation," 76.

<sup>49</sup>*Ibid.*, 76–77. Strictly speaking, it is more appropriate to say that the necessity for cultivation *resonates with* (rather than *recalls*) God's commission in Genesis 1:28 for humans to "subdue" the earth. This avoids conflating the two narratives.

<sup>50</sup>Peterson, *Changing Human Nature*, 19. Peterson interprets the image of God as including three aspects: *representing God* as his stewards, which our *capacity for reason* and our *unique personal relationship* with God make possible.

<sup>51</sup>Peter Bakken, Diane Jacobson, George L. Murphy, and Paul Santmire, "A Theological Basis for Earthcare," *Lutheran Forum* (Pentecost 1995): 25. The authors note that the words *'abad* and *shamar* in Genesis 2:15, while frequently translated "till" and "keep," are also used in the Old Testament to describe the acts of serving and guarding God's tent of meeting in the wilderness (e.g., Num. 3:7–8, 4:47; 16:9). Hence the vocation of tending the earth, God's garden, has a priestly dimension.

<sup>52</sup>Middleton, "A New Heaven," 76. We should also note that there are many features of the New Jerusalem in Revelation 22 that allude back to the Garden of Eden (e.g., the river of life, the trees of life, the absence of the curse, and the intimate presence of God). Thus, we have a renewed garden that has become a city-garden. Moreover, human stewardship is restored and redeemed human beings "will reign forever and ever" (v. 5). In addition, several features of the text of Revelation 21 identify the New Jerusalem as God's eschatological temple. See also Watts, "Making Sense of Genesis 1," paragraph 48.

<sup>53</sup>Irenaeus, *Against Heresies* IV/11.1–2; 38.1–4; V/8, 10, 15, in *The Apostolic Fathers with Justin Martyr and Irenaeus*, ed. Philip Schaff (Grand Rapids, MI: Eerdmans, 2001). See also Julie Canlis, "Being Made Human: The Significance of Creation for Irenaeus' Doctrine of Participation," *Scottish Journal of Theology* 58, no. 4 (2005): 434–54; Peterson, *Changing Human Nature*, 6, 25, 127, 171; Matthew C. Steenberg, *Irenaeus on Creation: The Cosmic Christ and the Saga of Redemption* (Boston, MA: Brill, 2008); and F. LeRon Shults, *Reforming Theological Anthropology: After the Philosophical Turn to Relationality* (Grand Rapids, MI: Eerdmans, 2003), 235–42.

<sup>54</sup>Osborn, *Irenaeus*, 85.

<sup>55</sup>Irenaeus, *Against Heresies* V/16.2 (p. 544); Osborn, *Irenaeus*, 79, 92. We need not follow Irenaeus's exegetical move of separating the "image" and "likeness" of God (the former given at creation, the latter to be given in Christ) in order to learn from his dynamic, developmental view of creation.

<sup>56</sup>Grenz, *Theology for the Community of God*, 172–3; and *The Social God and the Relational Self*, 147–8, 177.

<sup>57</sup>Irenaeus, *Against Heresies* III/16.6 (pp. 442–3). Osborn observes that the concept of recapitulation pervaded the theology of the second century, being found in Justin, Clement, and Tertullian (Osborn, *Irenaeus*, 97). For a thorough explication of Irenaeus’s doctrine of recapitulation see Osborn, *Irenaeus*, chapters 5 and 6 (pp. 97–140).

<sup>58</sup>For Irenaeus’s many comments about recapitulation, see *Against Heresies* II/22.4; III/16.6, 21.10, 23.1; V/12.4, 14.1, 19.1, 21.1. Osborn observes that one of the major themes in Irenaeus is that of “accustoming,” noting that “the first purpose of the economy was to accustom man to God and to accustom God to man.” The incarnation marks a new and particularly significant phase in the process of accustoming, as “in Christ, man is able to see God, to contain God, to accustom himself to participate in God while God is accustomed to live in man” (2.30.3). Osborn, *Irenaeus*, 80, 81.

<sup>59</sup>In light of this forward-pointing dimension, Peters suggests that the term “precapitulation” might be more appropriate than Irenaeus’s “recapitulation” (which Peters suggests gives the impression of a completed event in the past). Thus, “Christ establishes ahead of time what it is that will define who we as humans shall be” (Peters, *God – The World’s Future*, 152).

<sup>60</sup>I explore these themes in greater detail in my book *Being Human, Being Church: The Significance of Theological Anthropology for Ecclesiology* (Paternoster, forthcoming).

<sup>61</sup>For a nuanced exploration of six different approaches to origins, three of which affirm evolution but only one of which affirms atheism, see Gerald Rau, *Mapping the Origins Debate: Six Models of the Beginning of Everything* (Downers Grove, IL: IVP Academic, 2012). For an excellent recent example of an atheist who rejects naturalistic materialism on philosophical grounds, see Thomas Nagel, *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False* (New York: Oxford University Press, 2012).

<sup>62</sup>For a recent philosophical critique of this mythical war between science and religion, see Alvin Plantinga, *Where the Conflict Really Lies: Science, Religion, and Naturalism* (New York: Oxford University Press, 2011).

<sup>63</sup>One of Kenneth Miller’s greatest concerns about young-earth creationism is its tendency to fear and elude scientific truth. He writes,

Traditional creationists, after all, rejected not just evolution, but nearly all of mainstream science. They quarrelled with geology over the fossil record and the age of the earth, with astronomy over the distances of stars and galaxies, with cosmologists over the age and origin of the universe, and even with physicists over the laws of thermodynamics. (Miller, *Only a Theory*, 117)

<sup>64</sup>The transition of the world to its final eschatological consummation as the new creation is both gradual/progressive (in history) and sudden/fulfilled (at the end of history), and it involves both continuity and discontinuity with the present creation. A good analogy for the final transition is the resurrection of Jesus as applied to those who are “in Christ.” Just as believers have been regenerated and now, by the grace of God and sanctifying work of the Spirit, are progressing in love and holiness—yet must nevertheless undergo death and bodily resurrection to fully enter the new creation—so the present creation progresses for a while (by the Spirit’s drawing) but then must be remade as the new creation (whether or not it,

too, dies before being remade depends on the timing of the Lord’s final coming).

<sup>65</sup>As Ted Peters writes,

Through the ages of science what we see is the sequence of secondary causes. We do not see miracles, nor do we see primary causation. Science is free to limit itself to secular explanations for natural phenomena. Science provides theories of explanation within the self-imposed parameters of secondary relationships. (Peters, *Anticipating Omega: Science, Faith, and Our Ultimate Future* [Göttingen: Vandenhoeck & Ruprecht, 2006], 22)

<sup>66</sup>Andrew K. Gabriel, “The Intensity of the Spirit in a Spirit-Filled World: Spirit Baptism, Subsequence, and the Spirit of Creation,” *Pneuma* 34 (2012): 365–82.

<sup>67</sup>Gabriel, “Intensity of the Spirit,” 370–2. Note that only one of these biblical texts refers explicitly to the Spirit. However, theologically, the Spirit is implied in all of them (e.g., Eph. 1:23 and 4:6 refer to Jesus and the Father filling all things, but theologically we understand that it is by the Spirit that they do so, just as it is by the Spirit that Christ is present to and fills the church). Gabriel also cites a number of theologians in the Christian tradition who affirm that the Spirit pervades and fills all of creation, including Hilary of Poitiers, Gregory of Nazianzus, John of Damascus, Anselm of Canterbury, Thomas Aquinas, Martin Luther, John Wesley, Karl Barth, Jürgen Moltmann, Ives Congar, Kallistos Ware, Charles Hodge, Bernard Ramm, and Amos Yong.

<sup>68</sup>Gabriel, “Intensity of the Spirit,” 373–81.

<sup>69</sup>This view bears some similarity to that advocated by C. S. Lewis in his book *Miracles: A Preliminary Study* (New York: HarperSanFrancisco, 2001), which views miracles as compatible within the framework of the dawning of the kingdom of God (as hidden possibilities in the present). For an excellent survey of recent approaches to relating divine action to physical reality (including necessitarian, regularist, and antirealist approaches), see Yong, *The Spirit of Creation*, 106–12. With respect to miracles, Yong extends Lewis’s insights in pneumatological and eschatological directions that envision “the Holy Spirit as working in and through nature and its laws, but also proleptically and continually transforming such in anticipation of the general shape of the coming kingdom” (p. 125). Miracles are “the proleptic signs of the world to come” (p. 128) and “Christian life in the Spirit suggests our capacity in this world to walk according to the ‘laws’ of the coming kingdom” (p. 129). In light of this eschatological approach, Yong suggests (in constructive dialogue with C. S. Peirce) that “the laws of nature should be defined in habitual, dynamic, and general rather than in necessitarian terms” and are “real possibilities and tendencies through which the Holy Spirit is bringing about the coming kingdom.” Thus, they are “amenable to the basic actions of God and sufficiently flexible so that they can be miraculously redeemed to usher in the patterns and habits of the coming world (p. 131).

If my reading of Yong is correct, part of what confuses the discussion of miracles is a static and closed understanding of the laws of nature. If, however, the laws of nature are (a) themselves emergent phenomena rather than timeless universals, and (b) open to the future reality of God’s eschatological kingdom (a wider reality in which God will finally “fill all” and be “all in all” according to Eph. 1:23 and 1 Cor. 15:28), then it becomes possible to understand God’s interaction with natural laws theologically as *inten-*

# Article

## *Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

sifications of the eschatological Spirit's presence and power within the present order to draw it ever toward the reality of the present-yet-coming kingdom of God.

<sup>70</sup>It is important to note that what I am attempting to do here is provide a *theological* account of God's interaction with physical reality, rather than a scientific or causal explanation. Theology operates within the realm of symbolism and metaphor to point to that which is beyond the material realm. So, the primary theological question is: what metaphorical language does the most justice to both divine revelation (scripture) and the physical realities we observe? My suggestion is that the metaphor of "intensification" does better justice to the reality of God's interaction with the world than does that of "breaking the laws of nature." In the future, theology might propose better, more fitting, and comprehensive metaphors; however, the question of precisely how spiritual reality interacts with material/physical reality will always remain mysterious on some level (especially when discussing nonemergent spiritual reality—the transcendent Spirit of God—as opposed to emergent spiritual realities, for instance, the human "soul").

<sup>71</sup>This perspective may help create space theologically to integrate the insights of intelligent design with those of (often nonteleological) evolutionary theism. It could be relevant, for example, to Ralph Stearley's critically constructive interaction with Stephen C. Meyer in Stearley, "The Cambrian Explosion: How Much Bang for the Buck?," *Perspectives on Science and Christian Faith* 65, no. 4 (2013): 253–5.

<sup>72</sup>Evolution is just one among many processes in the natural world in which scientists have observed this interplay. See Arthur Peacocke, *Theology for a Scientific Age: Being and Becoming – Natural, Divine, and Human* (Minneapolis, MN: Fortress, 1993), 115; and John C. Polkinghorne, *Science and the Trinity: The Christian Encounter with Reality* (New Haven, CT: Yale University Press, 2004), 82, 83.

<sup>73</sup>Polkinghorne, *Science and the Trinity*, 68.

<sup>74</sup>Peacocke even argues that the presence of human beings represents an inherent inbuilt potentiality of that physical universe in the sense that intelligent, self-conscious life was bound eventually to appear although its form was not prescribed by those same fundamental parameters and relationships that made it all possible. (Peacocke, *Theology for a Scientific Age*, 119)

<sup>75</sup>Berry, "Nothing in Biology," 28.

<sup>76</sup>Peacocke identifies the following propensities: increase in complexity, information processing and storage, consciousness, sensitivity to pain, and even self-consciousness (Peacocke, *Theology for a Scientific Age*, 220).

<sup>77</sup>*Ibid.*, 106–7.

<sup>78</sup>Polkinghorne, *Science and the Trinity*, 67.

<sup>79</sup>Moltmann discusses creation as an "open system" in *God in Creation*, 196, 205–8 and *Science and Wisdom* (Minneapolis, MN: Fortress, 2003), 33–53.

<sup>80</sup>Polkinghorne, *Science and the Trinity*, 165–6. I agree with Polkinghorne that we are wise to reject pantheism as a present reality, but we may look forward with eschatological hope to a sacramental pantheism in the new creation. See also Peters's discussion and critique of pantheism in *God – The World's Future*, 131–2.

<sup>81</sup>Polkinghorne, *Science and the Trinity*, 84.

<sup>82</sup>Some might wonder why God would choose to create a world characterized by openness, randomness, or chaos. The likely answer is that such openness was necessary to

create the kind of world, and more specifically the kind of beings (humans) God envisioned. Peacocke argues that such a world is necessary for producing beings that are fit for fellowship with God (i.e., endowed with freedom and the capacity to love). Polkinghorne agrees, arguing that the existence of free creatures who return God's love is a greater good than the existence of "perfectly behaving automata." See Peacocke, *Theology for a Scientific Age*, 125–6, 157; and Polkinghorne, *Science and the Trinity*, 165.

<sup>83</sup>Polkinghorne, *Science and the Trinity*, 85–6, 144.

<sup>84</sup>*Ibid.*, 143.

<sup>85</sup>Intrinsic eternal life is properly and uniquely an attribute of God; all created life is contingent life. We live "on borrowed breath," as David Kelsey eloquently puts it (Kelsey, *Eccentric Existence*, part one).

<sup>86</sup>See Peacocke, *Theology for a Scientific Age*, 106–12; Polkinghorne, *Science and the Trinity*, 68–72; Miller, *Only a Theory*, 121.

<sup>87</sup>Jürgen Moltmann, *Sun of Righteousness, Arise! God's Future for Humanity and the Earth* (Minneapolis, MN: Fortress, 2010), 218. See also Alexander, *Creation or Evolution*, 73–92, and Dennis Venema's helpful posts: "From Variation to Speciation," Parts 1–4, *Evolution Basics: A New Introductory Course on Evolutionary Biology*, <http://biologos.org/blog/series/evolution-basics>.

<sup>88</sup>In addition, Peters notes that death may be interpreted in light of either the law or the gospel.

According to the law it is our just deserts for acting sinfully. According to the gospel, it is a gift that opens the door to an everlasting life free of the sufferings we undergo in this life. (Peters, *God – The World's Future*, 323)

<sup>89</sup>Death is also described in terms of rest or sleep (e.g., Pss. 13:3; 90:5; Dan. 12:2).

<sup>90</sup>This does not mean that we should be complacent about or complicit in the needless suffering of animals. Rather, the argument clarifies the basis on which human responsibility for animals rests. We should care about and have compassion for animals, not because they possess intrinsic dignity (animals are not "persons"), but *because we do*. Mistreating animals and other nonhuman parts of God's creation, mars the nobility and dignity of human beings and distorts their calling as stewards, priests, and gardeners. Such behavior is undignified and unfitting.

<sup>91</sup>Ray S. Anderson, *On Being Human: Essays in Theological Anthropology* (Eugene, OR: Wipf & Stock, 2010), 21. Anderson explores this theme throughout the second chapter of the book.

<sup>92</sup>Jürgen Moltmann gives classic expression to this theme in *The Crucified God: The Cross of Christ as the Foundation and Criticism of Christian Theology* (Minneapolis, MN: Fortress Press, 1993).

<sup>93</sup>Jürgen Moltmann, *Theology of Hope: On the Ground and the Implications of a Christian Eschatology* (Minneapolis, MN: Fortress, 1993), 161–3, 203, 213, 224–9.

<sup>94</sup>Dennis R. Venema, "Genesis and the Genome," 166–78.

<sup>95</sup>C. John Collins proposes a helpful typology of four basic approaches to interpreting Genesis. See his article, "Adam and Eve as Historical People, and Why It Matters," *Perspectives on Science and Christian Faith* 62, no. 3 (2010): 149.

<sup>96</sup>For example, he writes, "Our challenge as modern readers of the Bible, then, is to identify this ancient vessel [ancient science] and to separate it from, and not conflate it with, the life-changing message of faith." Similarly, "passages in Scripture that deal with the physical world feature

both a *Message of Faith* and an *incidental ancient science*." Thus, he suggests that "if evolution is true, then there is no reason why the biblical origins accounts could not be re-accommodated for our generation by using modern evolutionary science as an incidental vessel to transport the Messages of Faith in Gen. 1-3." See Lamoureux, *I Love Jesus*, 18, 69. The problem is not with Lamoureux's suggestion that we need to reflect on the ancient context hermeneutically in order to discern its primary message(s). Certainly we must do this. But this does not mean that the "vessel" of ancient science is "incidental" to the narrative's message. Such a move would seem to suggest that we could (theoretically) rewrite Genesis by substituting modern for ancient science without losing anything in the narrative. I fear that his distinction fails to account for the full richness (or "thickness") of what is going on theologically in the text, precisely *in and by*—not just *in spite of*—the "ancient vessel" that is its form.

<sup>97</sup>Collins, "Adam and Eve," 150.

<sup>98</sup>On the theological importance of this point for our understanding of the nature of Scripture, see John Webster, *Holy Scripture: A Dogmatic Sketch* (Cambridge: Cambridge University Press), 21-5.

<sup>99</sup>Collins, "Adam and Eve," 159-60.

<sup>100</sup>For example, Peter Enns, *The Evolution of Adam: What the Bible Does and Doesn't Say About Human Origins* (Grand Rapids, MI: Brazos, 2012).

<sup>101</sup>In his book, *The Evolution of Adam*, Enns devotes much attention to Paul's reading of the Adam story in passages such as 1 Corinthians 15 and especially Romans 5. What is unique about Enns's approach is that he argues that while Paul believed that Adam was a historical person, we do not have to follow Paul in this respect. We may take Paul's theological point about the universality of sin and the consequent need of all people for salvation in Christ without accepting Paul's explanation of the *historical cause* of the human sinful condition.

<sup>102</sup>According to Enns, Paul employs literary strategies and interpretive practices that were typical of Second Temple Judaism. Thus, "Paul does not feel bound by the original meaning of the Old Testament passage he is citing, especially as he seeks to make a vital theological point about the gospel" (*Evolution of Adam*, 103). Enns goes on to demonstrate this thesis by reviewing several instances of Paul reading the Old Testament theologically in light of Christ (2 Cor. 6:2 and Isa. 49:8; Gal. 3:11 and Hab. 2:4; Rom. 11:26-27 and Isa. 59:20; and Rom. 4 and Gen. 15:6). In addition, Enns notes that Paul, in his reflections on the creation and fall of Adam, goes well beyond the teaching of Genesis and the Old Testament as a whole. The Old Testament actually gives scarce attention to Adam and does not relate universal human sin, death, and condemnation to Adam's sin. Enns, *Evolution of Adam*, 81-2. On this point, see also Westermann, *Genesis 1-11*, 276-8.

<sup>103</sup>Enns, *Evolution of Adam*, 122, 131.

<sup>104</sup>Tremper Longman III, "What Genesis 1-2 Teaches (and What It Doesn't)," in *Reading Genesis 1-2: An Evangelical Conversation*, ed. J. Daryl Charles, 122-5. The early chapters of Genesis are difficult to classify in terms of genre, as they seem to be neither purely historical nor purely metaphorical. Westermann says that they are not "historical chronology" but rather "primeval events" (Westermann, *Genesis 1-2*, 275-8). Brueggemann comments that his "exposition will insist that these texts be taken neither as history nor as myth. Rather, we insist that the text is a

proclamation of God's decisive dealing with his creation" (Brueggemann, *Genesis*, 16).

<sup>105</sup>Quoted in Longman, "What Genesis 1-2 Teaches," 124.

<sup>106</sup>Perry Yoder points out that the abandonment of original sin tied to a historical fall causes little difficulty for Mennonites and other traditions that believe children are born into a state of innocence and only subsequently reach an age of accountability. Perry Yoder, "Will the Real Adam Please Stand Up!," *Perspectives on Science and Christian Faith* 58, no. 2 (2006): 99.

<sup>107</sup>In traditional Calvinist theology, Adam sinned because God withheld his saving grace and so *passively* rendered Adam's sin certain (this is posited in order to harmonize God's sovereignty with the problem of original sin without thereby attributing evil to God). To bring about salvation, God then actively and effectually calls the elect, justifies and then progressively sanctifies them in love and holiness. I do not personally hold to this Calvinist perspective; what I find helpful about it, however, is the insight that we cannot become fully human (in terms of God's ultimate destiny for us) on the basis of our own merit or by our own strengths and inherent capabilities. Becoming fully human in this sense requires the redemptive work of Christ and the sanctifying and perfecting work of the Spirit in drawing us toward eschatological consummation and finally effecting our transformation in glory.

<sup>108</sup>See the arguments of Murphy, "Roads to Paradise," 111.

<sup>109</sup>In addition, most scholars argue that the early chapters of Genesis read in light of their original context within the Old Testament are primarily about explaining the existence of Israel—its calling, purpose, and mission—with the recognition that Yahweh, who delivered Israel from Egypt in the Exodus, is, in fact, the one and only God, the Sovereign Lord over all nations and Creator of all peoples. As Westermann writes, "God's action, which Israel experienced in its history, is extended back to the whole of history and to the whole world"; and "The reason why this chapter is at the beginning of the Bible is so that all of God's subsequent actions—his dealings with humankind, the history of his people, the election and the covenant—may be seen against the broader canvas of his work in creation" (Westermann, *Genesis 1-2*, 65, 195).

Wenham articulates a similar view:

Clearly Gen 1-11 serves simply as background to the subsequent story of the patriarchs, and their history is in turn background to the story of Israel's exodus from Egypt and the lawgiving at Sinai which forms the subject matter of Exodus to Deuteronomy. (Wenham, *Genesis 1-15*, xlv)

Or, according to Brueggemann, the text

is not an abstract statement about the origin of the universe. Rather, it is a theological and pastoral statement addressed to a real historical problem. The problem is to find a ground for faith in this God when the experience of sixth century Babylon seems to deny the rule of this God. (Brueggemann, *Genesis*, 25)

<sup>110</sup>F. F. Bruce, *Tyndale Commentary on Romans* (Leicester: InterVarsity Press, 1963), 160; Quoted in R. J. Berry, "Adam or Adamah?," *Science and Christian Belief* 23, no. 1 (2011): 41.

<sup>111</sup>James D. G. Dunn, *Romans 1-8, Word Biblical Commentary* 38A (Dallas, TX: Word, 1988), 290.

<sup>112</sup>Daniel Harlow expresses this well when he writes, "Here a range of evidence establishes that virtually all of the acts considered 'sinful' in humans are part of the

# Article

## *Understanding the Beginning in Light of the End: Eschatological Reflections on Making Theological Sense of Evolution*

natural repertoire of behavior among animals ... including deception, bullying, theft, rape, murder, infanticide, and warfare, to name but a few. [Thus,] far from infecting the rest of the animal creation with selfish behaviors, we humans inherited these tendencies from our animal past. (Daniel C. Harlow, "After Adam: Reading Genesis in an Age of Evolutionary Science," *Perspectives on Science and Christian Faith* 62, no. 3 [2010]: 180)

See also Murphy, "Roads to Paradise," 114.

<sup>113</sup>Harlow makes a similar point (Harlow, "After Adam," 191).

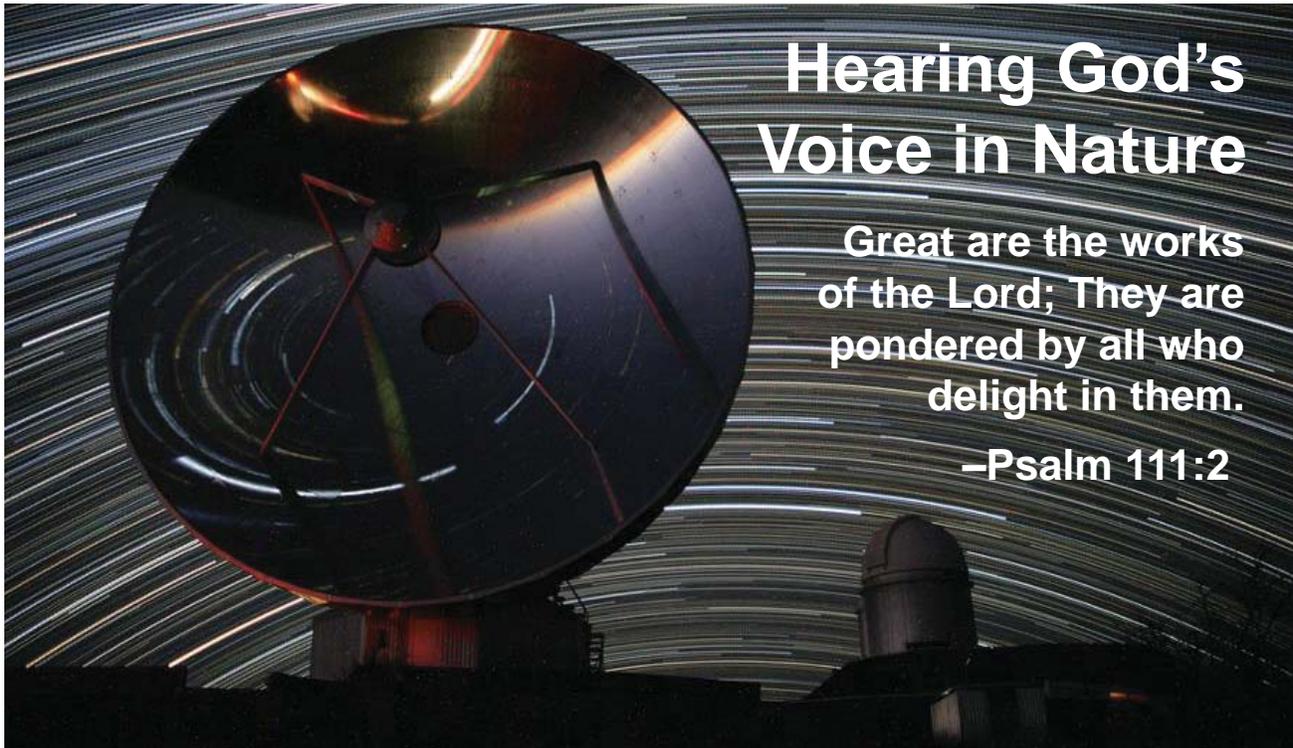
<sup>114</sup>I do not intend here to offer an exhaustive definition of sin (a complex concept conveyed through diverse and rich narratives and metaphors throughout scripture), but only to present the sinful condition in eschatological perspective.

<sup>115</sup>Peters's statement that God creates "from the future, not the past" must be held in balance with what he says elsewhere. I would prefer to speak of God's creating in the midst of the past, present, and future, as the Spirit's presence and power intensifies to draw creation forward toward God's envisioned consummation. God both

"pulls" the present and past into the future (eschatological drawing) and pushes creation forward from behind (as God's past creative work has ongoing effects in the present). With respect to our being transformed in Christ, while the resurrection of Jesus has determinative significance for human beings with respect to our future (we will rise with him), his incarnation has significance for our present (we are still dying in him). Thus, I find the following statement by Peters more satisfying: "Each moment God sustains the cosmos in being, provides an array of potentialities that makes contingency possible, and releases the present moment from the absolute grip of past determinism" (Peters, *Anticipating Omega: Science, Faith, and Our Ultimate Future* [Göttingen: Vandenhoeck & Ruprecht, 2006], 12, 14).

<sup>116</sup>Dietrich Bonhoeffer, *Ethics, Dietrich Bonhoeffer Works*, vol. 6, ed. Clifford J. Green, trans. Reinhard Krauss, Charles C. West, and Douglas W. Stott (Minneapolis, MN: Fortress, 2005), 146-70.

**ASA Members:** Submit comments and questions on this article at [www.asa3.org](http://www.asa3.org)→FORUMS→PSCF DISCUSSION.



## Hearing God's Voice in Nature

Great are the works of the Lord; They are pondered by all who delight in them.

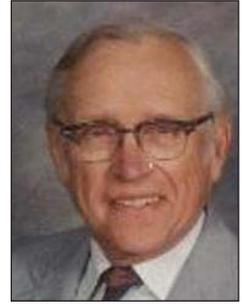
—Psalm 111:2

**ORU**

MAKE NO LITTLE PLANS HERE

American Scientific Affiliation Annual Meeting  
Oral Roberts University, Tulsa, Oklahoma  
July 24–27, 2015

*Dominic Halsmer, Program; Wesley Odom, Local Arrangements*



V. Elving Anderson

# Christian Commitment and the Scientist

V. Elving Anderson

*Objectivity and commitment are compatible attributes, and both are to be encouraged. The nature or pattern of commitment, however, may restrict one's openness to new facts or ideas.*

Objectivity and commitment are sometimes presented as opposing attributes. A person may ask, "How can you be intellectually honest and believe the Bible?" Science may be thought to represent the peak of objectivity, whereas religion stands for commitment. If these terms are indeed opposite in meaning, then direct conflict between science and religious faith appears inevitable.

In contrast to this point of view, I wish to suggest the following:

- (a) Objectivity and commitment are qualities of persons rather than of topics. Each person develops foci of commitment, and is more objective or less objective in different areas of life.
- (b) The person who is most deeply committed may be the one who is able to be the most objective.
- (c) It is the pattern of commitment (rather than its presence or absence) which conditions one's objectivity.

## Objectivity and Commitment

Huston Smith points out that objectivity is not equivalent to impartiality or neutrality.<sup>1</sup> Anyone active in research realizes the selective nature of his or her work. One is never able to study *all* the factors which might affect the problem under investigation; the researcher is forced to select those thought most significant. The

interpretation of results also involves the observer's personal sense of perspective. Complete impartiality would be possible only for an omniscient God. In a similar sense, complete neutrality is neither possible nor desirable. Neutrality may simply mask an inability to make decisions when they are needed.

It is more appropriate to think of objectivity as an individual's openness to new ideas or fairness to evidence. Smith elaborates,

This involves open-mindedness—the willingness, even eagerness, to entertain seriously every item of relevant evidence that has a bearing on the problem at hand. It involves maximum responsiveness to the facts, seeing each, insofar as possible, with discrimination and without distortion to the end that it may be assigned its appropriate and becoming weight.<sup>2</sup>

Objectivity is, thus, not a passive attribute which is given as a prize for good behavior. It requires energy to maintain. It involves a willingness to listen and an attempt to understand, followed by an appraisal of significance.

**V. Elving Anderson** (1921–2014) was Assistant Director of the Dight Institute for Human Genetics, University of Minnesota, Minneapolis and president of the ASA when he wrote this communication. It was based in part on a paper presented at the 18th Annual Meeting of the American Scientific Affiliation, Westmont College, Santa Barbara, California, August 19–23, 1963.

This communication was originally published in the *Journal of the American Scientific Affiliation* (now *PSCF*) 16, no. 1 (1964): 8–9.

# Communication

*Christian Commitment and the Scientist*

Teachers soon learn that students differ in their abilities to tolerate new ideas. Some students appear to feel that new evidence may markedly alter their systems of thought. They consider new ideas as a personal threat and are unable, or unwilling, to spend the effort required for re-evaluation.

Scientists also can reveal a lack of objectivity. A vigorous defense of a particular hypothesis can be a very stimulating exercise if it leads to new tests of the idea. But such a discussion can degenerate into an emotion-filled defense of an hypothesis as though it were personal property to be protected against all invaders. It is tempting to confuse one's models or interpretations of reality with the reality they are intended to represent.

On the other hand, a successful research scientist is often a deeply committed person. He or she must devote time and energy to study, planning, testing, recording data, and interpreting results. Furthermore, he or she is committed to basic assumptions, such as the following: (a) If an experiment is carefully designed, executed, and reported, the results can be verified by someone else. (b) If a principle or generalization is proved to be inadequate, it will be replaced by another more adequate one. (c) A good hypothesis is measured, not by its "truth," but by its usefulness in stimulating relevant research. (d) There is a reality which corresponds to the data supplied by his or her senses in answer to a research question.

## Commitment a Basis for Objectivity

It would seem, then, that objectivity and commitment are not alternative but mutually supporting attributes. Each person (whether theologian or scientist) reveals a pattern of objectivity and a pattern of commitment. Smith suggests that it is possible to possess a basic faith or commitment which

provides that matrix of ultimate confidence toward life which can accommodate the maximum open-mindedness ... We have now been brought to a paradox: the more faith a person has, the more open-minded he will be.<sup>3</sup>

Both objectivity and commitment are essential.

What happens, then, if we examine those commitments that we make as Christians who are also

scientists? I am personally committed to the faith that the Bible is God's revelation and that Jesus is both Savior and Lord. These, in fact, are the basic tenets which bring us together in the American Scientific Affiliation (ASA).

Some have urged strongly that we should add additional criteria for ASA membership: either specific interpretations of the Bible or specific ideas about the nature of science. The ASA Executive Council has resisted these pressures from both directions, feeling that our present statement of faith is a sound basis for fellowship and that we must not restrict open discussion of differing points of view.

Nevertheless, it may be appropriate for us as individuals to put into writing our personal "commitment profiles." This may be the only way we can discover the reasons for our differing opinions. Further discussion can be directed to these basic differences rather than to more secondary matters. It is in this spirit that I present the following as issues on which I am willing to take a stand.

- (a) The God who is my redeemer is also creator and sustainer of myself and of the universe.
- (b) In the world of nature about me, I see evidences of his activity. These are *evidences* in the sense that they demand a decision about faith in God, but not proofs which would compel an affirmative answer.
- (c) God's activity is involved both in what I think I understand and in what I know I do not understand.
- (d) Research is an appropriate task for a Christian, not just for the useful results which may accrue, but as part of God's command to subdue the earth and have dominion over it.
- (e) My faith creates no barriers to research, no forbidden areas. The earth is the Lord's and the fulness thereof. Certain methods of investigation, however, would conflict with my concept of the nature of humans. My research indicates that space is more vast, time more extensive, and nature more complex than I could possibly have imagined, and thus enlarges my concept of God.

Helmut Thielicke has described the difference between a "world picture" (the sum of scientific knowledge about the world) and a "world view"

## V. Elving Anderson

(which deals with the ultimate meaning of life and the world).<sup>4</sup> God as creator is part of my “world view.” I hope to grow in my comprehension of this idea and its relevance for me, but I do not expect to have my “world view” significantly altered by the results of research in any of the scientific disciplines. On the other hand, a good deal of my time and energy must be spent in trying to keep my “world picture” up to date. The rapid advances in molecular biology, for example, have dramatically modified some of the questions we address to the world of life as well as the answers we obtain.

This distinction is important for discussions of “evolution.” Some scientists are so deeply committed to evolution as a comprehensive explanation for the universe that any thought of God is rejected violently. Clearly evolution has become part of their worldview as a substitute for God as creator. But some Christians reject carefully documented data concerning natural selection or speciation in just as emotional a manner. These latter topics I would consider part of one’s world picture. I do not feel that my commitment to God as creator (as a creationist, if you please) should restrict my interest in genetic similarities between species or in natural selection in humans. If anything, my awareness of the problems of interpretation places me under some compulsion to become involved in this type of research.

### The Pattern of Commitment

Thus far I have argued that commitment and objectivity are compatible and that both are to be encouraged. But it is essential to point out that one’s *pattern* of commitment has an effect on one’s objectivity. The Russian commitment to Communist dogma, for example, has severely limited freedom for research in genetics. A commitment to the “gap theory” (an original creation in Genesis 1:1 followed by a large span of time and a re-creation) limits one’s objectivity in geology, even though some might hold this limitation to be desirable. A belief in vegetarianism would restrict openness to research in nutrition.

Furthermore, the pattern of commitment may be central or peripheral. That is, one’s energies can be devoted to simplifying and consolidating commitment or to protecting and up-dating a large number of specific beliefs. In general, it would seem that a larger number of commitment foci would place greater restrictions on objectivity.

Finally, it may be necessary occasionally to distinguish commitment to God’s word from commitment to traditional interpretations of the Bible. It would be presumptuous to claim that one has personally explored all facets of important questions and has arrived at independent conclusions. We must not discard the insights inherited from past centuries, but it is entirely possible that the Holy Spirit may yet have new lessons for us, if we will listen. ☺

### Notes

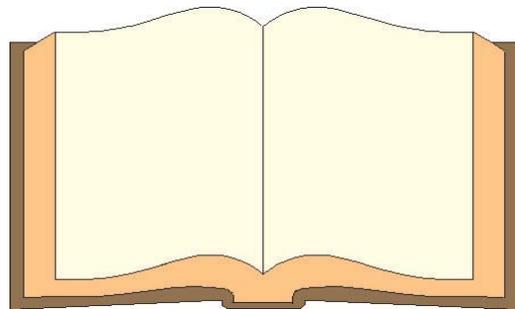
<sup>1</sup>Huston Smith, *The Purposes of Higher Education* (New York: Harper, 1955).

<sup>2</sup>Ibid., p. 43.

<sup>3</sup>Ibid, p. 46.

<sup>4</sup>Helmut Thielicke, *Man in God’s World*, trans. and ed. John W. Doberstein (New York: Harper & Row, 1963).

**ASA Members:** Submit comments and questions on this communication at [www.asa3.org](http://www.asa3.org)→FORUMS→PSCF DISCUSSION.



### A Call for Book Reviewers

The readers of *PSCF* have long appreciated the many insightful reviews published within its covers. If you would be open to being asked to contribute to this interesting and important service of writing a book review, please send a brief email to [patrick.franklin@prov.ca](mailto:patrick.franklin@prov.ca) that describes your areas of expertise and preferred mailing address. This information will be entered into a database that will bring you to the book review editors’ attention when a book of interest to you and *PSCF* readers becomes available for review. Of course, if a book is offered to you, you would still be able to accept or decline the mailing of the book at that particular time.



Stephen M.  
Contakes

## Communication

# Logical Pitfalls and Communication Gaps: Frequent Lines of Argument That Dead-End the Origins Conversation

Stephen M. Contakes

At a recent conference hosted by our ASA local section, there were many stimulating papers but also misdirections that obscured the issues or damaged the credibility of ideas that, at their core, are worthy of serious engagement. In order to promote more gracious and productive faith-science dialogue, this communication presents five pitfalls<sup>1</sup> that it can be helpful to avoid.<sup>2</sup>

1. *So, what is your argument? Don't worry—I think I just figured it out ... well, maybe.*

“God of the gaps” and “either/or” fallacies are so well known that their repeated occurrence in otherwise high-quality presentations at the conference seemed surprising. However, sometimes during the Q&A time, it became apparent that the speakers did not really believe that the absence of plausible scientific explanation in itself constitutes evidence for supernatural intervention or that either God or natural phenomena are mutually exclusive causes for all events.<sup>3</sup> They had simply left important parts of their arguments unstated.

To see how incomplete arguments can obscure important issues consider the following argument, which nominally exhibits the God of the gaps fallacy:

Origin of life science lacks a plausible overarching model for the origin of the first cell.

Therefore, God or an intelligent designer supernaturally intervened to produce the first life forms.

However, perhaps several propositions were left unstated and the following was intended:

Origin of life researchers exhaustively ruled out all natural mechanisms that could have produced the first cell.

Since, by definition, all causes are either natural or supernatural, therefore, life could not have arisen by natural causes; a supernatural designer must have been involved.

This possibly clarifies the argument and encourages discussion of whether origin of life science really has exhaustively ruled out natural mechanisms or that claims of supernatural intervention are justified. However, there is no guarantee that the original argument was accurately reconstructed. Maybe it was originally intended to be an inductive argument, perhaps as follows:

The physics and chemistry which bear on the origin of life are well known.

Origin of life researchers have been unable to develop a plausible overarching model for how the first cell may have arisen using known physiochemical mechanisms.

Notably, origin of life researchers have not been able to explain how highly stereospecific information-bearing homopolymers originated.

Therefore, it seems unlikely that life first arose by normal physiochemical means.

---

Stephen M. Contakes, PhD, Assistant Professor of Chemistry, Westmont College, Santa Barbara, CA.

*Perspectives on Science and Christian Faith*

In everyday experience, highly specific and complex systems like the above-mentioned biopolymers are the product of human ingenuity or of intelligent design.

Given the dearth of natural explanations and the presence of seemingly designed features in nature, it is reasonable to infer that God or an intelligent designer supernaturally intervened to produce the first life forms.

The above reconstruction might helpfully focus attention on additional issues that merit examination; however, it is also more speculative, as it focuses on a particular challenge in origin of life science<sup>4</sup> and assumes specific design arguments that were not mentioned in the original argument. Without more guidance from the argument's original author, it is impossible to be sure what, exactly, was intended.

Based on my experience with student lab reports and presentations, I suspect that most incomplete arguments are a failure of communication rather than a failure of logic. When one has deep convictions or has thought about something a great deal, it is easy to assume that others have a similar level of understanding. Nevertheless, any unstated portions of an argument will leave "logical gaps" that must be interpreted – and will perhaps be misinterpreted – by the audience.<sup>5</sup>

Nevertheless, all acts of communication rely on some level of knowledge and assumptions shared with an audience. Since the extent to which shared assumptions can be reasonably counted on varies from venue to venue, it is important for speakers and authors to carefully consider their audience. For instance, because the ASA encompasses a wider range of views on origins, scripture, and the nature of science than does the BioLogos Foundation or the Christian Scientific Society, arguments which appear plausible in the latter two venues might benefit from a more thorough exposition in ASA meetings and publications.<sup>6</sup>

*2. My simple back-of-the-envelope calculation just showed that, without a doubt, 42 is the "Answer to the Ultimate Question of Life, the Universe, and Everything."*<sup>7</sup>

Care should also be taken not to overstate the importance of results or make grandiose predictions from speculative theoretical models,<sup>8</sup> particularly when

important details of the phenomenon under study are unknown or neglected by the model. For example, consider Levinthal's model for protein folding.<sup>9</sup>

Protein folding occurs as a protein's polypeptide backbone randomly samples possible conformations.

Protein backbones can rotate around two bonds per peptide linkage, or  $2^{(N-1)}$  bonds in a peptide containing N amino acid residues.

Although a range of rotational angles is possible, let's generously assume that each bond can exist in only three conformations, for a total of  $3^{(N-1)}$  rotational states.

Therefore, a typical protein of 101 amino acids will need to sample  $3^{100}$  or  $\sim 5 \times 10^{47}$  conformational states.<sup>10</sup>

At typical bond rotation rates, the fastest that polypeptides can sample conformations is  $10^{13}$  times per second or  $\sim 3 \times 10^{20}$  per year.

Therefore, proteins should take approximately  $10^{27}$  years to fold, longer than the estimated age of the universe.

As written, the argument seems logically sound, but since most proteins spontaneously fold in under a second,<sup>11</sup> it leads to a false conclusion. One possibility is that protein folding involves the violation of natural law by a supernatural agent. Given the information presented this might be the best explanation; however, it would be wise to first establish that other alternatives are less likely. Levinthal himself suspected proteins might not randomly sample conformations; he thought that stable interactions might help lock properly folded regions into place during the folding process.<sup>12</sup> Indeed, Levinthal's suspicion was supported by subsequent experimental and theoretical work and protein folding is widely considered to occur naturally.<sup>13</sup>

Unfortunately, not all predictive models are subject to reproducible experimental validation. For instance, origin of life science lacks the sort of natural history artifacts needed to determine exactly how life started,<sup>14</sup> whereas predictive climate modelling awaits future validation. In such cases, it is especially important to clarify assumptions and to provide good-faith estimates of uncertainty.<sup>15</sup> When advocates for particular origins positions attempt to draw grand conclusions from simplistic models similar to those used by Levinthal, they can make it more difficult for scientists to give fair consideration to their propos-

# Communication

## *Logical Pitfalls and Communication Gaps: Frequent Lines of Argument That Dead-End the Origins Conversation*

als. For example, Michael Behe's grand conclusions about the limits of evolution in *The Edge of Evolution* were widely discounted as based on misused statistics and unwarranted assumptions,<sup>16</sup> even though the arguments he used were qualitatively similar to those in his earlier paper with David Snoke.<sup>17</sup> Had the conclusions in *The Edge of Evolution* been similarly qualified and followed up with an appeal for further work rather than a grand conclusion, the work may have generated more fruitful discussion. Indeed, a significant amount of subsequent ID-motivated research has followed up on Behe's proposals.<sup>18</sup>

### 3. *The point you raise is difficult to address; let's discuss another one that better fits my interests.*

Red herrings involve redirecting discussion of a pertinent but often challenging issue to an irrelevant but often easier one to argue. Consider the following exchange:<sup>19</sup>

Cocky Locky: There is no evidence that the sky is falling. The proposal by Chicken Little and his coworkers is unsupported by anything other than his own testimony.

Chicken Little: Cocky Locky seems to be unaware of the progress we've made since that unfortunate incident with Foxy Loxy. For instance, we've shown that air is a fluid through which objects can fall. Furthermore, our work has been critically reviewed in the prestigious *Poultry Farm Journal of Meteorology*, and numerous peer-reviewed papers supporting our theory have been published in *Caelo-Plungexity*, under the editorship of our most devoted supporters.

Notice how the original issue, the alleged lack of experimental evidence for a falling sky, has been replaced with the red herring of Cocky Locky's familiarity with the sky is falling literature. This charge may be related to the main issue (e.g., perhaps one of the papers in question presents the evidence which Cocky Locky claimed does not exist), but nothing Chicken Little says indicates this clearly. Thus Chicken Little's argument is unconvincing, though it may be misinterpreted as a legitimate refutation.<sup>20</sup>

Although the Chicken Little example was intended to be humorous, faith-science discussions can unintentionally take similar turns when a questioner does not keep the discussion on the presentation at hand. For instance, one of the speakers at our section's conference last winter argued that a popular

faith-science movement was "disingenuous" — a very serious charge meriting discussion and, if appropriate, refutation. However, constructive exploration of the charge was sidetracked when an adherent of the view in question refocused the discussion on the original presenter's familiarity with the movement's publications.<sup>21</sup>

Red herrings can also result when scientific controversies are not explained in enough detail to properly inform the audience. This is why many biologists consider it misleading to say that they are divided over "evolution"; a casual hearer is likely to assume that the evolutionary biology community has not reached a consensus over whether evolution occurred at all when, in fact, the disagreement is over the mechanisms by which it occurred.<sup>22</sup> Such loose language may be acceptable if the context is clear from the setting or from the rest of the argument; however, for an average audience, unqualified claims of "scientific controversy" might *de facto* result in the inconsistency fallacy, in which differences of opinion about something are used to charge that it is indefensible as a whole.<sup>23</sup>

### 4. *As everyone knows, "those people" are wrong; none of "us" would ever think that.*

There has been too much name calling in the dialogue over origins. Young earth creationists and intelligent design proponents are sometimes ridiculed as "ignorant," "obscurantist," or "IDIOTS," while theistic evolutionists are portrayed as "insincere," "compromised," or "counterfeit" Christians who do not take the Bible "seriously." Such name calling quenches genuine dialogue by effectively dismissing the views in question. Worse, it creates a climate in which the adherents of the specific view feel minimized. It can be tempting to think this is not a problem in ASA circles, especially since the ASA "strives to create a safe environment in which dialogue can flourish, and diverse, even contrasting, ideas can be discussed with courtesy and respect."<sup>24</sup> However, the tendency to be dismissive or demeaning in one's attitude and intimations (e.g., by using "us" and "them" language) is more insidious and, indeed, took place at a recent ASA annual meeting.<sup>25</sup>

### 5. *Dialogue? What dialogue? You finally messed up! Now I've got you.*

This fallacy assumes that just because an argument is fallacious its conclusion is false. The soundness of

an argument's logical structure does not necessarily prove the correctness of its conclusion. Logically sound arguments can lead to false conclusions if one of the premises is false (as in the Levinthal's hypothesis example), while unsound arguments can lead to true conclusions. In other cases, arguments that are logically unsound as deductive proofs can plausibly be reformulated as inductive arguments or abductive inferences to the best explanation.

Indeed, if the faith-science dialogue is to move forward, we should beware of easy "wins." Instead, we should seek to strengthen, reformulate, and otherwise engage the best arguments for those positions with which we disagree. In doing so, we are helping to move the faith-science dialogue forward, not just establishing that our own way is the right one. Indeed, perhaps the greatest prerequisite for fruitful dialogue is a willingness to seek and to follow the truth wherever it leads. These reflections are offered in the hope that a better understanding of logical fallacies and communication missteps can help us avoid two temptations that work against openness—the fear of being deceived and the fear of being wrong. Believers who are equipped to analyze, and if necessary, challenge questionable arguments, can confidently engage opposing views while offering appropriately nuanced arguments to advocate for their own views. It is the author's hope that this will make for more fruitful dialogue over issues of origins. 

### Acknowledgments

I wish to thank Westmont College for providing me with a sabbatical leave and Professors David Vander Laan, Michael Everest, and James Peterson for helpful conversations and feedback.

### Notes

- <sup>1</sup>Note that in offering these pitfalls, I am not claiming or intimating that particular speakers at the conference committed these fallacies or even that all of the listed fallacies were committed at the conference. In fact, the list and examples given reflect my training and interest as a chemist and my idiosyncratic interests in the relation of faith and chemistry more than anything else.
- <sup>2</sup>Although a number of books and websites treat these issues more rigorously than is done here, the chief novelty of this communication is its focus on contemporary discourse among ASA members. The ASA website contains a page on logical fallacies with links to additional resources at <http://www.asa3.org/ASA/education/think/fallacies.htm>.
- <sup>3</sup>For example, logically fallacious god of the gaps arguments involve assertions based solely on lack of evidence; the label does not strictly apply when a positive argument is offered for why the gap exists. See C. John (credited as

Jack Collins) Collins, "Miracles, Intelligent Design, and God of the Gaps," *Perspectives on Science and Christian Faith* 55, no. 1 (2003): 22–9. Such arguments should be carefully examined and not casually dismissed as fallacious. See Robert Larmer, "Is There Anything Wrong with 'God-of-the-Gaps' Reasoning?," *International Journal for Philosophy of Religion* 52, no. 3 (2002), 129–42. Del Ratzsch has pointed out that even "god of the gaps"-type arguments are commonly used in science. See Delvin Lee Ratzsch, *Nature, Design, and Science: The Status of Design in Natural Science*, SUNY Series in Philosophy and Biology (Albany, NY: State University of New York Press, 2001).

<sup>4</sup>The significance of the informational biopolymer problem is acknowledged in both the scientific and intelligent design literature. For an example of the former, see P. L. Luisi, *The Emergence of Life: From Chemical Origins to Synthetic Biology* (Cambridge: Cambridge University Press, 2006). A relatively recent example of the latter is Stephen C. Meyer, *Signature in the Cell: DNA and the Evidence for Intelligent Design*, 1st ed. (New York: HarperOne, 2009).

<sup>5</sup>Logical gaps force the reader to fill in missing information; they can lead to misunderstandings. See George Gopen and Judith Swan, "The Science of Scientific Writing," *American Scientist* 78, no. 6 (1990): 550–8, for a helpful discussion of this issue along with helpful examples illustrating how logical gaps can be detected and avoided.

<sup>6</sup>This is not to denigrate either the BioLogos Foundation or the Christian Scientific Society, whose more monolithic character allows them to serve different roles than the ASA.

<sup>7</sup>In Douglas Adams, *The Hitchhiker's Guide to the Galaxy* (New York: Harmony Books, 1995), the supercomputer Deep Thought ultimately calculates 42 as the "Answer to the Ultimate Question of Life, the Universe, and Everything."

<sup>8</sup>Here it is important to distinguish between models that are somewhat speculative from those that have been validated to the extent that they can be used to challenge experimental conclusions. For instance, computational chemistry has advanced to the point that its results can be used to challenge questionable experimental assumptions. One of the best-known examples occurred when Fritz Schaefer challenged Gerhard Herzberg's claim that the methylene radical was linear, and later work proved Schaefer correct. For details, see Henry F. (Fritz) Schaefer III, "Methylene: A Paradigm for Computational Quantum Chemistry," *Science* 231, no. 4742 (1986): 1100–7.

<sup>9</sup>Levinthal's paradox is a staple of undergraduate biochemistry texts. The numbers given are from R. Zwanzig, A. Szabo, and B. Bagchi, "Levinthal's Paradox," *Proceedings of the National Academy of Sciences* 89, no. 1 (1992): 20–2.

<sup>10</sup>Here I am expressing Levinthal's paradox in its usual form although Professor David Vander Laan of Westmont College points out that on average a protein will only need to explore about half these states before finding the proper folded conformation. However, this does not materially affect the overall argument, especially given the approximations Levinthal employs.

<sup>11</sup>For a sampling of folding rate constants see David De Sancto and Victor Muñoz, "Integrated Prediction of Protein Folding and Unfolding Rates from Only Size and Structural Class," *Physical Chemistry Chemical Physics* 13, no. 38 (2011): 17030–43. The slowest protein listed has a time constant of 4.3 seconds; the fastest, 4.8 microseconds.

<sup>12</sup>Cyrus Levinthal, "How to Fold Graciously," in *Mossbauer Spectroscopy in Biological Systems: Proceedings of a Meeting Held at Allerton House, Monticello, Illinois*, ed. J. T. P.

# Communication

## Logical Pitfalls and Communication Gaps: Frequent Lines of Argument That Dead-End the Origins Conversation

DeBrunner and E. Munck (Champaign, IL: University of Illinois Press, 1969), 22–4.

<sup>13</sup>Although Levinthal's paradox remains incompletely resolved, in many cases folding rates can be reliably predicted from amino acid sequence data as long as their structural class is known. See M. Michael Gromiha, "A Statistical Model for Predicting Protein Folding Rates from Amino Acid Sequence with Structural Class Information," *Journal of Chemical Information and Modeling* 45, no. 2 (2005): 494–501. For a brief review of the state of the protein folding field, see Ken A. Dill and Justin L. MacCallum, "The Protein-Folding Problem, 50 Years On," *Science* 338, no. 6110 (2012): 1042–6. A well-referenced overview of progress on the protein folding rate problem is presented in the introduction to Sergiy O. Garbuzynskiy et al., "Golden Triangle for Folding Rates of Globular Proteins," *Proceedings of the National Academy of Sciences* 110, no. 1 (2013): 147–50.

<sup>14</sup>Most origin of life researchers are currently seeking to discover plausible mechanisms for how life might have arisen; none are, to my knowledge, seeking to find out exactly how life historically arose on the earth.

<sup>15</sup>For instance, the Intergovernmental Panel on Climate Change (IPCC) clearly states the assumptions behind their predictive models and provides estimates of uncertainty. Note also that critics of speculative models have a responsibility to properly interpret the uncertainty involved, and, in no case, should they use the uncertainty to claim that the prediction is untrue. That would be to commit the argument from uncertainty fallacy. They might, however, incorporate the uncertainty into a risk-benefit analysis when deciding what courses of action are warranted by the predictions.

<sup>16</sup>See Michael J. Behe, *The Edge of Evolution: The Search for the Limits of Darwinism* (New York: Free Press, 2007). Nevertheless, it should be noted that Behe admirably takes pains to lay out and think about his assumptions. The issue is the degree to which he was willing to consider the fallibility of his assumptions. Like Levinthal, Behe uses well-attested experimental results to make seemingly generous assumptions about the potential of natural processes. However, he seems less ready than Levinthal to consider whether the assumptions implicit in his model might be incorrect or in need of modification. Indeed, critical reviews of the focus of Behe's book question his assumptions and charge him with misuse of statistics. See Sean B. Carroll, "God as Genetic Engineer," *Science* 316, no. 5830 (2007): 1427–8; Kenneth R. Miller, "Falling over the Edge," *Nature* 447 (28 June 2007): 1055–6.

In fairness, it should also be noted that Behe appropriately attempted to foresee and address potential criticisms of his argument. Furthermore, given Behe's rejection of methodological naturalism, it was not necessarily irrational for Behe to interpret his models as indicating that there are limits to what natural processes can explain. However, he would have been well served by first ruling out naturalistic mechanisms that might have invalidated one or more of his assumptions. This process of ruling out alternatives is common in science. For instance, when establishing a chemical reaction mechanism as likely, it is just as important to rule out alternative mechanisms as it is to establish the reasonableness of the one under consideration.

<sup>17</sup>Behe, *The Edge of Evolution: The Search for the Limits of Darwinism*; M. J. Behe and D. W. Snoke, "Simulating Evolution by Gene Duplication of Protein Features That Require Multiple Amino Acid Residues," *Protein Science*

13, no. 10 (2004): 2651–64; Behe and Snoke, "A Response to Michael Lynch," *Protein Science* 14, no. 9 (2005): 2226–7. The 2004 Behe and Snoke paper was also criticized but much of the criticism was diffused after Behe and Snoke clarified that their model might simply indicate that other evolutionary pathways were involved.

<sup>18</sup>This is not to say that Behe's arguments would have been accepted as definitive proof for his intelligent design proposals; given the state of the public debate over ID in 2007 (and now), it is unlikely that they would have been met with a warm reception by the scientific community anyway. However, by drawing more appropriately nuanced conclusions that encouraged future investigations into the reliability of his assumptions and the potential of alternate mechanisms, Behe could have at least proposed a research plan for establishing the public belief in ID-motivated scientific research, perhaps similar to that currently being conducted at the ID-associated Biologic Institute. Even this is not to say that his intelligent design proposals themselves would have been accepted as scientific; it is only to say that a more appropriately curtailed set of conclusions would have made it more difficult for his opponents to reject his proposals out of hand.

<sup>19</sup>This exchange is somewhat analogous to one that occurred at the conference, although many details have been changed, and it should not be taken as representative of any particular individual's or movement's approach.

<sup>20</sup>Redirection may be used intentionally in order to distract an audience's attention from the main point. However, this tactic will not promote a constructive public discourse on faith and science.

<sup>21</sup>It should be noted that in the incident under discussion, there is no evidence that the original question was sidetracked by the questioner to avoid the original presenter's charge that his movement's ideas were "disingenuous." The questioner, in fact, dismissed that charge based on personal incredulity—a move which was not wholly inappropriate since the issue in part involved the questioner's own personal motivations. However, the questioner still redirected the discussion to a point of his own.

<sup>22</sup>This is not to say that all scientists are convinced that evolutionary accounts of natural history are, in general, correct, but only to say that it is almost universally accepted among biologists. Nor is it to say that the existence of consensus alone constitutes an argument that evolution is an adequate explanation for natural history (that would be to commit another logical fallacy). However, the existence or lack of a scientific consensus might reasonably affect the degree of caution one uses when challenging existing ideas in the field.

<sup>23</sup>One might argue that uncertainty over the mechanism of a process is coupled to uncertainty over whether it occurred. However, in that case, it is important to make that argument.

<sup>24</sup>"About the ASA," American Scientific Affiliation, <http://network.asa3.org/?page=ASAAbout>.

<sup>25</sup>See Caroline Crocker's reflections on the 2011 ASA Annual Meeting (Caroline Crocker to Uncommon Descent, 2011, <http://www.uncommondescent.com/evolution/has-the-american-scientific-affiliation-forgotten-their-stated-identity/>). Even though I would classify myself as a theistic evolutionist, I also have recollections of being put off by the anti-ID attitudes expressed by some speakers at that meeting.

**ASA Members:** Submit comments and questions on this communication at [www.asa3.org](http://www.asa3.org)→FORUMS→PSCF DISCUSSION.



**JUST WATER: Theology, Ethics, and the Global Water Crisis** by Christiana Peppard. Maryknoll, NY: Orbis Books, 2014. 230 pages, notes. Paperback; \$28.00. ISBN: 9781626980563.

According to Christian Peppard, *Just Water* seeks to inform readers of the significance of fresh water in an era of economic globalization, providing an ethical analysis and recommendations regarding water use and scarcity within the backdrop of Catholic social thought. The book is directed at “educated nonspecialists.”

*Just Water* starts with chapters serving as a primer for understanding the relationship between twenty-first-century theology and ethics followed by a primer on the global freshwater crisis.

In chapter one, Peppard suggests that the growth of human knowledge, diversity in culture, deeper understanding of race and gender, and better understanding of power structures have shaped theological thinking in the twenty-first century. The second chapter describes the reasons why our rates of use and the types of fresh water available to us are creating a worldwide scarcity. The third chapter lays out arguments for water as a human right and not an economic commodity, and the fourth chapter provides insight into Catholic social thinking while posing the question as to whether access to clean water is a right-to-life issue. The remaining chapters of the book describe some of the contextual issues that relate to water scarcity: agricultural practices (that account for 90% of fresh water consumption), climate change and its impact on global water, and hydraulic fracking. Interposed among these chapters are two chapters connecting water to faith. These chapters explore the question of what Jesus had to do with water, through a historical and hydrological examination of the key river of the Bible, the Jordan, and exploration of the New Testament story of Jesus’s interaction with the Samaritan woman at the well.

I believe that water scarcity is the most serious problem of the twenty-first century. Water cannot be conceived of in isolation of human activities. There is a connection between water and food, energy, security, war, climate change, law, and if you allow, even beer production. (A recent article in the *Chicago Tribune* described the water nexus with brewing: It can take up to 20 gallons of water to make a single pint of beer and, with water in scarce supply, more than one-quarter of beverage production is in jeopardy.)

I wish Peppard had made a stronger case for water being a human right rather than a commodity. Although her examples of the bottled water industry and the Bolivian “water war” are interesting, and the fact that the Vatican and United Nations have declared water a human right, I do not believe that there is either consensus or understanding of the issues by the “educated nonspecialist.” I would have liked to have seen her do more to secure her argument on the side of human rights.

All countries need energy. Some countries are blessed (a mixed blessing at best) with the natural resources that allow them to be exporters of energy, usually with significant financial returns to that country. Others have to purchase the energy, making them dependent on whatever country is providing that energy. Most countries want energy independence (read, energy security). Energy production and transportation is messy at best. Usually, energy production is harmful to the environment, risky, and always has a water price tag. Peppard chose to describe the hydraulic fracturing process as an example of energy extraction that may have significant impact on the water scarcity issue. Fracking is an extraction process that is being used in many countries in the world. Many countries have banned this process because of the serious environmental impacts. Others are going forward, in spite of the inherent risks and one has to ask the why question.

The chapter entitled, “The Jordan River,” starts with a quote from theologian Denis Edwards.

The number of Christians who are deeply committed to ecology find it easy enough to see their commitment in relation to God as Creator, but they cannot see a connection with the story of Jesus. (The) urgent task for theology is to show the interconnection between living memory of Jesus and the issues that confront the global community. Only when this connection is made will ecological action be seen not only as ethically responsible but also radically Christian.

Peppard asks the question: what does water have to do with Jesus? I was drawn to this chapter because I wanted to understand the Jesus connection. However, being baptized in a river that is now polluted and even questionably a present-day stream, or using this river as an example of holy waters, or inferring that the degradation of the river should be of particular concern to Christians did not help me form a linkage between Jesus and ecology. A recent *National Geographic* article by Peter Schwartzstein asked the question: “Biblical Waters: Can the Jordan River Be Saved?” It described how, with the swelling ranks of Syrian refugees in Jordan, the over-

## Book Reviews

stressed Jordan River is at risk of going dry. Further, very little water is drawn from the Lower Jordan, which is pitifully small by the time Syria, Israel, and Jordan have dirtied and drained it of 96 percent of its water. Environmentalists see water issues in the Middle East and along the Jordan River in particular as emblematic of a wider inability to crack the Israeli-Palestinian conflict. I wish the Jesus connection were more evident for me in Peppard's book.

Peppard's book points toward a renewed vision for environmental ethics and ecological theology, but falls short in developing it. This vision is important for politicians, scientists, economists, and others working in the real world. They are seeking sound ethical guidance in their work and on the recommendations they make. She has made a start with *Just Water*. I look forward to seeing where she can go in her future writings.

There were words in this book I just did not understand in the context in which they were used. It made for difficult reading at times. In her acknowledgments, Peppard states that a number of chapters in *Just Water* are adapted from articles she wrote or online media contributions. I felt the book read as such. Several chapters could have used more development, and I had difficulty seeing connections between chapters.

The message that Peppard wishes to convey is too important not to speak to us all. As James Famiglietti of the University of Southern California said about the global water crisis:

We have a crisis of understanding: does the public and do our elected officials really understand what's happening with water, nationally and globally? If they did, I contend that we could make some real progress towards managing this crisis. I made the point that hydrologists like myself have a clear mission "to help elevate awareness of critical water issues to the level of everyday understanding."

*Reviewed by John Mickus, Professor Emeritus, Benedictine University, Lisle, IL 60532.*



### GENERAL SCIENCES

**THE WHY OF THINGS: Causality in Science, Medicine, and Life** by Peter Rabins. New York: Columbia University Press, 2013. 253 pages. Hardcover; \$28.95. ISBN: 9780231164726.

Philosophers have wrestled with the concept of causation at least since Aristotle; *The Why of Things* presents a fresh analysis. Peter Rabins is a psychiatrist;

nevertheless, he undertakes a broad, interdisciplinary analysis of how causation can be inferred. He succeeds, although his examples are more nuanced and effective in areas close to medicine.

Rabins acknowledges that "cause" does not enjoy a univocal definition, that understandings of causation have varied across time and cultures, and that one cannot prove causality. Nevertheless, he begins with the premise that "causes exist and causal relationships can be discovered and confirmed" if not proven. His analysis is multifaceted, built around the metaphor of a tetrahedron with each of the visible faces representing a different aspect of causality. Facet 1 consists of *conceptual models* of causal logic: the categorical (something is a cause or it is not), the probabilistic (causes that predispose a possible outcome), and the emergent (as found in self-organizing systems). Facet 2 describes four *levels of analysis*: predisposing, precipitating, programmatic, and purposive; these are not simply a reformulation of Aristotle's four causes (material, formal, efficient, and final) although they bear a resemblance. Facet 3 describes three *logics* (i.e., methods) by which causal knowledge is obtained: empirical, empathic, and ecclesiastic.

Rabins follows this sketch of his model of causation with a well-written historical overview, walking the reader through Aristotle's analysis of causation; the narrowing of the concept during the scientific revolution in response to Galileo's critique of Aristotle; the philosophical analyses of Mill, Hume, and Kant; the social science perspectives of Weber and Jaspers; and the twentieth-century impacts of quantum mechanics and mathematical undecidability. He concludes with a critique of Popper's falsifiability notion, which he regards as overly restrictive for causal inference.

Rabin then turns to the three conceptual models, devoting a chapter to each. He analyzes the strengths of the categorical model (simplicity, ease of producing observable results, seeming cognitive innateness) and its limitations (there are typically many complex and interconnected causes and it requires choosing a level of analysis). He discusses the standard criteria for inferring categorical causation—for A to be a cause of B, A and B must be sequential, ordered temporally, in a relationship that occurs with regularity, and the inference must be plausible. He rejects the assertion that causation is merely a social construct, but acknowledges that a claim of causation requires an unprovable belief that causation exists and that causal inferences are partially subjective due to the plausibility criterion. He then turns to probabilistic causation defining it as "events that affect the likelihood another event will occur."

Once again he addresses strengths and limitations, notably that probabilistic causation does not seem to be a universal characteristic of human reasoning; nevertheless, it seems a better tool for dealing with multiple, interacting causes, an assertion backed up by several examples. The choice between categorical and probabilistic causation, Rabins suggests, is simply utility in a situation. The chapter on emergent causation is largely an explanation of the concept of self-organizing systems—these constitute a different type of causation because properties emerge in such systems that cannot be inferred from their individual components.

The account of facet 1 (the three conceptual models) was thorough and carefully organized. Rabin does not offer separate sections on facet 2; rather, he integrates discussion of them into several chapters organized around facet 3 and the case studies with which he concludes. I think the book would have been stronger had he devoted a chapter to discussing the four levels of facet 2; nevertheless, he does a reasonable job, clarifying the levels as he proceeds.

Rabin begins his discussion of the logics by which causal knowledge is obtained with a general discussion of empirical methods in physical science. He argues from relativity theory, quantum mechanics, and Gödel's incompleteness theorem to the existence of limitations on human ability to obtain causal knowledge. The limitations can be partially surmounted, however; he uses plate tectonics as a case study of how consensus on a causal model has developed in physical science in spite of the limitations. He then presents a more detailed analysis of empirical methods, drawing on his knowledge of biology and epidemiology. He does quite a nice job presenting the historical development and rationale for randomized clinical trials and includes a clear, intuitive discussion of the statistical techniques involved; he also explains other approaches such as convergent validity and counterfactual techniques used to investigate causality in situations in which randomized control trials (RCTs) are not possible.

He then contrasts the approach to causal inference, typically used in the study of history combined with the study of natural science. His discussion of the empathic or narrative method as used by historians is insightful, as it avoids the simplistic cliché that science is objective and history is subjective while respectfully treating the differences in their methods and subject matter. For instance, he writes,

Scientists seek a comprehensive understanding of the natural order that exists whether or not they are studying it. Historians seek a comprehensive

understanding of events by dint of the individual's ability to link together convincingly what is known.

He explicitly rejects the notion that the study of history is so dependent on the perspective of the observer that it lacks usefulness; rather, he sees this limitation as another form of human inability to obtain absolute knowledge. He explains the narrative method clearly, asserting that its main advantage "is its ability to increase our understanding of unique past and present events." He illustrates his account with three case studies—holocaust denial, the Wright brothers' invention of the airplane, and Alexis de Tocqueville's *Democracy in America*.

Rabin turns next to "cause in the ecclesiastic tradition." He uses a single definition for religion and spirituality: "overarching beliefs that explain such basic questions as the origin, purpose, and proper form of life." His use of the word "ecclesiastic" emphasizes that these characteristics are shared among groups of individuals, are relatively stable over time, and are based in *given* truth. He emphasizes that the logic of causal analysis in religion is the opposite of the logic of the empirical and empathic methods—rather than seeking universals, the ecclesiastic method "begins with the knowledge of what they are." As a result, ecclesiastic systems place a major emphasis on "why" questions and purposes and on prescribing how people should live; he also notes that the ecclesiastic approach involves a much stronger emotional component than the other two approaches, although these distinctions are not absolute. This foundational analysis is helpful but the structures he builds on it—comparing the ecclesiastic method with the empiric and empathic, and briefly reviewing causality as found in both Hinduism and the Abrahamic religions—are lightweight. For instance, in comparing the empiric and ecclesiastic approaches, he settles on the nonoverlapping magisteria perspective most closely associated with Stephen Jay Gould. While respectful of both approaches, it ignores the fact that, in some situations, the magisteria do overlap. Also, he does not address primary and secondary causation or any of the literature on the nature of divine providence.

Rabin concludes with six case studies to which he applies his causal analysis: the emergence of HIV/AIDS as a worldwide epidemic disease, evolution as a causal concept, causality in US law, Alzheimer's disease, human aggression, and the etiology of depression. These are nicely done and effectively illustrate his four levels of analysis.

Even though the ecclesiastical section is lightweight, overall I found this book to be the best analysis of

## Book Reviews

causal inference that I have encountered. Its scope is broad. It is well organized and highly readable. It addresses the main issues carefully. I give it an A and highly recommend it.

Reviewed by James Bradley, Emeritus Professor of Mathematics, Calvin College, Grand Rapids, MI 49546.



### HISTORY OF SCIENCE

**TRYING BIOLOGY: The Scopes Trial, Textbooks, and the Antievolution Movement in American Schools** by Adam R. Shapiro. Chicago, IL: University of Chicago Press, 2013. 193 pages including notes and index. Hardcover; \$35.00. ISBN: 9780226029450.

With its dramatic events, rich symbolism, and memorable cast of characters, the Scopes Trial of 1925 is remembered as a landmark in the twentieth-century encounter between Christianity and science. In the nearly nine decades that have passed, this “trial of the century” has received no small amount of amateur and scholarly attention, including the 1960 Hollywood film *Inherit the Wind* and Edward J. Larson’s Pulitzer Prize-winning *Summer for the Gods* (Harvard University Press, 1997). Just when it might seem to be losing its fruitfulness for new historical inquiry, Adam R. Shapiro offers a fresh perspective that reveals an even deeper drama, a renewed symbolism, and an enlarged cast. *Trying Biology* is a persuasively argued account of the role the textbook industry played in the antievolution movement of the interwar period. It explores how the conflict personified by William Jennings Bryan and Clarence Darrow was about more than fundamentalist opposition to evolution and a threatening biology curriculum; it was also part of a widespread backlash against an expansion and standardization of compulsory secondary education that used science to promote a particular view of citizenship and social progress.

Shapiro is a lecturer in intellectual and cultural history at Birkbeck, University of London, specializing in the history of science, religion, and education in American culture. His previous publications include “The Scopes Trial beyond Science and Religion,” in *Science and Religion: New Historical Perspectives* (Cambridge, 2010).

The six central chapters of *Trying Biology* are structured around four themes. Chapters two and three examine the textbook business from the late nineteenth century until the 1920s. Describing an industry comparable to those of steel, oil, and gas, these chapters uncover how textbooks were written, published,

and marketed; how politics and corporate maneuvering, rather than content, determined sales; and how these factors contributed to the events that eventually led to the trial. Shapiro pays particular attention to the development of statewide adoption of textbooks and highlights the irony of how Tennessee’s use of George William Hunter’s *Civic Biology* made the trial possible because the state-adopted text contained the state-prohibited ideas.

Chapter four focuses on the way *Civic Biology* represented a new way of thinking about biology as a discipline and about science’s potential role in education. Previously, the study of life was divided between botany and zoology. Hunter’s holistic approach, coupled with a strong social Darwinian, progressivist ethos, offered not just a new view of the subject but also a way to understand the nature, practice, and potential of science education for shaping students’ minds. As Hunter’s title suggests, biology had the ability to serve as the centerpiece for educating students for an urban, democratic society. Such a book may have affirmed attitudes in America’s rapidly growing cities, but for those in the rural South, its statewide adoption, timed with the expansion of compulsory education beyond urban centers, signaled a threat to deeply held beliefs. According to Shapiro, it was the response to these issues, rather than religion that offered the primary motivation for school antievolutionism.

Chapter five shifts focus from textbooks to the trial in order to explore “how Scopes was framed,” as the title puts it. Shapiro distinguishes between *Tennessee v. John Scopes*, the legal case, and the “Scopes Trial,” the public spectacle that pitted science and freedom against Christianity and the Bible. For all involved, including the defense, the outcome of the former was never in doubt. Scopes’s guilt was a foregone conclusion. (Indeed it was the ruling desired by the ACLU, the organization that orchestrated the trial.) It was the outcome of the latter, by contrast, that dominated public attention, and in doing so defined the debate. As a result, the participants arguing for harmony between creation and evolution were overshadowed by those with a narrow understanding of the Bible and Christianity that insisted upon conflict. Shapiro rightly points out that if Scopes’s actions and the meaning of the law had been addressed, he may have been acquitted. But there were broader issues at stake that both the prosecution and defense were eager to expose.

The final chapters consider the effect the Scopes Trial had on textbook authors and publishers. In one sense, the trial should have had no effect; the law only regulated teachers. Still, no company wanted

to jeopardize sales over controversial content. Many within the industry thus assumed changes were in order, but the changes that came about were largely ambiguous and superficial, merely striking the word “evolution” from the text or removing an offensive illustration without changing the content, as was done for Hunter’s *New Civic Biology*. The principles of evolution were still included, only without the labels. Thus the real effect of the trial had almost nothing to do with the way textbooks were written and nearly everything to do with the way they were read and taught. As long as the word itself was avoided, neither the book nor the teacher could be accused of promoting evolution. According to Shapiro, this had an unfortunate (and ironic) effect on American science education: a return to rote teaching where a literal interpretation of the textbook was encouraged to the detriment of rigorous engagement with the text and its meaning.

On the whole, Shapiro has provided an excellent new analysis and welcome contribution to the field. Readers of *PSCF* will probably be most interested in the second half of the book, but the exploration of the textbook industry should not be skipped. Readers may also question a few minor points in his argument, such as the extent to which he distinguishes religion from other social and cultural factors that prompted the Southern objection to evolution in the schools. Yet overall this book offers valuable insight into one of the defining events of the twentieth century.

*Reviewed by Christopher M. Rios, Assistant Dean for Graduate Studies, Baylor University, Waco, TX 76798.*

**CURIOSITY: How Science Became Interested in Everything** by Philip Ball. Chicago, IL: University of Chicago Press, 2013. 452 pages. Hardcover; \$35.00. ISBN: 9780226045795.

The book *Curiosity* by Philip Ball is certainly a stimulating romp through the beginnings of science in the early modern period, whatever else it is. The book is primarily about the development of science in the late sixteenth and the seventeenth centuries, but it is much more than that. It is a book about the cultures of the time, and the rich interplay between the kind of thinking that ultimately led to modern science and the ways of thinking that took place in those days, which in many ways were decidedly different from what we might expect of “scientific men.”

As Ball recounts, the usual narrative concerning progress in this period centers on the so-called scientific method as a key innovation (p. 4). He offers

instead (whence the book receives its title) that perhaps tracking the notion of the changing meaning of *curiosity* might better account for the developments toward modern science. As he tells the story, for the ancient Greeks the meaning was not clearly articulated, but it was nevertheless represented to be the cause of the ills of the world in relation to Pandora’s Box (p. 10). Based on the account of the Fall and some historical references, early Christians are supposed to have thought of curiosity as a danger.

Fast-forward to the late medieval period: this curiosity expresses itself in the “allure of secrets” (p. 32). With this backdrop, Francis Bacon referred to a knowledge of the “web of secrets” of nature and is famously known for saying that “knowledge is power.” In ensuing chapters, we read of a surprising array of curiosity seekers with their “cabinets of curiosities” (p. 53) and the formation of secret societies for exchanging knowledge of the secrets of nature. Just to give one example, Giambattista della Porta, founder of the Accademia dei Segreti in Naples, in 1558 wrote a book *Natural Magick*, in which he portrayed magic as “nothing else but the knowledge of the whole course of Nature” (p. 42). Della Porta was also known for his own collection of curiosities which contained “plants and botanical specimens, gems, stones and all manner of things and unusual” (p. 53). Inspired by della Porta’s book, the still-teenage Duke of Umbria, Frederico Cesi, founded his own society called the Academy of Lynxes (Accademia dei Lincei), motivated by a statement in della Porta’s book: “examine with lynx-like eyes those things which manifest themselves” (p. 64). This Cesi, who ultimately became della Porta’s benefactor, is the same Cesi who supported Galileo in his publishing and with his difficulties with the church.

In another example, which shows how these cabinets of curiosity move to museum status and finally to set the stage for the modern museums we have today, we see the collection of John Tradescant, which contained a vast collection of items from all over the world. Just to name a few of the things mentioned to be in the collection there were

a pelican, a remora, a lanhado from Africa ..., a flying squirrel, another squirrel like a fish, all kinds of brightly colored birds from India ..., an ape’s head, ..., the hand of a mermaid, the hand of a mummy ..., a small piece of wood from the cross of Christ ..., a girdle such as the Turks wear in Jerusalem ..., a scourge with which Charles V [the Holy Roman Emperor] is said to have scourged himself, a hat band of snake bones. (pp. 158-9)

This collection was opened to the public for a door fee. When Tradescant died, the collection passed to

## Book Reviews

his son, whom Elias Ashmole convinced to deed the collection to himself upon the son's own passing, a promise the son later regretted but could not reverse (p. 160). Ashmole in turn ultimately donated the collection to the University of Oxford where it eventually became the Ashmolean Museum. Was I surprised to find out that this famous Museum had its roots in trickery, in order to gain the collection!

Fast-forward again to the seventeenth century, and we see well-known figures such as Johannes Kepler as men between worlds. Rather than a person who thinks as modern scientists do, we find Kepler continuing to try to fit his elliptical orbits into a model motivated by the five Platonic solids as explanation for the planetary spacing (p. 198). That he never abandoned this earlier model was certainly news to me, but it does show Kepler as a man of his times. He, like most others of his time, also dabbled in astrology, which is not the usual conception we would have of one of the scientists who ushered in the age of modern science. Galileo, having heard through Cesi of Kepler's finding that the planets orbit in ellipses, refused to accept this suggestion, since it was too far afield from his view of the mathematical cosmos (p. 196). And so even Galileo and Newton do not escape the charge that they were thinking more like the ancients than a modern in their approach to experiment. It was said that they were not so much motivated "from curiosity to discover how nature behaves as a desire to verify prior hypotheses" (p. 209). That is to say, that from the point of view of modern eyes, these times were a "perplexing mix of the new and the old, of the seemingly occult and the 'modern,' the enchanted and the rational."

Later, with the increasing use of scientific instruments, the importance of this progress and its influence on those who begin to experience new phenomena becomes clearer. Perhaps my favorite part of the book was the section that describes the growth of the Royal Society in England, first as competing societies between London and Oxford, but then as a rich interplay between the likes of Robert Boyle, Robert Hooke, and Christopher Wren. In accounts of the use of the microscope, and the development of the vacuum chamber, these men really came alive as flesh and blood individuals with passions, and not simply idols of history. There is also a fair amount of political involvement mentioned, in order to set the historical stage. The accounting is not entirely linear in relation to a historical timeline. For example, after discussing the microscope, Ball opens a new chapter in which he revisits some of the same time periods,

but focusing on a different subject, the development of an understanding of light and the description of the rainbow. Here we see in full force the apparent feud between Robert Hooke and Isaac Newton, to the extent that Newton withdrew his membership from the Royal Society and refused to publish his book on optics until Hooke had died (p. 338). The next chapter brings us the news that the activities of members of the Royal Society were not altogether appreciated. Indeed, in the form of a play, *The Virtuoso*, by Thomas Shadwell, the activities of the Royal Society are openly criticized as being useless and impractical, and the main point of focus was Hooke himself (p. 354). This attitude seems to be fairly commonly shared at the time, though Ball comments that with hindsight we see how myopic this view was.

There is much more in this book than I have outlined above but I hope I have given a suggestive spirit as to how the book is written. Now I would like to say a few words about the relation of this book to the Christian milieu in which it takes place. Though Ball is not writing from a Christian perspective per se, there are many references to God and to the church and other Christian doctrines. For example, in the earlier chapters it is evident that there was a tacit assumption of the veracity of the Scriptures, and an acceptance of such doctrines as the creation story of Adam and Eve, and the Fall of man. In later chapters, there are references to the pious attitudes and responses to their discoveries from men such as Robert Boyle and Robert Hooke. While these are reported in passing, as I think any good historian would do, it is possible that some emphases by the author might be somewhat altered had he approached them from a more focused Christian perspective. Nevertheless there are many indicators of the role of religion in general and Christianity in particular, so those looking for some input into the science and religion discussion will find helpful insights here.

Whether Ball actually accomplished the goal of portraying a major role for shifting notions of curiosity, it certainly did well as a running theme. Some further criticism might be that the book was somewhat unpredictable in its organization. What would the next chapter be about? And why was it included in this order? Nevertheless, the book is a fascinating one and a delight to read, and anyone who would like to gain a richer understanding of this period in relation to the development of science would enjoy the read.

*Reviewed by Don Petcher, Department of Physics, Covenant College, Lookout Mountain, GA 30750.*



## ORIGINS & COSMOLOGY

**NEANDERTHAL MAN: In Search of Lost Genomes** by Svante Pääbo. New York: Basic Books, 2014. 275 pages. Hardcover; \$21.00. ISBN: 0465020836.

*What makes humans unique?* This question has driven Svante Pääbo for most of his scientific career. In his new book, he recounts the story of his work sequencing genomes of long-dead organisms. His quest toward uncovering ancient genomes began in secret in 1984, when as a graduate student he conducted covert experiments on beef liver during nights and weekends to protect himself from ridicule. It culminated in 2011 with international recognition and two publications presenting the complete sequence of Neanderthal and Denisovan genomes. The technical advances required in the intervening years came from disciplined and detailed work on the part of Pääbo and his team, and developments in molecular biology and genomics generally. The project was possible because of the global community of scientists the author recruited to his Neanderthal Genome Consortium. The book reveals examples of his disciplined work (many years' worth of wash steps from DNA preparations that were stored in a freezer became a massive stockpile of ancient DNA when techniques were improved), advances in the field (his first presentation of ancient DNA work was in a session where future Nobelist Kary Mullis described PCR), and the contributions of his global team (key leaders on the project came from three continents and a dozen countries).

The book is an autobiography that reads like a scientific mystery novel. In his story, each career move, collaboration, technological breakthrough, and seminal paper brings him another step closer to answering his driving question. The book provides enough technical explanation to permit those outside of genomics or archeology to follow along without slowing down the action with unnecessary lectures. Those seeking a more detailed understanding of his work will appreciate the references to his relevant papers throughout the text.

For Christians who embrace a theistic evolutionary understanding of human origins, the book is an interesting read about the hard work needed to produce groundbreaking science. For those who believe in recent, special creation of modern humans, however, the author's work may be troubling due to the overwhelming genetic similarities shown between Neanderthals, Denisovans, and modern humans.

Additionally, the book provides strong evidence of gene flow between modern humans and both Neanderthals and Denisovans. These data support the complex history and messy speciation that best explains the rise of humans as we exist today. The work supports the hypothesis that modern humans evolved in Africa and then spread from there into the wider world. In their travels, our ancestors encountered other archaic humans like Neanderthals and Denisovans. While some of these encounters may have been violent, explaining the extinction of both species after contact with modern humans, others produced offspring that were raised by modern humans and incorporated, genetically, into the population. These other humans may be gone, but humans today still carry some of their genes. In the hands of Pääbo and his team, each of us becomes a living fossil.

One weakness of the book is the author's periodic references to his own, colorful sexual history. The stories are not numerous, but they do serve as a distraction from the overall arc of the book. These intrusions are ironic considering the author's assertion that, "To me, 'who had sex with whom' in the Late Pleistocene is a question of secondary importance. What matters is that Neanderthals did in fact contribute genes to people today." Likewise, those of us interested in the contribution of Neanderthals to our own genome may not be interested in who had sex with whom among elite scientists. More distractions come from his initial descriptions of his collaborators and competitors. He is frank to the point of critical, even of people with whom he worked closely for years. Some of his descriptions are even quite comical. For example, he says of Jim Mullikin, former head of the National Human Genome Research Institute, "He somehow reminded me of Winnie the Pooh, but a very, very competent version of the friendly bear."

Considering that this book is written by a world-renowned scientist who is a native Swede and works in Germany, it is very easy to read. For those with questions about human origins and speciation, this book provides many answers. For anyone interested in what is required to perform science at the very highest level, Pääbo's story can serve as a useful guide. His achievement required unflinching commitment, remarkable timing, and a dedicated team. With *Neanderthal Man* we are able to appreciate his commitment, timing, and team in a way that goes far beyond what can be seen in his award-winning papers.

*Reviewed by Clayton Carlson, Assistant Professor of Biology, Trinity Christian College, Palos Heights, IL 60445.*

## Book Reviews

**DEATH BEFORE THE FALL: Biblical Literalism and the Problem of Animal Suffering** by Ronald E. Osborn. Downers Grove, IL: IVP Academic, 2014. 195 pages, endnotes, index. Paperback; \$27.39. ISBN: 9780830840465.

Ronald E. Osborn's *Death Before the Fall: Biblical Literalism and the Problem of Animal Suffering* is an interesting and, one hopes, a helpful addition to the ongoing conversation about the question of human and cosmic origins in Christian circles. Osborn's particular contribution to the conversation involves his exploration of the moral problem of animal predation and suffering in light of what he calls "literalistic" readings of Genesis 1 (pp. 17-19). Another interesting angle here is the author's background in the Seventh-Day Adventist movement. Osborn quite consciously presents this work as an "open letter" to fellow Adventists struggling with questions of the tensions between Genesis and evolutionary science (p. 18). One consequence of this is that Osborn's conversation partners are often very conservative voices from within the Adventist church, and yet readers from other conservative, evangelical traditions will still find most of this book to be accessible and applicable.

Osborn himself admits that he is not a trained biblical scholar or theologian, but refers to himself as a "lay theologian" wrestling with the issues at hand (p. 39). That said, the author holds the PhD from the University of Southern California, with a particular specialization in the thought of Nietzsche, Marx, and Darwin. He is, consequently, a trained philosopher and an excellent thinker, both of which are obvious throughout the book.

There are certainly moments where Osborn's lack of biblical training is obvious to the specialist, particularly in his reading of Genesis 1 in chapter 2 of *Death Before the Fall*. There is nothing really objectionable about Osborn's reading of Genesis, but he spends what seems to be an inordinate amount of time establishing concepts which are taken for granted by biblical scholars (e.g., the meaning of *tob*, or "day"), and he occasionally imposes foreign categories upon the biblical text (e.g., a distinction between "very good" and "perfect"). Still, he does depend on excellent work by others (e.g., Stott and Walton) and his overall reading is quite acceptable.

The book is laid out in two major parts. Part 1 deals with what Osborn refers to as "biblical literalism." He uses this phrase in distinction from "literal" reading. The former indicates an approach that demands the "scientific and historical harmony (or 'concord') of the primeval stories (Genesis 1-11) as defined by

contemporary notions of scientific and historical objectivity, regardless of the actual weight of scientific and historical evidence" (p. 40). The latter refers to a "plain sense" reading of a given text, and may include symbolic or metaphorical interpretations (p. 25). Chapters 2-9 deal extensively with the problem of literalism, where Osborn argues that this type of approach to the Bible is not intrinsically Christian so much as it is intrinsically Modernist. He suggests that literalism is simply a form of philosophical foundationalism, and is thus little more than the mirror image to ideologies like radical atheisms (pp. 46, 58).

This portion of Osborn's work covers no truly new ground, but it is a very helpful overview of the epistemological questions at hand in a discussion of the relationship between the Bible and human origins. An element of particular note is the time, care, and attention Osborn gives to presenting accurate representations of various versions of literalism or creation "science" (e.g., his attempt to find the original source for a famous James Barr quote, pp. 50-1). This is, in fact, one of the most laudable elements of the work as a whole. There is a great deal of invective and vitriol on both sides of this particular debate, and Osborn tries very hard (with mostly good results) to give an honest examination to even ideas he clearly finds absurd. Others writing in this field would do well to note and emulate Osborn's irenic spirit.

This first section includes the aforementioned equation of literalism with foundationalism (chaps. 2-3); a helpful overview of certain elements of the philosophy of science, with a particular emphasis on the work of Kuhn and Lakatos that identifies creation "science" as a degenerating line of inquiry (chap. 4); an extended theological argument against literalism (chap. 5); a sociological and psychological exploration of the "enclave mentality" of literalism, focusing especially on its exclusivism and on its dismissal of all competing theories or readings a priori (chap. 6); an argument that creationism is a kind of Gnosticism (chap. 7); an overview of four historic scholars/theologians whose interpretations of Genesis 1 do not fit the literalistic mould, including Barth, Calvin, Maimonides, and Augustine (chap. 8); and, finally, a positive epistemological argument in favor of a critical realism over and against the naive realism of foundationalist epistemologies (chap. 9).

Part 2 moves into Osborn's more novel argument, which is an exploration of animal predation and suffering as a moral and theological problem. The basic problem involves the question of how, apart from evolutionary processes, the violence and predation of the animal world came about, and what moral

implications the conclusions on this issue might have. In chapter 10, Osborn explores three theories that he has encountered from biblical literalists, all of which begin with the initial presupposition that predation and violence were not features of creation, but were consequences of the Fall into sin. In each case predation is a negative outcome of human sin. But, Osborn argues, this creates an intractable moral problem as it implies that by condemning all of creation along with human beings, God is responsible for causing the suffering of an entire world full of morally innocent creatures.

Osborn himself suggests instead that violence and predation are design-features of creation, constructing his argument especially from Job 38–40 (pp. 152–6). By bringing the book of Job into the argument, Osborn takes the larger canonical witness seriously, and provides a helpful counterpoint to naive readings of Genesis 1–2. But Osborn does not want to leave the conversation with a simple acceptance of predation and violence as intrinsic to God’s creative purposes. He still confesses discomfort with the notion of much of the suffering and death that is “natural” to the created order (p. 157). He also wishes to take seriously the New Testament teaching that “death is the final enemy” (p. 158).

Osborn’s solution? “The destiny of humankind is not simply a recapitulation or recurrence, paradise lost, paradise restored. Rather, the end is greater than the beginning—and was always meant to be so through the mystery of the incarnation” (p. 159). Thus the incarnation of Christ brings about the beginnings of the radical redemption of all of creation, and is consistent with its eternal telos. Osborn suggests that predation and animal suffering are elements of original creative design, but that “creation was never a static golden age but [is] always an unfolding story with an eschatological horizon” (p. 159). That is to say, creation is process, and always was. This also necessarily involves what he calls “a high premium on creaturely freedom,” and is thus consistent with free-will theisms, but may be very difficult to fit into the mould of classical theisms. As an aside, I see here an unacknowledged tension between Osborn’s key biblical text, the book of Job, and his focus on creaturely freedom, given that the book of Job focuses heavily on divine sovereignty.

Osborn’s final chapter explores the ethical outworkings of his preceding theology. This involves taking seriously the human responsibility to care for creation, and to behave ethically toward animals. Osborn also argues strongly for the rediscovery of the vital practice of Sabbath, in all its sacramental

richness (here he shows his Adventist roots again). Both human beings and the land are to be offered Sabbath, which suggests an ethic of care and rest for the human person, as well as care and generosity toward the rest of God’s creation (land, animals). Here again Osborn’s work takes the form not only of a critique of “scientific” creationism per se, but of modernism more generally, equating the indifference toward the earth and the animal world that is all too common among Christians to Nietzsche’s reprehensible ethic of the *Übermenschen*.

The book as a whole is a valuable resource. It is well argued throughout, generous in spirit, and, at times, interestingly eclectic in the voices it engages. Osborn’s tone is perhaps somewhat uneven. At times, he writes in a highly accessible way, which appears to be consistent with his chosen audience. At other times, however, his arguments presume a relatively high degree of familiarity with philosophical discourse—perhaps enough so that some lay readers may find certain chapters difficult to access. That said, Osborn tackles a difficult topic with kindness and respect, and provides yet another compelling case for the consideration of theistic evolution as a legitimate possibility for conservative Christians. I would happily recommend this book to interested laypeople, to academics working in the social or natural sciences who are looking for a theological engagement with the question of human origins, and to theologians and Christian ethicists engaging the question of animal death and suffering.

*Reviewed by Colin M. Toffelmire, PhD, Ambrose University College, Calgary, AB T3H 0L5.*



## RELIGION & SCIENCE

**THE OUTER LIMITS OF REASON: What Science, Mathematics, and Logic Cannot Tell Us** by Noson S. Yanofsky. Cambridge, MA: MIT Press, 2013. 424 pages. Hardcover; \$29.95. ISBN: 9780262019354.

*“Who knows the mind of the LORD? Who is able to give him advice?” (1 Corinthians 2:16).*

This is a popular-level science book in the publishing niche of classics such as Hofstadter’s *Gödel, Escher, Bach*, or Penrose’s *The Emperor’s New Mind*. It is an exploration of the limits of reason. What can reason tell us about the limits of reason? A fascinating read that goes against the grain in choosing to explore what science, mathematics, and reason tell us cannot be revealed, rather than what they have or have not yet fully explained. As the author (a computer scientist from Brooklyn College) advocates, in many

## Book Reviews

ways that which we cannot reach is more intriguing; why are there limits to what we can know? Why cannot reason take us beyond those limits? Essentially the book is a gathering together of recent (~ the last 100 years) results in physics, mathematics, and computing science that shed light on the scientific limitations of reason: if you will, an updating of traditional philosophical thinking on epistemology.

Firstly, the book is well written and thoughtfully put together. Explanations are accessible to the non-expert; this shines through particularly in the discussions on quantum mechanics, which were the best I have read. It's an engaging read, covering subjects in depth, while remaining lighthearted and often witty. Diagrams and figures are used effectively to aid understanding. Mathematical equations are virtually absent as the author confesses to following the publishing adage that "every equation reduces the readership by half." Each chapter ends with further reading suggestions; footnotes are used effectively pointing to references, deeper explanations, and interesting side comments.

Individual chapters are essentially self-contained, addressing the central issue from different points of view, so we have nine chapters covering such diverse topics as language, philosophy, physics, mathematics, computing science, and metaphysics. Each of the chapters contains a treasure chest of known paradoxes and limitations. Examples include the liar paradox, Zeno's paradoxes, the travelling salesman problem, Turing's halting problem, Gödel's incompleteness theorem, and Schrödinger's cat. Usually these types of puzzles put my head in a spin, leaving me unsatisfied by the resulting intractability. However, I did not find that to be the case in this book; the author adeptly steers the reader on a route through many of these limitations without diminishing one's appreciation of the world we inhabit. Yanofsky unpacks these limitations, putting them in context and helping to uncover why these boundaries of reason arise.

The tenth and final chapter seeks to gather these separate chapters together to build a collective picture. Certain themes emerge. Of utmost importance is that of the common occurrence of self-referential systems: for example, "I am lying," the set that contains all sets that don't contain themselves, and even the universe that observes itself. Another theme is distinguishing between what is describable and what is indescribable. The author explains that by "... the very nature of language, what can be described is countably infinite. In contrast, what actually exists 'out there' is uncountably infinite" (p. 345). Yanofsky further adds:

This is stated without proof because I cannot quantify all phenomena. To quantify them, I would have to describe them and I cannot do that without language. So there might be an uncountably infinite number of phenomena and only a small, countably infinite subset describable by science. This is the ultimate, nonscientific (science must stay within the bounds of language) limitation on science's ability. (p. 175)

What we know is a drop, what we don't know is an ocean. (Isaac Newton, quoted by Yanofsky, p. 345)

The book does not advocate any particular religious (or nonreligious) perspective; however, it does address many topics that arise in science-faith discussions, such as the anthropic principle, interpretations of quantum mechanics, the unreasonable effectiveness of mathematics in natural sciences, chaos theory, philosophy of science, et cetera. At many conjunctions, a deity is posited as a possible solution among others to mysteries arising from these topics.

Let us seek to fathom those things that are fathomable and reserve those things which are unfathomable for reverence in quietude. (Goethe, quoted by Yanofsky, p. 354 n11)

The modern scientific revolution has resulted in an explosion of human knowledge and understanding of the workings of the universe. We have gained immense predictive capacities and developed remarkable technological innovation. And yet the methods of science and mathematics now see their own limits. This may seem humbling, and it is, but as the author concludes, as humans we typically live beyond reason. We make decisions not purely on logic and reason, but by feelings and intuitions. We value beauty, ethics, and wonder that defy rational explanation but provide life with real meaning. I would add that the transcendental conditions of our experience are not sensible unless we say that they are grounded in Jesus the author of life.

Overall, an enjoyable book that I am sure I will return to in the future.

*Reviewed by Sam Pimentel, Assistant Professor of Mathematical Sciences, Trinity Western University, Langley, BC V2Y 1Y1.*

**BIG BANG, BIG GOD: A Universe Designed for Life?** by Rodney D. Holder. Oxford: Lion Hudson, 2013. 208 pages. Paperback; \$14.95. ISBN: 9780745956260.

I received a copy of this book for review just at the time that observational evidence for the effects of gravitational waves from the very early universe,

and thus for primordial cosmological inflation, was announced by the BICEP2 collaboration. Since that time, some doubts have been expressed about this claim, so that it cannot be regarded as definite as this review goes to press. In any case, the news highlights the timeliness of a book dealing with cosmology and religion. The strong support that it provides for inflationary cosmologies also has implications for parts of this book's discussion. (For example, the ekpyrotic universe, sketched here on p. 125, now seems to be ruled out and the case for a multiverse is strengthened.)

Rodney Holder, who has degrees in both theology and astrophysics, is a former Course Director of the Faraday Institute and currently a fellow of St. Edmund's College, Cambridge. This book, his fourth in the science-religion area, is a very competent presentation of the history and current state of scientific cosmology as part of an enterprise of natural theology.

The survey of the development of modern cosmology, with emphasis on big bang models and their triumph over the steady state theory, shows how religious discussions accompanied the scientific advances. Some, like Fred Hoyle, resisted anything like a traditional understanding of creation whereas others, including Pope Pius XII, used evidence for a big bang to support a Christian apologetic. Georges Lemaître, a Roman Catholic priest who was one of the main figures in the development of models of an expanding universe, provided a salutary example by refusing to make an easy identification of scientific and theological concepts.

And as Holder points out in his chapter "The Christian Doctrine of Creation," it is wrong to identify the idea of a "moment of creation" as the primary meaning of the Christian doctrine. The basic point of that teaching is that all things depend ultimately on God alone for their existence. God's ongoing work of upholding the universe—and this means also being the driving force of an evolving cosmos—is at least as important as the divine work of bringing the universe into being.

Thus claims of cosmologists such as Krauss and Hawking that science has removed any need for God, are considerably weakened. But the author goes on to show clearly the incoherence of arguments that physics is now able to explain the origin of the universe "from nothing" in anything like the theological sense of *creatio ex nihilo*. The quantum vacuum is not "nothing," as the atheists themselves recognize, so it is only word play to say that the production of

particles from the vacuum is creation from "nothing." Holder brings this out nicely with an amusing passage (and the accompanying illustration) from *Alice in Wonderland*.

Some further consideration here of what it may mean to speak of a "need" for God would have been helpful. Holder quotes Bonhoeffer's prison letters to the effect that the concept of the autonomy of the world began with the speculations of Nicholas of Cusa and Bruno about an infinite universe. But he does not point out that Bonhoeffer gave his own ideas in this matter a Christological grounding, saying in another of those letters that "God lets himself be pushed out of the world on to a cross" (*Letters and Papers from Prison* [Macmillan, 1958], 360). Looking at questions about a need for God from the standpoint of a theology of the cross, as Eberhard Jüngel has done in *God as the Mystery of the World* (Eerdmans, 1983), can suggest answers different from those of a natural theology independent of historical revelation.

Evidence for cosmological fine-tuning and its theological implications are the major themes that occupy the second half of the book. Holder proceeds in a thorough and orderly way toward his answer to the question posed by the book's subtitle. Chapter 5, "The Goldilocks Enigma" (a phrase used by Paul Davies in connection with the "just right for life" character of the universe), sets out twelve examples of the apparent fine-tuning of the universe, including the ratio of the electromagnetic and strong interaction strengths, the value of the cosmological constant, and the dimensionality of space.

Having established that the "coincidences" are real, the book goes on to conclude that these results need some explanation, and to consider what such an explanation might be. The two possible explanations that receive attention in the three final chapters are God and multiple universes. Those possibilities are not mutually exclusive, as Holder indicates by sketching the views of four Christian thinkers who are comfortable with the idea of a multiverse. But he himself sees "Multiple Problems for Multiverses" in a chapter with that title.

If it holds up, the claim of evidence for inflation that I mentioned at the beginning of this review would seem, to many cosmologists, to strengthen the case for some type of multiverse since that is implied by most theories of inflation. If a multiverse does finally have to be accepted, it will not simply eliminate the problems that Holder describes, but will make them questions that need to be answered within a multiverse theory.

## Book Reviews

The final two chapters compare two explanations for our “Goldilocks” universe: God, or a multiverse *without God* (that final qualification is crucial). Holder analyzes the probabilities of these two options with the use of Bayes’s theorem (described in an appendix) and concludes in his final chapter that “Theism Wins.” That title is a bit too triumphal for my taste, but it does not affect the strength of the argument. As is always the case with arguments of natural theology, how unbelievers will react can only be known by field-testing these arguments.

*Reviewed by George L. Murphy, Trinity Lutheran Seminary, Tallmadge, OH 43209.*



**ASK THE BEASTS: Darwin and the God of Love**  
by Elizabeth A. Johnson. London: Bloomsbury, 2014.  
xvii + 286 pages, notes, bibliography, index. Hardcover; \$32.95. ISBN: 9781472903730.

“Consider an entangled bank,” invites Elizabeth Johnson in *Ask the Beasts: Darwin and the God of Love*. Through this invitation, echoing Darwin, Johnson pulls her reader into the heart of a theological conversation that listens to the voice of the nonhuman world through the sciences and the Bible. Her vivid and engaging poetic prose compellingly draws the reader through considerations of history, biology, theology, hermeneutics, and ecology.

In the first four chapters, Johnson embarks on a journey through the history of evolution. After a general introduction, chapter 2 explores Darwin’s life and societal context, helping the reader to see the milieu out of which evolutionary theory was formed. Along the way, Johnson dispels several historical myths, such as universal opposition to evolution from the clergy. Chapter 3 carefully outlines the argument of *On the Origin of Species*, tracing through the chapters of the book while highlighting the richest and most memorable of Darwin’s examples. This chapter will give readers who have not read *Origin* a very good idea of its contents and structure. Chapter 4 highlights aspects of the theory of evolution that have changed since Darwin’s day, including the genetic, geological, and ecological discoveries that have adjusted and nuanced (but not replaced) Darwin’s original concept. The first third of the book sets the scene for Johnson’s theological reflection in the next four chapters.

In chapter 5, Johnson re-explores the notion of *creatio continua* through a pneumatological lens. Focus on

the Spirit, she claims, reduces the dualities of mind/body, natural/supernatural, and nature/grace that have led to the misuse and abuse of the nonhuman world. Exploring biblical symbols of the Spirit and a theology of participation, she weaves a deeply Trinitarian approach to creation as God’s dwelling place, allowing one to see afresh the graced sacramentality of nature. Chapter 6 follows on from this, rooting divine action in the empowerment of love. Instead of God’s creative action being something that forcefully directs its objects, Johnson argues that creative action accompanies creatures toward their own fulfilment, allowing them significant freedoms. Johnson defends a neo-Thomistic view of divine action: that God is at work in the world through secondary causes by acting as the primary cause. She carefully sets out her position in contrast to other proposals of divine action, and defends her position with sharp insight.

Chapter 7 seamlessly leads on from the discussion of divine action with an exploration of evolutionary suffering. God creates, we affirm, but the creation groans and suffers in and through this creation. Johnson faces the issues squarely, acknowledging the full necessity of pain, suffering, and death in the ongoing creation and refuses to attribute the natural violence of creation to moral fault or satanic corruption. Nor does she attempt to rationalize evil. Instead, she writes,

Rather than a theodicy, what is needed is a theological inquiry that takes the evolutionary function of affliction at face value and seeks to reflect on its working in the view of the God of Love made known in revelation. (p. 187)

Reflection on the autonomy, or free process, of creation and the compassionate copresence of God grounds her argument. Then Johnson ties together Niels Gregersen’s concept of “deep incarnation” with Sallie McFague’s “Christic paradigm” to argue that God’s solidarity in suffering through Christ and his cross extends to the whole of suffering creation and is not limited to humans alone. Johnson ends with the proposal of “deep resurrection.” She suggests that just as Christ is united to all creation by deep incarnation, so too all creation is tied into Christ’s resurrection by merit of the same unity. “Christ is the firstborn of all the dead of Darwin’s tree of life” (p. 209).

Chapter 8, “Bearer of Great Promise,” moves from the concept of ongoing creation (*creatio continua*) to the notions of creation in the beginning (*creatio originis*) and the new creation (*creatio nova*). In light of theology, what can we say about the very beginning

of the universe and the new creation that will come at its very end? From the original creation, Johnson argues, we can derive the concepts of the gratuitous nature of matter: that it was made freely out of nothing, but also that it was created good. In light of the end of the universe, Johnson explores different concepts of redemption and roots her own view in the idea that the love of God ensures redemption for every creature. The symmetry between creation and redemption is clear: just as God created all things, so also will God renew all things. In both creation and new creation, Johnson is careful to distinguish between scientific and theological viewpoints. Scientific analysis speaks of the Big Bang at one end of the universe and either the Big Crunch or the Big Freeze at the other. None of these ought to be conflated with the theological affirmations of creation out of nothing or the final redemption of new creation.

The last two chapters begin to investigate the questions that humans uniquely bring to the table. In chapter 9, Johnson looks unflinchingly at the issues of pollution, climate change, overpopulation, mass extinction, and the theological injunctions against these abuses. Here, more than anywhere else in the book, a Catholic perspective becomes primary. Chapter 10 compares two models of human-earth relationship: dominion models (including stewardship) and the models that see humanity as part of the community of creation. Johnson advocates for the latter, arguing that it is perhaps the only way to inspire the dramatic changes necessary if we are going to avoid continuing to do irreparable harm to the earth.

*Ask the Beasts* is an incredibly well-written, clear, and engaging read. While Johnson does not bring a great deal of innovation to the discussion ("deep resurrection" being one important conceptual contribution), she ably navigates the complexities of the science and religion debate. She cuts with the hand of a skilled surgeon, pruning away ossified and dead-end debates, while focusing the reader on the most creative and essential elements of the current dialogue. Her approach is dedicatedly theological while not ignoring, overruling, or side-stepping the sciences. Nor does she give in to the temptation to attribute the attractive parts of nature to God's creative action and the violent or harsh parts to some other ill-defined creative force (such as is found in Deane-Drummond or Hoggard Creegan). The result is a powerfully clear reflection on the nature of evolution, the place of humans in world, and the voice of the nonhuman creation. This book is a joy to read.

*Reviewed by Bethany Sollereder, University of Exeter, UK EX4 4QJ.*

**FOUR VIEWS ON THE HISTORICAL ADAM** by Matthew Barrett and Ardel B. Caneday, eds. Grand Rapids, MI: Zondervan, 2013. 288 pages. Paperback; \$19.99. ISBN 9780310499275.

A recent addition to Zondervan's Counterpoints: Bible and Theology series, *Four Views on the Historical Adam* edited by Matthew Barrett and Ardel B. Caneday, is an excellent entrée into the ongoing discussion of the theological implications of Adam's historicity. The book consists of four essays addressing the historicity of Adam from different Christian perspectives. Each essay is followed by a response from individual contributors and concludes with a response to the responses by each essay's original author. The format is ideal for a reader who wants to eavesdrop on this dialogue. While the essays focus on Adam's historicity, inevitably perspectives on the age of the earth, evolution, and the Fall are interwoven in each essay.

Denis Lamoureux's essay begins the conversation. He argues that Adam is not historical, the earth is old, and humans came to be by the process of evolution just like other living things. His argument rests on a strong rejection of scientific concordism and an acceptance of creation as a God-ordained and sustained, purpose-driven, natural process that we can uncover using the scientific method. He argues that scripture, Genesis as well as Paul's writings, describes an ancient scientific worldview, and we need to read scripture through that lens rather than try to fit modern science into a worldview confined by ancient science. Given this foundation, Lamoureux rejects the idea that Adam is a historical figure; rather, he describes Adam as an "incidental vessel to deliver inerrant spiritual truths" (p. 61). Lamoureux, a self-described born-again evangelical Christian, argues that rejecting the historicity of Adam does not impact the foundational beliefs of orthodox Christianity, which he asserts includes the "Bible as the Holy Spirit-inspired Word of God" (p. 39), a belief in miracles, and faith based "only on Jesus Christ, his sacrifice on the cross, and his bodily resurrection from the dead" (p. 38).

John Walton presents an archetypal view of the historical Adam. While he believes that Adam and Eve are real, historical people, he believes that it is more important to understand them as "archetypal figures who represent all of humanity" (p. 89). He believes that an archetypal reading of Genesis helps us find the essential theological meaning of the text: humanity is mortal, provisioned by God, given the role of service in sacred space, and is in relationship with God, each other, and the rest of creation. Not only

## Book Reviews

does Walton believe that Adam was historical, albeit archetypal, he also believes that the Fall was a real, historical event in which Adam and Eve were the main participants. Walton leaves room for an evolutionary view of human origins by suggesting that Adam and Eve do not necessarily have to be the first humans or the genetic source of the rest of humanity but rather real individuals that play a “particular representative role in sacred space” (p. 109).

C. John Collins also believes that Adam and Eve were real, historical figures and that the Fall was both historical and moral, occurring at the beginning of humanity’s existence. He allows for an old earth and ascribes to a day/age view, making room for natural explanations of cosmology and geology and human evolution only with a supernatural intervention by God (p. 164). Collins holds tightly to a perspective that places Adam and Eve as the source of all humankind (p. 154) and finds it theologically critical to understand Adam and Eve as the ancestors of all the families of Earth in order to understand Israel’s role in bringing God’s light to all the world (p. 154) or, in other words, to maintain the essential biblical story line. It is unfortunate that Collins wanders into a God-of-the-gaps argument when he suggests that it is “simply unreasonable to suppose that one can arrive at human capacities without some help from outside” (p. 170).

William Barrick takes the most uncompromising position in subscribing to a young earth; a six-day, literal creation; Adam and Eve as real, historical figures; and a literal Fall. He holds firmly to biblical inerrancy and scientific concordism as evidenced in his attempt to explain the relationship between Adam and Eve. “Even the first woman came from Adam,” states Barrick; “she possesses his DNA as altered by God at the time he formed her” (p. 213). He argues that a real, historical Adam and Eve are essential to our understanding of the rest of scripture, including creation, the nature of humanity, sin, salvation, and the authority of scripture. The importance Barrick places on the historicity of Adam is evidenced in his statement, “Denial of the historicity of Adam, like denial of the historicity of Christ’s resurrection, destroys the foundations of the Christian faith” (p. 223). Barrick does not take God’s revelation in the created world and revealed in scientific inquiry into account as he lays out his argument. His own essay and his responses reveal his lack of scientific understanding (p. 81), which makes a meaningful dialogue difficult.

This book does not offer much that is new in the ongoing dialogue around the historicity of Adam or origins in general. All four authors have presented

more extensive versions of their essays in other publications, which they often reference. The book may have been stronger if Peter Enns’s perspective on Adam’s historicity had been included. I also wish that all four authors had made a serious attempt to address the scientific issues that provide insight into human origins. Only Lamoureux deals in any serious way with scientific evidence for human origins.

What this book does offer of significant value is a new and highly accessible synthesis. For readers who want a place to start to explore various perspectives on the historicity of Adam, I would highly recommend this book. The interplay between authors offers valuable insight into the ongoing conversation and reveals areas of serious disagreement and misunderstanding. It is a good resource for those who tend to avoid perspectives that are different from their own since any reader is sure to find themselves aligned with only one or two of the authors.

The book concludes with two pastoral reflections, which are intended to help readers understand what impact the historicity of Adam does or does not have on the Christian life. While this is well intentioned, I found that it only partially worked. Greg Boyd’s pastoral reflection, which calls for unity in a diversity of perspectives on issues that are peripheral to salvation, does achieve a pastoral posture. However, rather than offering pastoral reflection, Philip Ryken offers his own view on the historicity of Adam. I found this ending to the book disappointing and wished that a call for Christian unity and further dialogue had been the final word.

*Reviewed by Sara Sybesma Tolsma, PhD, Professor of Biology, Northwestern College, Orange City, IA 51041.*

You are invited to draft an article related to

### The Image of God and Lab Rats

The ASA and CSCA websites have posted an essay by Keri McFarlane on “Living Relationally with Creation: Animals and Christian Faith.” The essay is intended as an invitation. Readers are encouraged to take up one of the insights or challenges concerning lab rats, pets, hunting, factory farming, vegetarianism ... or maybe a related one that was not mentioned, and to draft a piece (typically about 5,000–8,000 words) that contributes to the conversation. The essay can then be submitted for possible inclusion as an article in an upcoming *PSCF* theme issue.

---

## American Scientific Affiliation

The American Scientific Affiliation (ASA) is a fellowship of Christians in science and related disciplines, who share a common fidelity to the Word of God and a commitment to integrity in the practice of science. Founded in 1941, the purpose of the ASA is to explore any and every area relating Christian faith and science. *Perspectives on Science and Christian Faith* is one of the means by which the results of such exploration are made known for the benefit and criticism of the Christian community and of the scientific community. The ASA Statement of Faith is at [www.asa3.org](http://www.asa3.org) → HOME/ABOUT → ASA BELIEFS.

### Executive Director, ASA:

RANDALL D. ISAAC, PO Box 668, Ipswich, MA 01938-0668

### Executive Council, ASA:

KEITH B. MILLER, 1740 Fairview Ave., Manhattan, KS 66502-4042  
–President

HARRY L. POE, Union University, 1050 Union University Dr., Jackson, TN 38305 –Past President

JOHNNY W. LIN, PO Box 53182, Bellevue, WA 98015 –Vice President

LYNN L. BILLMAN, 12800 W Ellsworth Pl, Lakewood, CO 80228-1611  
–Secretary-Treasurer

STEPHEN O. MOSHIER, Wheaton College, Wheaton, IL 60187

HANNAH E. RYAN, 4265 Hidden Rock Road, Black Forest, CO 80908  
–Students and Early Career Scientists Representative

### Editor, *God and Nature*:

Emily Ruppel, PO Box 668, Ipswich, MA 01938-0668

---

## American Scientific Affiliation Forums

We encourage members to submit comments and questions on the articles published in this journal on the **ASA PSCF Discussion Forum** at [www.asa3.org](http://www.asa3.org) → FORUMS → PSCF DISCUSSION.

The ASA home page/forums also contains links to four other members-only discussion groups. The **General Discussion** is for thoughtful discussion of various issues in science and faith. **Books** hosts a series of discussions on seminal books on science and faith. There are also forums for discussion about the **Annual Meeting** and **Education**.

An **Open Forum** is open to the public for dialogue on topics of science and faith at [www.asa3.org](http://www.asa3.org) → FORUMS → OPEN FORUM.

---

## Canadian Scientific & Christian Affiliation

A closely affiliated organization, the Canadian Scientific and Christian Affiliation, was formed in 1973 with a distinctively Canadian orientation. The CSCA and the ASA share publications (*Perspectives on Science and Christian Faith* and the *God and Nature* magazine). The CSCA subscribes to the same statement of faith as the ASA, and has the same general structure; however, it has its own governing body with a separate annual meeting in Canada.

Canadian Scientific and Christian Affiliation, PO Box 63082, University Plaza, Dundas, ON L9H 4H0. Website: [www.csc.ca](http://www.csc.ca).

### Executive Director, CSCA:

DON McNALLY, NetAccess Systems, Hamilton, ON

### Executive Council, CSCA:

ARNOLD SIKKEMA, Trinity Western University, Langley, BC –President

E. JANET WARREN, Medicine/Theology, Hamilton, ON –Vice President

BOB GEDDES, The Presbyterian Church in Canada, Hamilton, ON  
–Secretary-Treasurer

BETHANY SOLLEREDER, University of Exeter, Devon, England –Student and Early Career Representative

JAMES C. PETERSON, Roanoke College and Virginia Tech Carilion School of Medicine, Roanoke, VA –Past President

---

## How Do I Join the ASA?

Anyone interested in the objectives of the Affiliation may have a part in the ASA. Membership and subscription applications are available at [www.asa3.org](http://www.asa3.org) → HOME/ABOUT → WHO CAN JOIN?

**Full membership** is open to all persons with at least a bachelor's degree in science who can give assent to our statement of faith. Science is interpreted broadly to include anthropology, archeology, economics, engineering, history, mathematics, medicine, political science, psychology, and sociology as well as the generally recognized science disciplines. Philosophers and theologians who are interested in science are very welcome. Full members have voting privileges and can hold office.

**Associate membership** is available to interested nonscientists who can give assent to our statement of faith. Associates receive all member benefits and publications and take part in all the affairs of the ASA except voting and holding office.

Full-time students may join as **Student Members** (science majors) with voting privileges or as **Student Associates** (nonscience majors) with no voting privileges.

**Spouses** and **retirees** may qualify for a reduced rate. **Full-time overseas missionaries** are entitled to a complimentary membership.

An individual wishing to participate in the ASA without joining as a member or giving assent to our statement of faith may become a **Friend** of the ASA. Friends receive all member benefits and publications and take part in all the affairs of the ASA except voting and holding office.

**Subscriptions** to *Perspectives on Science & Christian Faith (PSCF)*, are available at \$50/year (individuals), \$85/year (institutions) and \$20/year (student premiers).

---

## How Do I Find Published PSCF Articles?

Articles appearing in *Perspectives on Science and Christian Faith* are abstracted and indexed in the *Christian Periodical Index; Religion Index One: Periodicals; Religious & Theological Abstracts*, and *Guide to Social Science and Religion in Periodical Literature*. Book Reviews are indexed in *Index to Book Reviews in Religion*. Present and past issues of *PSCF* are available in microfilm form at a nominal cost. For information, write to NA Publishing, Inc. PO Box 998, Ann Arbor, MI 48106-0998 or go to [www.napubco.com](http://www.napubco.com).

Contents of past issues of *PSCF* are available at [www.asa3.org](http://www.asa3.org) → PUBLICATIONS → PSCF.



**American Scientific Affiliation**  
55 Market Street, Suite 202  
PO Box 668  
Ipswich, MA 01938-0668

Phone: (978) 356-5656

FAX: (978) 356-4375

E-mail: [asa@asa3.org](mailto:asa@asa3.org)

Website: [www.asa3.org](http://www.asa3.org)



**Editorial**

What Is Not Said 129 James C. Peterson

**Articles**

- The English Bible and the Days of Creation:  
When Tradition Conflicts with Text 130 Harry Lee Poe
- Genetic Insights for Human Origins in Africa  
and for Later Neanderthal Contact 140 David L. Wilcox
- Understanding the Beginning in Light of the End:  
Eschatological Reflections on Making Theological Sense of Evolution 154 Patrick Franklin

**Communications**

- Christian Commitment and the Scientist 171 V. Elving Anderson
- Logical Pitfalls and Communication Gaps: Frequent Lines of Argument  
That Dead-End the Origins Conversation 174 Stephen M. Contakes

**Book Reviews**

- Just Water: Theology, Ethics, and the Global Water Crisis* 179 Christiana Peppard
- The Why of Things: Causality in Science, Medicine, and Life* 180 Peter Rabins
- Trying Biology: The Scopes Trial, Textbooks, and the  
Antievolution Movement in American Schools* 182 Adam R. Shapiro
- Curiosity: How Science Became Interested in Everything* 183 Philip Ball
- Neanderthal Man: In Search of Lost Genomes* 185 Svante Pääbo
- Death Before the Fall: Biblical Literalism and the Problem of Animal Suffering* 186 Ronald E. Osborn
- The Outer Limits of Reason: What Science, Mathematics, and Logic Cannot Tell Us* 187 Noson S. Yanofsky
- Big Bang, Big God: A Universe Designed for Life?* 188 Rodney D. Holder
- Ask the Beasts: Darwin and the God of Love* 190 Elizabeth A. Johnson
- Four Views on the Historical Adam* 191 Matthew Barrett and  
Ardel B. Caneday, eds.